Data Processing Report

for

BASS STRAIT

Oil for Australians

Bass Strait Oil Company Limited

Level 25, 500 Collins Street,
Melbourne 3000, Victoria

Area: Oscar 3D, VIC/P41
Gippsland Basin

WG Contract Number: AS19
Client Project Number: GAP04D
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Table of Contents

1.0 Introduction

The report details the data processing of Oscar 3D, VIC/P41 (Gippsland Basin) Marine Seismic Survey carried out by WesternGeco (WG) in Perth. The project was conducted in Bass Strait, Victoria, Australia under client project number GAP04D by Apache Energy Northwest Pty Ltd for Bass Strait Oil Company Limited (BSOC). The objective of the project was to improve the structural definition of the leads identify in VIC/P41. These leads extend from the Kipper oil and gas field to the west and south of the Sole gas field to the north. The target zone was 1000-2300 ms.

The project consisted of approximately 493 full fold km^2 or 24583.2 linear CMP kilometres of data. The area of coverage is shown in **Appendix 6.1**. The field data were acquired by WesternGeco (m/v Western Trident) between 17 February and 1 March 2005. Data processing was carried out between 21 March and 25 August 2005. The entire processing was performed and coordinated in Perth office.

The processing parameters and sequences were optimized and established with BSOC representative Ian Reid. The project was managed for WesternGeco by Sharon Tan with geophysical support from Richard Patenall and supervised by Tony DeLorenzo.

The data were processed through a prestack sequence consisting of 2 passes of SWATT, Tau-p linear noise attenuation, DBS, 3D bin regularisation by interpolation, 3D PreStack Time Migration, Radon multiple attenuation. On the whole, three passes of velocity analyses were performed; 1st pass at 1 km x 1 km grid, 2nd and 3rd pass were at 0.5 km x 0.5 km grid. The data were full offset stacked and angle stacked with final (3rd pass) picked velocities then followed by poststack crossline trace interpolation from 25 m to 12.5 m.

Two lines GAP04D1152P1001 (shallow water) and GAP04D1648P1043 (deep water) were chosen by BSOC as primary test line and verification line respectively. The primary test line was firstly tested with all the confirmed production parameters derived from Moby 3D survey for reconfirmation. Occasionally, additional testing for additional test lines were carried out to further improve the data quality when necessary. Testing was performed concurrently with the production. **Section 4** lists the significant tests that were run, including processes that were tested but not used in the production sequence.

2.0 Project Management

2.1 Reporting Procedure

Project progress reporting was done on a weekly basis covering the period Monday to Friday. This was accomplished each Friday via e-mail and included the following:

- estimated completion date
- action for client / processing group to date
- data received to date
- status summary with completion % to date
- tests / confirmation to date
- data sent to date

2.2 SuperVision

WesternGeco had setup a SuperVision website for this project in order to upload and download data. This was primarily utilised as for verification of production processing and to provide quality control examples that have been carried out during production, namely, noise analysis plot files, fold of coverage plot files and data quality examples. BSOC has access to this SuperVision site.

3.0 Seismic Data Processing

3.1 Reformat

The 8x 384 trace (49 accepted sequences) demultiplexed field data were reformatted from SEGD 8058 to an in-house source-gathered seismic file omega format.

Diagnostics from the transcription program list input and output record numbers, plus parity and block length errors. Each printout was checked against the observer logs to ensure that all the data had been correctly transcribed. Every 100th shot record and near trace sections were displayed for quality control on each sail-line (or all 16 sub-surface lines). All data were output to 5120 ms record length at 2 ms sample rate.

3.2 Navigation and Seismic Data Merge

The navigation data (UKOOA P1/90 format) supplied by field crew have the following information:

Projection type : Universal Transverse Mercator (UTM) Southern Hemisphere
Projection zone : 55 South
Geodetic datum : GDA94
Spheroid : GRS80
Central meridian : 147 Deg East

The navigation source & receiver XY co-ordinates were merged with the seismic data traces. Navigation and seismic data were matched using unique Field Shot Identifier (FSID), unique trace number and cable number.

3.3 Deterministic Designature

The conversion to minimum phase of the source signature embedded within the seismic dataset is often a prerequisite to the application of spiking or predictive deconvolution. Alternatively, converting the source signature to zero phase can be performed as the first stage in the process of converting the recorded seismic data to zero phase, particularly when long-gapped or no predictive deconvolution is being applied. The objective of dephase is to obtain an operator that will convert the recorded or model far field source signature to its minimum or zero phase equivalent.
In the conventional marine acquisition case, the far field source signature is assumed to be an accurate measure of the down-going source wavelet produced by the airgun array. The source signature can be determined either by measuring the far field airgun response, or by generating a synthetic signature using known source and array parameters.

The derivation of the dephase filter operator that applied to seismic data has the following sequence:

1) Far field source signature at 2 ms sample rate
2) Add cable ghost to (1)
3) Zero phase equivalent of (2)
4) Zero phasing operator to shape (2) into (3)

Parameter values:

Far field source signature	: Supplied by field crew
Desired output wavelet	: Zero phase equivalent
Number of coefficients	: 540
Sample index of time-zero of operator	: 270
Sample interval	: 2 ms

Coefficients: Refer to **Appendix 6.6**

3.4 Resample

An anti-alias filter was applied to whole survey and the data were re-sampled.

Parameter values:	
Input trace length	: 5120 ms
Output trace length	: 5120 ms
Input sampling interval	: 2 ms
Output sampling interval	: 4 ms
Anti-alias filter:	
Phase type	: Zero
Cutoff frequency	: 105 Hz
Cutoff slope	: 60 dB/Octave

3.5 Trace Edits

Records flagged as bad in the observer's logs or as displayed in the near trace gathers and shot records were edited from the processing sequence.

3.6 Amplitude Recovery

A Time Squared Function Gain (with exponential value of 2) was applied to whole survey. Trace samples were scaled by the time of the sample raised to a user specified exponential value.

$$A_o(t) = A_i(t) * t^n$$

where:

$A_o(t)$	=	Amplitude of output sample at time t
$A_i(t)$	=	Amplitude of input sample at time t
t	=	Time in seconds
n	=	User supplied exponential value

3.7 Low Cut Filter

A zero phase band-pass filter described by low-cut frequencies and associated dB/octave cutoff slopes were applied to seismic data. The specified cutoff frequencies are located at the half-power (-3dB in amplitude) response points and the slopes at these frequencies are equal to the respective dB/octave values. The slope is an approximate cosine squared function in the amplitude domain. The filter was normalized so that output amplitudes were the same as input amplitudes for frequency components within the pass-band.

Parameter values:	
Output phase	: Zero
Low cut frequency	: 3 Hz
Low cut slope	: 12 dB/octave

3.8 Swell Noise Attenuation (SWATT)

Swell noise is caused by data acquisition in rough sea conditions, particularly when the cables are being towed at a relatively shallow depth. SWATT aims to attenuate this noise by transforming the processing gather into the frequency domain and applying a spatial median filter. Frequency bands that deviate from the median amplitude by a specified threshold are either zeroed, or replaced by good frequency bands interpolated from neighbouring traces.

By applying the process in different domains improved noise attenuation can be achieved because the noise to signal relations are different in different domains. This means that noise might be anomalous in one domain, but not in another.

Two passes of SWATT in shot domains and two passes of SWATT in receiver domains were carried out as shown in the table below.

Parameter values:

Processing domain : Shot (first-pass)
Width of spatial median filter : 23 traces
Frequency range processed : 0 - 30 Hz
Processing window start time : Water bottom + 200 ms
Processing window length : 300 ms
Processing window overlap : 100 ms
Threshold values:

Time (ms)	Threshold (%)
0	7
1500	5
4000	2
5120	2

Processing domain : Shot (second-pass)
Width of spatial median filter : 25 traces
Frequency range processed : 0 - 125 Hz
Processing window start time : Water bottom + 200 ms
Processing window length : 300 ms
Processing window overlap : 100 ms
Threshold values:

Time (ms)	Threshold (%)
0	7
2000	5
4000	3
5120	2

Processing domain : Receiver (first-pass)
Width of spatial median filter : 29 traces
Frequency range processed : 0 - 20 Hz
Processing window start time : Water bottom + 200 ms
Processing window length : 500 ms
Processing window overlap : 100 ms
Threshold values:

Time (ms)	Threshold (%)
0	20
2000	17
2500	11
4000	6
5120	4

Processing domain : Receiver (second-pass)
Width of spatial median filter : 29 traces
Frequency range processed : 20 - 125 Hz
Processing window start time : Water bottom + 200 ms

Processing window length	: 500 ms
Processing window overlap	: 200 ms

Threshold values:

Time (ms)	Threshold (%)
0	20
2000	17
2500	11
4000	6
5120	4

3.9 *First Pass Velocity Analysis*

Velocity analysis was performed using WesternGeco's Interactive Velocity Analysis (InVa) system. This is an integrated velocity interpretation and QC system.

Pre-processed CMP gathers were selected across the whole survey at a regular interval before input to velocity analysis. From this data Multi-Velocity Function Stacks (MVFS) and velocity semblance displays were computed. For each velocity location, the gathers, MVFS data and semblances are displayed interactively allowing stacking velocities to be interpreted. Changes made to one window are automatically applied to all other windows. Velocities can be picked from either the MVFS or semblance display. When velocities are interpreted at a location a velocity database is updated and the CMP gather is displayed with the NMO correction.

The interpreted velocities, were QC'd using a range of tools available in InVa, including iso-velocity displays and horizontal contours, they were then used to generate a velocity model for subsequent processing.

First pass velocity analyses created at 1 km x 1 km grid were picked by WG and a general review was performed by BSOC.

These velocities were used for the Targeted PSTM Velocity Lines with a 3 km smoothing function applied. Both the interpolated stacking velocity field and interpolated/smoothed migration velocity field (in original WesternGeco VELF format) were archived to a CD-ROM (#CD001) for sending out to BSOC on 1 Sept 2005.

The input to first pass velocity analyses has the following steps applied concurrently with the production flow in order to obtain an appropriate set of picked velocities ready for subsequent processing: K-filter/Trace reduction/DBS (36ms gap,200ms operator length,1 window)/3D CMP Sort

Parameter values:

Central fan function : Single velocity (derived from 2D velocities supplied by BSOC)
Number of fan functions : 15

Fan separation: Time (ms)	/ Separation (%)
0	/ 4
5000	/ 4

Analysis interval	: 1 km
Number of CMPs per analysis (MVFS display)	: 15
Number of CMPs per analysis (Semblance display)	: 7

3.10 *Tau-p Linear Noise Attenuation*

To eliminate linear noise within the data the source gathers were transformed into the Tau-p domain where unwanted linear noise was removed (muted). The resulting signal only Tau-p gathers were then subtracted from the original Tau-p gathers to produce noise only Tau-p gathers which were then transformed back to the T-X domain. The noise only T-X gathers were then subtracted from the original input gathers to result in noise filtered NMO corrected gathers.

This convoluted description of double subtraction (in the Tau-p and then the T-X domain) is based on the principal of only modeling the unwanted signal and not allowing the primary signal to be transformed into Tau-p space. This is due to the imperfection of the radon transform that will never return 100% of Tau-p transformed data back to T-X space.

Shot records were preconditioned prior to the transform. The gathers were applied with removable AGC to prevent transform aliasing gathers that were spatially interpolated then followed by linear moveout correction using velocity of 1510 m/s.

Parameter values:

Processing domain	: Tau-p
Removable AGC window length	: 500 ms
Moveout type	: Linear
Reference offset	: 4990 m
Moveout lower limit at reference offset	: -3500 ms
Moveout upper limit at reference offset	: 500 ms
Maximum frequency	: 125 Hz
Number of p-traces	: 800
Moveout type	: Pass
Moveout mute (low to high)	: -1800 ms to 300 ms
Moveout taper	: 32 ms

3.11 K-Filter

A seismic section such as a shot gather, CMP gather or stack section is a two-dimensional array of samples representing the amplitude of the seismic signal as a function of reflection time (t) and trace position (x). A Fourier transform can be used to convert trace position to the spatial frequency or wavenumber (k) domain. The filter can then pass a specified range of wavenumbers and a taper also applied to the filter boundaries to smooth the transition between the pass and the reject regions.

Later in the processing sequence, due to the application of K-filtering, the shot records can be reduced in size by dropping alternate traces in **Section 3.14 (Trace Reduction)**. Consequently, the k-filter was chosen to act as an anti-aliasing filter in the wavenumber domain, attenuating energy that would otherwise have become aliased when the trace separation was doubled by the dropping of alternate traces.

For convenience, the k-filter was implemented in the f-k domain. A 2-D Fourier transform was used to convert trace position to the wavenumber domain and reflection time to the frequency (f) domain. After implementation of the k-filter the data were inverse Fourier transformed back to the t-x domain.

Prior to the f-k transform, shot records were NMO corrected using first pass velocity (FPV) field and a data dependent scaling (typically AGC 120 ms) was applied to the data. This has the effect of reducing the impact on the transform of high amplitude events, particularly at the edges of the gather. After transformation back to the t-x domain the inverse of the scaling was applied, so largely preserving relative amplitudes. The NMO correction was also removed from the data.

Parameter values:

Processing domain	: Shot records (NMO corrected using FPV)
Pass wavenumber (k) values	: +/- 0.45
Taper	: 0.1

3.12 Deconvolution Before Stack (DBS)

A Wiener-Levinson least-squares, predictive deconvolution operators was designed from autocorrelations of a window within each trace and were applied on a trace-by-trace basis. Start-times were used to control the location of the design window so that high amplitude such as first break energy was excluded but application included all data earlier than the start time to the end of the trace. The relevant DBS design and application parameters used were as follows:

Parameter values:

Deconvolution type	: Trace-by-trace
Autocorrelation window number	: 1
Window near trace start time	: WB + 400 ms
Window length	: 2500 ms
Predictive distance	: 24 ms
Operator length	: 240 ms
White noise	: 0.01 %

3.13 Tidal Static Correction

The data were corrected for tidal variations throughout the acquisition period. The compensation was corrected based on tidal information for the area supplied by company GEMS (Global Environmental Modelling Systems Pty Ltd) on 10 May 2005. The data were merged with the seismic data based on time of day.

3.14 Trace Reduction

The data volume was reduced in size by decimating the shot gathers. The near offset was retained and every second trace (even number) was removed. This was possible due to the application of a K-Filter in **Section 3.11** to prevent spatial aliasing.

The effective group interval was doubled to 25 m after trace reduction.

3.15 Trace Edits

Second round trace edits based on DBS noise analysis was carried out prior to subsequent major processes like 3D bin regularisation by interpolation and 3D prestack time migration.

3.16 3D Grid Definition (PreStack)

The 4 corner points of Processing Master Grid are defined as follows:

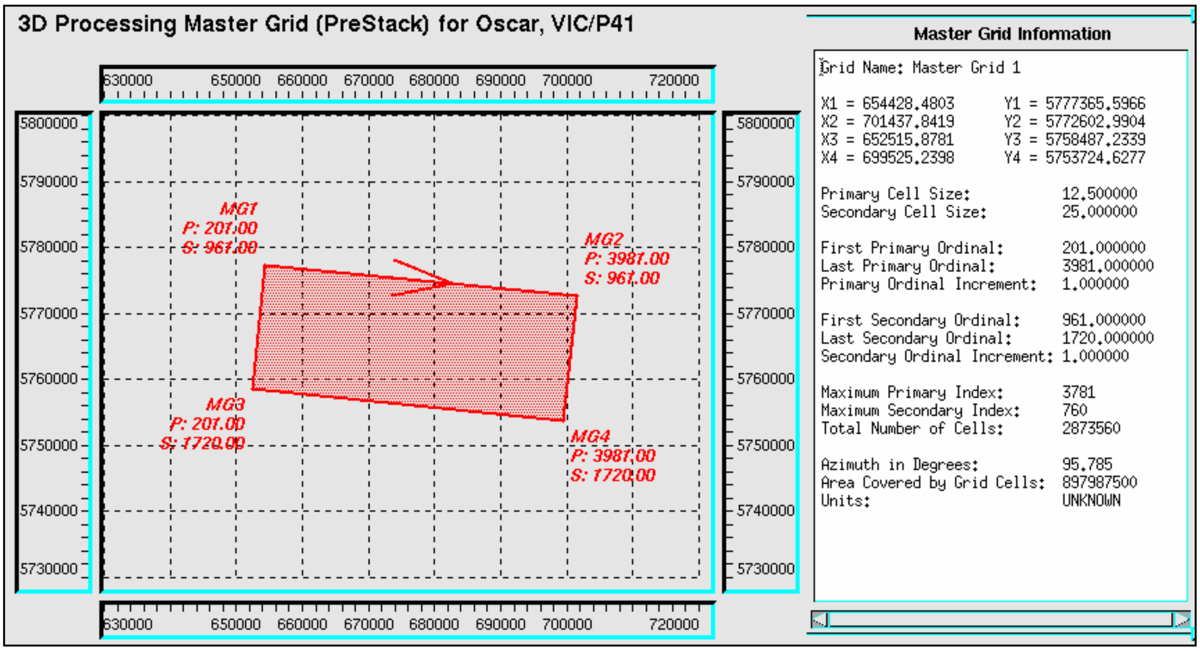
PreStack output grid = 12.5 m x 25 m, crosslines 201-3981 incr 1
inlines 961-1720 incr 1

	X-Coordinates	Y-Coordinates	Crossline	Inline
P1	654428.4803	5777365.5966	201	961
P2	701437.8419	5772602.9904	3981	961
P3	652515.8781	5758487.2339	201	1720
P4	699525.2398	5753724.6277	3981	1720

Crossline cell size: 12.5 m
Inline cell size: 25.0 m

Crossline increment: 1
Inline increment: 1

Primary axis azimuth: 95.785 degrees



3.17 Common Offset Sort

The data were sorted into 64 common offset planes and traces within each offset plane were then sorted into inline order. Prior to common offset sort, the inverse of time squared function gain was applied for later PSTM processing.

3.18 3D Bin Regularisation By Interpolation

This process is a seismic interpolation and regularisation tool for prestack 3D data that are irregularly sampled in space. It provides an improved method of regularising 3D fold coverage relative to the conventional flex binning approach of copy and move employed to fill gaps in coverage. The process also allows for the prestack regularisation of traces to move them (via interpolation) to their respective cell-centre positions.

In partial regularisation, the original data remain unaltered and traces are only interpolated to fill empty cells. Such partial regularisation can be useful prior to Prestack Time or Depth Migration where irregular subsurface fold can result in undesired amplitude variations.

Each interpolated output trace was calculated from a cluster of nearby input traces using adaptive interpolation. An optional dip map was computed to guide the interpolation and thus enable it to handle steeply dipping events. At each sample, the data were scanned over a range of dips to determine the local dominant dip. The dip-search was accomplished by computing the unnormalised semblance (correlation) between nearby traces for the range of dips of interest; peaks in the semblance indicate local dominant dips. The interpolated trace was then constructed by a weighted sum of input traces along the local dominant dip for each output sample.

The interpolation process was performed on common offset planes using a time-space (t-x) sinc interpolation that adapted to the local input cluster density and dominant dip. The traces were corrected with a differential moveout function which enabled data continuity without the over stretching involved with a full NMO correction. Limits were set for the maximum number of traces in an output cell. To accomplish this, redundancy editing was applied and the two traces closest to the cell centre were kept. This redundancy was based on full fold of the cell. After binning, the data were then inverse differential moveout with the same first pass velocity (FPV) field.

Parameter values:

Processing domain	: Common offset
Total common offset planes	: 64
Moveout correction	: Differential moveout using FPV
Operation mode	: Infill holes / trace regularisation
Maximum number of nearest trace in input cell	: 2
Interpolation length (inline x crossline)	: 11 x 11 cells
Maximum number of dip scans	: 11
Dip range	: -4 ms/cell to +4 ms/cell
Correlation width	: 31 cells
Correlation time length	: 48 ms
Maximum number of trace in output cell	: 1

3.19 Targeted PSTM Velocity Lines

Targeted 3D PreStack Time Migration (PSTM) to every 500 m velocity lines were processed for subsequent velocity analyses. The migrated data was obtained using the same parameters outlined in **Section 3.21 (3D PreStack Time Migration)**.

3.20 Second Pass Velocity Analysis

Most of the analysis parameters were identical to the first pass velocity analyses as detailed in **Section 3.9** except the critical change was to use the first pass velocity function as the centre velocity reference and a tighter fan separation.

Second pass velocity analyses created at 500 m x 500 m grid were picked by WG and a general review was performed by BSOC.

These velocities were used for the final 3D Prestack Time Migration with a 3 km smoothing function applied. This set of interpolated/smoothed migrated velocity field was reformatted to BSOC preferred format for Petrosys loading (The inline numbering was doubled at BSOC request and inline & crossline fields were switched in the text file) for archiving to the CD-ROM (#CD001) prior sending to BSOC on 1 Sept 2005. In addition, the same set of final migrated velocity field (in WesternGeco VELF format with original inline/crossline numbering) was also archived to a CD-ROM (#CD003) for sending out to BSOC on 29 Sept 2005.

The input to second pass velocity analyses has applied with mild Radon multiple attenuation in order to assist with the velocity picking.

Parameter values:

Central fan function : First pass velocity field
Number of fan functions : 15

Fan separation: Time (ms)	/ Separation (%)
1	/ 2
1500	/ 3
3000	/ 4
5000	/ 4

Analysis interval	: 500 m
Number of CMPs per analysis (MVFS display)	: 15
Number of CMPs per analysis (Semblance display)	: 7

3.21 3D PreStack Time Migration (PSTM)

The Kirchhoff Time Migration Seismic Function Module (SFM) performs seismic time migration using the Kirchhoff summation method. The migrated image is constructed by summing weighted amplitudes along diffraction curves or curved surfaces for the 3D case. These diffraction curves are determined by two-way travel times from the surface to subsurface scatters that are computed from the user-supplied velocity field. In prestack mode, migration is performed on common offset volumes for 3D data.

Theoretical basis Kirchhoff Migration is based on Green's theorem, a mathematical equation that states a relationship between the observations of a wave field on a closed surface and the wave field at any point inside that surface (see Schneider, W.A., 1978). The name of Gustav Kirchhoff is associated with the method because of his work in 1882 on optical diffraction. The formula for migration that is derived from Green's theorem has the form of an integral (or a summation in the case of discretely sampled data) over observations made on the surface of the earth. The migrated image calculated by that summation represents the acoustic reflectance throughout a section of the earth beneath the surface observations.

Key parameters to the migration process are the maximum dip filter angle and spatial anti-aliasing factors. Kirchhoff Migration typically provides a better migration solution, compared with other time migration algorithms, when the velocities vary both laterally and temporally. One feature of the WesternGeco's Kirchhoff Migration is the ability to define an output location, line or volume independently of the input data. This allows the user to target the output of selected lines or locations that are fully 3D migrated without the associated time/cost of migrating the whole volume. This target output option is particularly useful when processing 3D prestack as it allows the generation of targeted velocity analyses prior to running the full migration. Under such circumstances, the process does not waste time migrating those input traces that do not contribute to the output profile.

Prestack time migration is achieved by migrating the sorted common-offset panels into individual zero-offset panels. During migration the traces are effectively NMO-corrected; however, inverse NMO using the migration velocity is typically applied prior to output of the data. This allows a final (third pass) velocity analyses and moveout to be performed on the data prior to final stacking the whole volume.

Parameter values:

Processing domain	: Common offset
Total common offset planes	: 64
Migration algorithm	: 3D Kirchhoff Migration
Travel time computation	: Ray bending
Maximum aperture radius	: 3000 m
Maximum dip limit	: 60 degrees
Migration velocity field	: 100% second pass velocity field smoothed over 3 km

3.22 3D CMP Sort

The PSTM data were re-sorted back to 3D Common Mid Point (CMP) gathers for subsequent processing.

3.23 Third (Final) Pass Velocity Analysis

Most of the analysis parameters were identical to the first or second pass velocity analyses in **Section 3.9 (First Pass Velocity Analysis) & Section 3.20 (Second Pass Velocity Analysis)** except the critical changes were to use the second pass velocity function as the centre velocity reference and a tighter fan separation.

Third (final) pass velocity analyses created at 500 m x 500 m grid were picked by WG.

The final set of stacking velocities was used for subsequent processes such as Radon multiple attenuation, final full offset stack and stacking of the angle gathers. This set of interpolated stacking velocity field was reformatted to BSOC preferred format for Petrosys loading (The inline numbering was doubled at BSOC request and inline & crossline fields were switched in the text file) for archiving to the CD-ROM (#CD001) prior sending to BSOC on 1 Sept 2005. In addition, the same set of final stacking velocity field (in WesternGeco VELF format with original inline/crossline numbering) was also archived to the CD-ROM (#CD003) for sending out to BSOC on 29 Sept 2005.

The input to third pass velocity analyses has applied with mild Radon multiple attenuation in order to assist with the velocity picking.

Parameter values:

Central fan function : Second pass velocity field
Number of fan functions : 15
Fan separation: Time (ms) / Separation (%)

Time (ms)	Separation (%)
2	2
1500	3
3000	4
5000	4

Analysis interval : 500 m
Number of CMPs per analysis (MVFS display) : 15
Number of CMPs per analysis (Semblance display) : 3

3.24 Radon Multiple Attenuation

Radon Multiple Attenuation is principally a modeling and subtraction process. CMP gathers are transformed to the Radon (Tau-p) domain, unwanted coherent noise is isolated in this domain, transformed back to the time-offset (t-x) domain, and then subtracted from the original data. The transform separates events according to moveout (or velocity), and hence multiple energy can be isolated in the Tau-p domain (by means of a mute) provided it has a different velocity to that of the primaries.

Effective separation of coherent signal (primaries) and noise (multiples) requires that both are adequately focused in the Radon domain. Conventionally this is achieved in two steps. For a parabolic Radon transform, the first step is to condition coherent signal and noise events such that their moveout is approximately parabolic, and their amplitude and phase are approximately constant across all offsets. The second step is to apply a geometry compensation filter during the transform, which attempts to reduce artefacts caused by the input gather geometry. A least-squares geometry compensation filter requires the moveout range for the transform to be adequate to model all coherent events. The transform minimizes the difference between the input and the forward and reverse transformed data (the residual) and if a significant amount of coherent energy lies outside the modeled moveout range, artefacts will result.

In Radon Multiple Attenuation, normally two velocity fields are required:
- An estimate of the stacking velocity field, V_s.
- A maximum velocity for multiple attenuation, V_m. This is usually a percentage of V_s.

CMP gather data are conditioned prior to the transform. Typically the gathers are moveout corrected with velocity V_s, which ideally results in flattened primary reflections and under corrected multiples. For convenience we refer to over-corrected data as having negative dip (decreasing time with increasing offset), under-corrected data as having positive dip (increasing time with increasing offset) and flat data as having no discernible change in time with offset. To prevent transform aliasing the gathers can be spatially interpolated and the amplitudes may also be preconditioned, for example by using a reversible AGC.

The data are then transformed into the Tau-p (Radon) domain using a parabolic Radon transform. After hyperbolic normal moveout (or higher-order moveout correction), residual moveout has an approximately parabolic shape and hence a parabolic Radon transform is appropriate.

The range of moveouts to transform, measured in ms at a reference offset (X_{ref}), is chosen to cover the range of both primary and multiple energy. Following this, parts of Tau-p domain representing primary energy are zeroed by application of a mute. For this purpose 'primary energy' is usually assumed to be any data with a velocity faster than V_m. This allows for time-variance in the separation of primary and multiple events. V_m does not need to be the actual velocity of the multiples but rather a velocity that is as fast or faster than multiples of interest while being slower than the primary velocity. Primary energy is protected at late times by imposing a minimum moveout (p) value on the mute. Note that for some deep-water datasets, the mute may be safely defined by use of the minimum p value alone, without reference to V_m. The boundary between the zeroed and preserved regions is tapered in the p direction.

Inverse Tau-p transform and removal of the pre-transform conditioning produces a model of the multiple energy. This is subtracted from the original data to produce the multiple-attenuated output.

In the Oscar 3D processing, the method used for the subtraction of the modelled multiples from the primary data was to use time-variant reductions of the primary NMO velocity field as detailed below. This is referred to as a velocity mute method. The energy which is output from the multiple model in Tau-p domain with RMS velocities lower than these percentages of the primary velocity was considered to be multiple energy and was subtracted from the data. In this case, three velocity fields were required:

- An estimate of the stacking velocity field, $V_{s.}$
- An upper boundary reduced version of the stacking velocity field, called V_H as below, and
- A lower boundary reduced version of the stacking velocity field, called $V_{L,}$ which was 10% of V_s

Parameter values:

Pre-transform conditioning	: NMO with primary velocity (final velocity field) 500 ms AGC
Reference offset (X_{ref})	: 5020 m
Moveouts (Δt) at the reference offset (X_{ref}):	
Minimum moveout (i.e. for the first p-trace)	: -400 ms
Maximum moveout (i.e. for the last p-trace)	: 3000 ms
Moveout type	: Parabolic
Number of p-traces	: 480
Maximum frequency	: 100 Hz
Multiple mute velocity (V_m)	: Time variant % of final velocity field (0 ms - 90 %, 1000 ms - 94 %, 5000 ms - 94 %)
Velocity mute taper	: 32 ms

Note: Moveouts used in making intermediate p-traces were linearly interpolated between the minimum and maximum moveouts.

3.25 Normal Moveout Correction / Outer Mute / Stack

Normal Moveout (NMO) correction was performed using final set of 3D velocity field.

After NMO, an outer trace mute was applied to remove first break noise, refractions and wide angle reflections and any data which NMO had stretched beyond acceptable limits. To prevent a rapid amplitude change between the muted and live parts of the trace in trace mute process, a typical 64 ms taper was applied from zero amplitude to full amplitude. This prevents distortion to the frequency spectrum of the stacked data, which would otherwise by introduced by an abrupt boundary.

The data were stacked and normalized sample by sample using the following function:

$$s(t) = \frac{1}{w(t)}$$

Where *w(t)* is the summed weight function for a given output trace

The nominal CMP fold was 64. Selected stack monitors (NMO-CMP gathers) at very 500 m interval were QC'd with water bottom dependent final outer trace mute patterns over-laid. Similarly, every 500 m interval of inline stacks were QC'd prior to loading the raw stack cube to OmegaVu system for inline / crossline / time-slice QC.

The water bottom dependent final outer trace mute patterns applied to the data are as follows:

Parameter values

WB time (ms)	: Offset (m) - Time (ms) in pairs
4	: 238-004, 400-010, 600-200, 750-500, 1500-1000, 2400-1700, 3200-2400, 5100-3700
160	: 238-004, 400-020, 600-300, 750-500, 1500-1100, 2400-1800, 3200-2500, 5100-3800
400	: 238-180, 400-200, 600-500,1020-800,1695-1400, 2595-2100, 3345-2800, 5100-4000
700	: 238-480, 400-500, 750-600,1245-950,2000-1700, 2700-2200, 3750-3100, 5100-4000

Mute times were linearly interpolated between the specified offsets and extrapolated for the offsets larger than the last offset specified.

The final set of raw PSTM/RADON NMO-CMP gathers (with gun/cable static correction of +10 ms and without offset mute application) was SEGY archived to a portable Lacie hard disk for delivery to BSOC on 22 Sept 2005. The hard disk was returned to WesternGeco on 30 Sept 2005.

3.26 Near, Mid and Far Angle Stacks

The velocity functions used to derive the angle mutes were calculated from the smoothed final velocity field. The mutes were calculated using bending rays, to compensate for refraction, with interval velocities calculated using Dix approximation. The resulting velocity function was finally modified by a Least Squares fit to prevent oscillations in interval velocities causing unstable mute patterns.

The 3 angle stack volumes generated were:

- Near 0^{O} - 14^{O}
- Mid 14^{O} - 28^{O}
- Far 28^{O} - 42^{O}

For the mid angle range, the water bottom dependent final outer trace mute patterns as specified above were incorporated to mute off some of the noisy data below 3 seconds. Similarly, for the far angle range, the water bottom dependent outer trace mute patterns were designed to mute off some of the noisy data below 2 seconds.

The traces within each angle-muted gather are stacked to form a single output trace. The resultant trace is normalized sample by sample using the following function:

$$s(t) = \frac{1}{w(t)}$$

Where *w(t)* is the summed weight function for a given output trace

3.27 3D F-K Footprint Removal

Spatially periodic artefacts (footprint) caused by recording geometry in the 3D input volume (t-x-y) are transformed into peaks in frequency slices in the transform domain (f-k_x-k_y). These peaks are suppressed by use of notch filters. For a given geometry, the peaks occur at different locations depending on structural dip, and footprint character may change in the time direction, hence the data is spatially and temporally windowed into regions of similar structural dip and footprint character. The windowed regions are overlapped sufficiently to avoid windowing artefacts.

The notch filters can either be defined by the user or can be automatically derived. The automatic derivation works by summing the k_x-k_y slices over frequency then detecting peaks over a threshold percentage of the peak at the origin (which corresponds to flat events). In the case of a dominant structural dip within the t-x-y window, the slices are shifted before summation to compensate for that dip. The detected peaks are then suppressed on each frequency slice by application of tapered elliptical notch filters.

Parameter values:

In-line window width	: 50 traces
In-line window overlap	: 20 traces
Cross-line window width	: 66 traces
Cross-line window overlap	: 20 traces
Time window length	: 1000 ms
Time overlap	: 500 ms
Notch filter derivation	: Automatic

3.28 Post-Stack Crossline Trace Interpolation

A frequency-space (f-x-y) 3D interpolation algorithm is used to generate interpolated traces within each offset plane to yield the desired output trace spacing.

The stack volume is windowed in all 3 directions to create sub-volumes within which the interpolation takes place. These sub-volumes are overlapped to allow for blending of the interpolation results. This is done in order to conform to the premise of the algorithm that seismic events are linear or planar within each sub-volume.

Each sub-volume is Fourier transformed in time to form a cube of f-x-y data with each frequency slice then being interpolated separately.

The interpolated output data was re-grid to reflect the new bin size. The original inline numbers were doubled after interpolation at BSOC request.

Parameter values:

Input trace spacing (inline x crossline)	: 12.5 m x 25.0 m
Output trace spacing (inline x crossline)	: 12.5 m x 12.5 m
Time window length	: 1000 ms
Window width (inline x crossline)	: 21 x 21 traces
Operator width (inline x crossline)	: 5 x 5 traces

3.29 3D Grid Definition (PostStack)

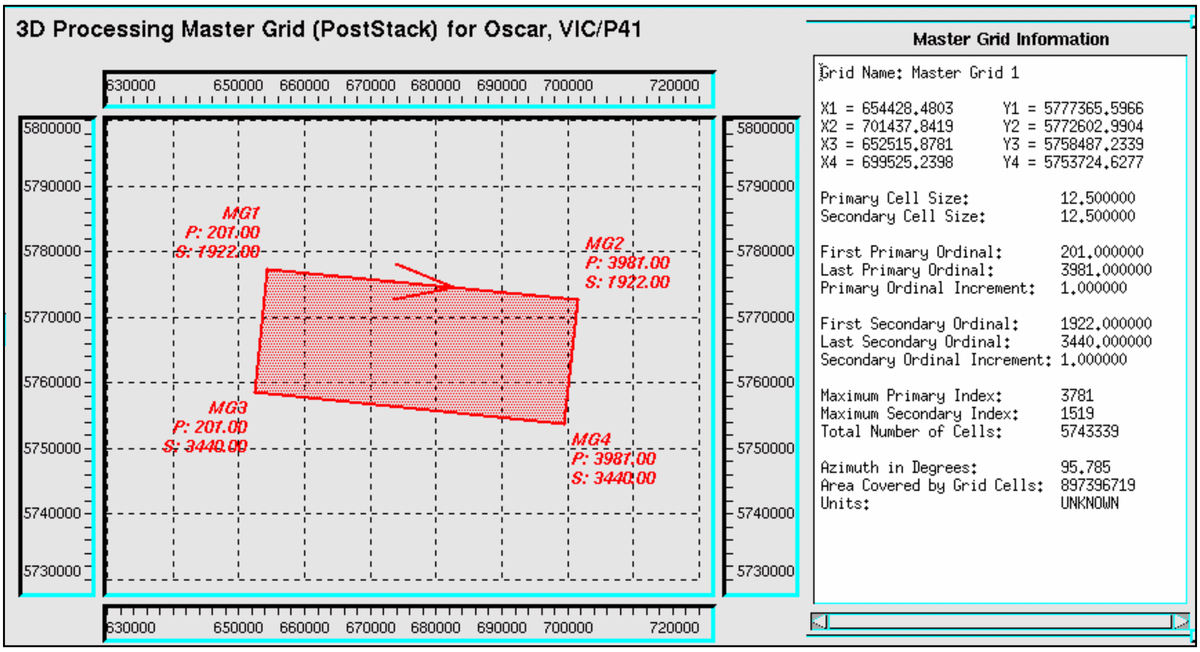
The above poststack 3D interpolated data were re-grid to reflect the new bin size as follows: (The inline numbering was doubled at BSOC request)

PostStack output grid = 12.5 m x 12.5 m, crosslines 201-3981 incr 1
inlines 1922-3440 incr 1

	X-Coordinates	Y-Coordinates	Crossline	Inline
P1	654428.4803	5777365.5966	201	1922
P2	701437.8419	5772602.9904	3981	1922
P3	652515.8781	5758487.2339	201	3440
P4	699525.2398	5753724.6277	3981	3440

Crossline cell size: 12.5 m
Inline cell size: 12.5 m
Crossline increment: 1
Inline increment: 1

Primary axis azimuth: 95.785 degrees



3.30 Gun and Cable Static Correction

The gun and cable depth corrections to mean sea level were applied to all final migrated full offset & angle stack volumes. With the averaged gun depth of 7 m & cable depth of 8 m and using the water velocity of 1500 m/s, a static correction of 10 ms was calculated and applied.

3.31 Time Variant Spectral Shaping (TVSS)

The primary purpose of spectral shaping is to modify the wavelet to achieve maximum vertical resolution. Optimum wavelet resolution is achieved by shaping the wavelet's amplitude spectrum to become broad and flat. The extent to which this may be usefully undertaken is limited by the signal to noise ratio of the data.

It is assumed prior processing has converted the data to zero-phase. This is maintained by making the spectral shaping operators also zero-phase.

The wavelet spectrum cannot be directly estimated from the data, without knowledge of the reflectivity spectrum. Spectra measured from seismic data are the combination of the wavelet spectrum and the earth reflectivity spectrum. To separate the earth reflectivity from the trace spectra a measurement of the reflectivity has to be made. This can be computed from well bore data. If this is ignored, general spectral shaping programs assume the reflectivity to be "white" or random - an unrealistic assumption. A reflectivity trace is constructed from well data utilizing the p-wave velocity and density logs and is converted to the time domain. A highly smoothed reflectivity spectrum is constructed which describes the overall trend of the earth's reflectivity spectrum. This is then used in the shaping operator design.

A spectral shaping operator is then derived that will produce an output trace spectrum with a spectrum equal to the well reflectivity trend. Having applied such an operator the trace spectrum is coloured, but the wavelet spectrum is flat, thus achieving maximum vertical resolution.
The beta factor specified below is a control on the 'flatness' of the coloured output trace spectrum. A larger beta value allows more whitening of the higher frequencies and less to the lower frequencies. A smaller beta factor gives a flatter trace spectrum with more equivalent boosting at both the low and high frequency ends of the trace spectrum. The output trace spectrum was also controlled between 10 and 40 Hz where no gain, or spectral boosting, was applied. This frequency range was determined by estimating the dominant frequency of the signal at target depth.

Parameter values:

Filter specification : Automatic
Number of filters generated : 9

Passband Corner frequencies (Hz)	Passband Amplitudes
1	0.001
8	1
60	1
85	0.001

Gain window length : 512 ms
Percent white noise : 10
Beta factor : 0.5
Number time coefficients : 128
No-gain low frequency : 10 Hz
No-gain high frequency : 40 Hz

3.32 Exponential Gain

The data were scaled with a time variant exponential gain function (that is, the trace sample at 2 seconds is multiplied by a value a specified amount higher in dB than the trace sample at 1 second). This scaling was applied from the trace's first time sample down to a time of t_{stop} after which the gain was held constant, according to the formulae:

$A_o(t) = A_i(t)$ $\quad t \leq 0$

$A_o(t) = A_i(t)\, e^{(t * PWR)}$ $\quad t > 0,\ t \leq t_{stop}$

$A_o(t) = A_i(t)\, e^{(t_{stop} * PWR)}$ $\quad t > t_{stop}$

where

$A_o(t)$ is the output trace sample at time t

$A_i(t)$ is the input trace sample at time t
t is the time in seconds
PWR is the exponential gain function

Parameter values:

Exponential gain function : 3 dB/sec
t_{stop} : 3000 ms

3.33 Time Variant Filter (TVF)

A zero-phase Time Variant Filter (TVF) was applied to the data. The filter passbands were described by low- and high-cut frequencies and associated dB/octave cutoff slopes. The specified cutoff frequencies are located at the half-power (-3 dB in amplitude) response points and the slopes at these frequencies are equal to the respective dB/octave values. The slope is an approximate cosine squared function in the amplitude domain. The filters were normalized so that the output amplitudes were the same as the input amplitudes for frequency components within the passband.

Parameter values:

Filter centre time (ms)	Low-cut frequency (Hz)	Low-cut slope (dB/octave)	High-cut frequency (Hz)	High-cut slope (dB/octave)
WB+ 4	6	36	80	72
WB+ 2000	6	36	70	72
WB+ 3500	5	36	60	72
WB+ 5000	4	36	55	72

Note: The times are those at the centre of the filter where the full effect of the filter is attained.
The first filter was applied from the beginning of the trace to the first filter centre time.
Intermediate filters were linearly tapered and blended with the preceding and succeeding filter between the filter centre times.
The last filter was applied from the last filter centre time to the end of the data.

3.34 Scaling (AGC)

User-specified time windows were used to derive and apply scale factors to each data sample. These multipliers were calculated by centring the window over a sample, taking the average absolute amplitude of the window, defining a multiplier to make this average 0.9 times the desired output RMS amplitude and applying it to the sample. The window centre was then moved down one sample and a new multiplier calculated and applied. In this way, multipliers were computed and applied to each sample from the first window application point to the last window application point.

Parameter values:

RMS amplitude : 2000
Window length : Constant

Window length (ms)	Start time (ms)	End time (ms)
1000	4	5000

Note: The times specified are the time of the first sample to be included in the first window and the time of the last sample to be included in the last window.

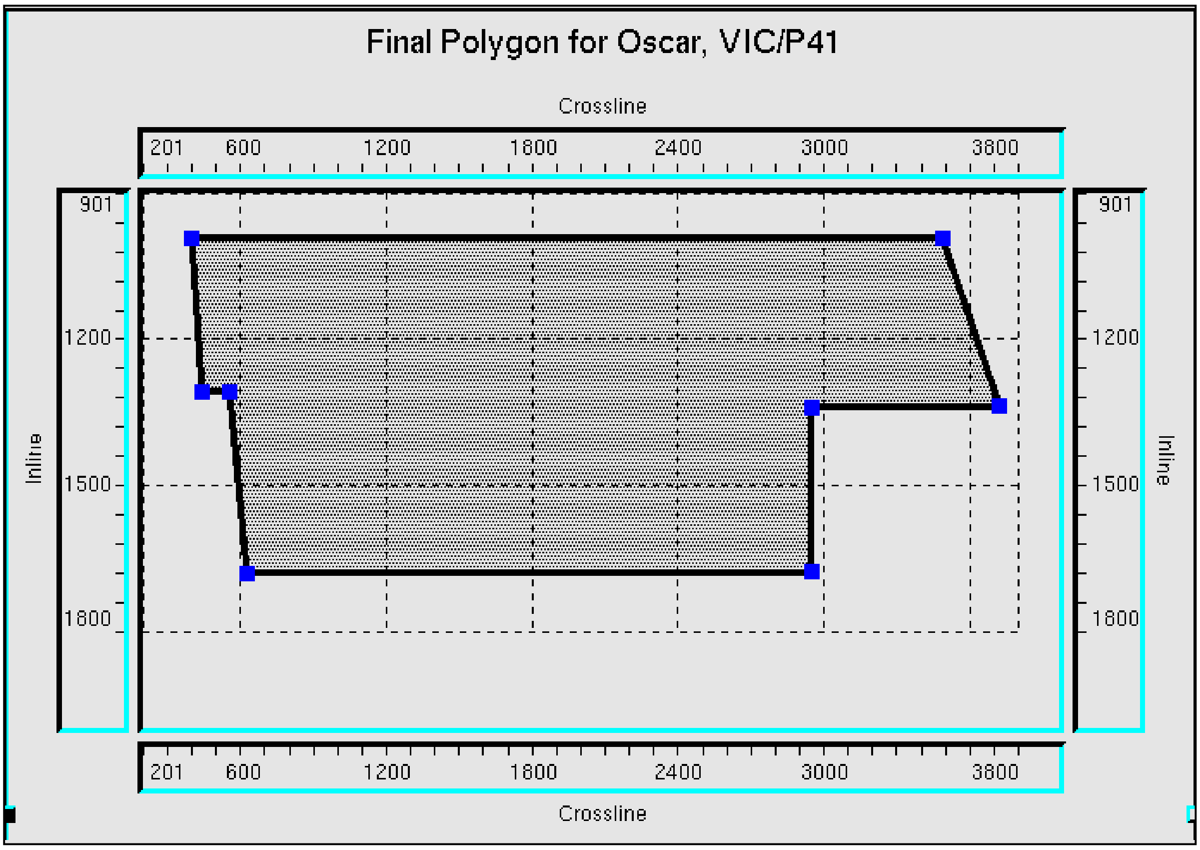
The multiplier for the first window was applied constantly back to the first sample on the trace. The last multiplier calculated was applied constantly until the last live sample.

3.35 Polygon Select Of Input Area

All full offset and angle stack volumes and the final set of prestack gathers were cut according to the polygon select of input area given below.

The 9 corner points of this polygon are as follows:

Point	Crossline	Inline(PreStack)	X-Coordinate	Y-Coordinate
1)	401	995	656830.07	5776267.94
2)	3490	995	695245.92	5772375.95
3)	3725	1337	697306.66	5763573.41
4)	2950	1340	687660.94	5764475.25
5)	2950	1679	686806.69	5756043.41
6)	630	1681	657949.34	5758916.75
7)	560	1310	658013.68	5768232.71
8)	445	1310	656583.50	5768377.60
9)	401	995	656830.07	5776267.94



4.0 Parameter Testing

To maintain the agreed delivery date the testing was performed concurrently with production stages.

Primary test line: GAP04D1152P1001 (shallow water)
Verification line: GAP04D1648P1043 (deep water)
Additional lines: GAP04D1040P1015 (noisier data) & GAP04D1008J1021 (strum noise)

4.1 Deterministic Designature

Selected 8 shot records from test lines 1152P1 & 1648P1:

- No designature
- Zero phase designature

4.2 Amplitude Recovery

Selected 8 shot records from test lines 1152P1 & 1648P1 with desig/resample applied:

- Raw shots
- Time squared function gain

4.3 Low Cut Filter

Selected 8 shot records from test lines 1152P1 & 1648P1 with desig/resample/T**2 gain applied:

- No low cut filter
- 3 Hz zero phase low cut filter
- 4 Hz zero phase low cut filter
- 5 Hz zero phase low cut filter

Reconfirmed on 11 April 2005: Zero phase low cut filter of 3 Hz with 12 dB/octave slope.

4.4 Swell Noise Attenuation (SWATT)

Selected test lines 1152P1, 1648P1 & 1040P1 with desig/resample/T**2 gain/LCF applied:
<First-pass shot SWATT>

- No SWATT
- SWATT with 23 tr filter width, 500 ms window length
- SWATT with 23 tr filter width, 300 ms window length
- SWATT with 23 tr filter width, 300 ms window length, revised threshold % -----(best result sht1)

<Best result sht1 input to second-pass shot SWATT>

- SWATT with 25 tr filter width, 500 ms window length
- SWATT with 25 tr filter width, 300 ms window length, revised threshold % -----(best result sht2)

<Best result sht1+sht2 input to first-pass receiver SWATT>

- SWATT with 29 tr filter width, 500 ms window length, revised threshold % -----(best result rcv1)

<Best result sht1+sht2+rcv1 input to second-pass receiver SWATT>

- SWATT with 29 tr filter width, 500 ms window length, revised threshold % -----(best result rcv2)

Compared brute stacks / nmo-cmps (with single vel derived from 2D vels supplied by BSOC) / shot records and their difference plots.
Reconfirmed on 27 April 2005: Apply 2 passes of SWATT in shot domain followed by another 2 passes of SWATT in receiver domain.

4.5 F-K Filter

Selected test lines 1008J1, 1152P1 & 1648P1 with desig/resample/T**2 gain/LCF/SWATT applied:

- No shot F-K filter
- Shot F-K filter: pass dips +-3.5 ms/tr, taper 2 ms/tr
- Shot F-K filter: pass dips +-4.5 ms/tr, taper 2.25 ms/tr
- Shot F-K filter: pass dips +-5.5 ms/tr, taper 3 ms/tr
- Shot F-K filter: pass dips +-6.5 ms/tr, taper 3.25 ms/tr

Compared selected shot records and their difference plots.
Reconfirmed on 19 May 2005: Not to apply F-K filter in shot domain.

4.6 Tau-p Linear Noise Attenuation

Selected test lines 1008J1, 1152P1 & 1648P1 with desig/resample/T**2 gain/LCF/SWATT applied:
• No Tau-p LNA
<Tau-p LNA (LMO half shot record)>
• No reversible AGC, moveout range –1500to500 ms, 401 p-tr, moveout mute –1400to300 ms (*)
• Reversible AGC, moveout range –1500to500 ms, 401 p-tr, moveout mute –1400to300 ms
<Tau-p LNA (reversible AGC, LMO full shot record, moveout mute tests)>
• Moveout range –2000to500 ms, 627 p-tr, moveout mute –1400to300 ms
• Moveout range –2000to500 ms, 627 p-tr, moveout mute –1600to300 ms
• Moveout range –2000to500 ms, 627 p-tr, moveout mute –1800to300 ms
• Moveout range –2000to500 ms, 627 p-tr, moveout mute –1800to400 ms
<Tau-p LNA (reversible AGC, LMO full shot record, white noise tests)>
• Moveout range –3500to500 ms, 961 p-tr, moveout mute –1800to300 ms, white noise 1%
• Moveout range –3500to500 ms, 961 p-tr, moveout mute –1800to300 ms, white noise 5%
• Moveout range –3500to500 ms, 961 p-tr, moveout mute –1800to300 ms, white noise 10% (**)
<Tau-p LNA (reversible AGC, LMO full shot record, white noise 10%, p-tr tests)>
• Moveout range –3500to500 ms, 961 p-tr, moveout mute –1800to300 ms
• Moveout range –3500to500 ms, 800 p-tr, moveout mute –1800to300 ms
• Moveout range –3500to500 ms, 600 p-tr, moveout mute –1800to300 ms
Compared selected shot records and their difference plots.

<Tau-p LNA + shot F-K filter>
• Tau-p LNA (*) + shot F-K filter (pass dips +-5.5 ms/tr, taper 3 ms/tr)
• Tau-p LNA (**) + shot F-K filter (pass dips +-6.5 ms/tr, taper 3.25 ms/tr)
Compared selected shot records, stacks / nmo-cmps (with first pass velocity) and their diff. plots.
Confirmed on 19 May 2005: Apply Tau-p LNA only (ie. No second pass of FK-LNA).

4.7 K-Filter

Selected few shot records from test lines 1152P1 & 1648P1 with desig/resample/T**2 gain/LCF/SWATT/Tau-p LNA applied:
• No K-filter
• K-filter: pass wavenumber of +-0.45, taper 0.1
Reconfirmed on 20 May 2005: Apply K-filter before trace reduction.

4.8 Tau-p / T-X Deconvolution Before Stack

Selected test lines 1152P1 & 1648P1 with desig/resample/T**2 gain/LCF/SWATT/Tau-p LNA/K-filter applied:
• No Tau-p decon / No T-X decon
<Tau-p decon: constant 32 ms gap, 240 ms operator length, 1 window>
• Moveout range –2200to3300 ms, 1100 p-tr, time variant moveout mute
• Moveout range –3700to3700 ms, 1480 p-tr, time variant moveout mute
• Moveout range –1200to3700 ms, 980 p-tr, moveout mute –1200to1650 ms
<Tau-p decon: p-dependent gap-30 ms, operator length+30 ms, 1 window>
• Moveout range –1200to3700 ms, 980 p-tr, moveout mute –1200to1650 ms
<Tau-p decon: p-dependent gap-30 ms, operator length*2.2, 1 window>
• Moveout range –1200to3700 ms, 980 p-tr, moveout mute –1200to1650 ms
<T-X decon (tr-by-tr)>
• 240 ms operator length, 1 window, gap 32 ms
• 240 ms operator length, 1 window, gap tests 12, 24, 36 ms ---- for 1152P1 (SP1252-1452 full fold)
Compared selected shot records, stacks / nmo-cmps (with first pass velocity) and their difference plots. All qc have 500 ms autocorrelations appended below shot / stack / nmo-cmp.

Confirmed on 27 May 2005: Not to apply targeted Tau-p decon due to additional cost involved.
Confirmed on 6 June 2005: Apply T-X predictive deconvolution tr-by-tr using 240 ms operator, 24 ms gap, 2500 ms window length with start design & apply from WB+400 ms.

4.9 Radon Multiple Attenuation Before PSTM

Selected test lines 1152P1 & 1648P1 with desig/resample/T**2 gain/LCF/SWATT/Tau-p LNA/K-filter/DBS applied:

- No Radon multiple attenuation
- Radon multiple attenuation (no shot-interpolation, no reversible AGC): velocity mute 90% of FPV
- Radon multiple attenuation (no shot-interpolation, reversible AGC): velocity mute 90% of FPV
- Radon multiple attenuation (1:3 shot-interpolation, no reversible AGC):velocity mute 90% of FPV
- Radon multiple attenuation (1:3 shot-interpolation, reversible AGC): velocity mute 90% of FPV

Compared stacks / nmo-cmps (with first pass velocity) and their difference plots.
Confirmed on 24 June 2005: No shot interpolation for Radon multiple attenuation; and run multiple attenuation after full migration using residual stacking velocities picked from 500 x 500m grid.

4.10 3D Bin Regularisation By Interpolation

Selected near/mid/far common offset (OFF) planes with DBS/tidal static correction/trace reduction applied:

- OFF01, OFF30, OFF64 without 3D bin regularisation by interpolation
- OFF01, OFF30, OFF64 with 3D bin regularisation by interpolation:
  - Dip range tests 0, 1, 2, 8 ms/cell
  - Dip range tests +- 1, +-4, +-6, +-8 ms/cell

Compared selected inlines, crosslines & time slices.
Reconfirmed on 28 June 2005: Apply 3D bin regularisation by interpolation with dip range of +- 4 ms/cell.

4.11 Radon Multiple Attenuation After PSTM

Selected PSTM CMP gathers from vel-lines VL1148 & VL1628:

- No Radon multiple attenuation
- Radon multiple attenuation (reversible AGC): velocity mute 90% of final velocity field
- Radon multiple attenuation (reversible AGC): velocity mute 94% of final velocity field
- Radon multiple attenuation (reversible AGC): velocity mute time variant 90-94% of final vel field

Compared selected inlines, crosslines & time slices.
Reconfirmed on 7 July 2005: Apply Radon multiple attenuation after PSTM using velocity mute time variant 90-94% of final velocity field.

4.12 Outer Mute

Selected nav-seis merged CMP gathers from test lines 1152P1 & 1648P1:

- Preliminary outer mute patterns hang from WB

Selected Swatt/Tau-p LNA CMP gathers from test lines 1152P1 & 1648P1:

- Preliminary outer mute patterns hang from WB

Selected PSTM/Radon CMP gathers from vel-lines VL1148 & VL1628:

- Preliminary outer mute patterns hang from WB
- Final (or milder) outer mute patterns hang from WB

In all cases, the selected NMO-CMP gathers were overlaid with the water bottom dependent preliminary/final outer mute patterns for reviewing. Stacks were also produced and compared.
Confirmed on 18 July 2005: Final set of milder outer trace mutes that hang from water bottom.

4.13 3D F-K Footprint Removal

Selected a small test cube (IL1295-1384, XL389-1000) from final stack volume:

- No 3D F-K footprint removal
- 3D F-K footprint removal: IL/XL window width 100x130 traces
- 3D F-K footprint removal: IL/XL window width 50x66 traces

The test cubes were loaded into OmegaVu for reviewing.
Confirmed on 15 August 2005: Apply 3D F-K footprint removal to the final stack volume.

4.14 Post-Stack Crossline Trace Interpolation

Selected the same test cube (IL1295-1384, XL389-1000) from final stack volume with 3D F-K footprint removal applied:

- No poststack crossline trace interpolation
- Poststack crossline trace interpolation

The test cube was loaded into OmegaVu for reviewing.
Confirmed on 15 August 2005: Apply poststack crossline trace interpolation (& re-grid with inline numbering doubled at BSOC request) after 3D F-K footprint removal.

4.15 Exponential Gain

Selected IL1299 from the same test cube with 3D F-K footprint removal applied:

- No exponential gain
- Exponential gain tests: 2, 3, 4, 5 db/sec
- Exponential gain tests: 2, 3, 4, 5 db/sec and hold constant below 3sec

Selected IL2304 & IL3296 (equivalent to original IL1152 & IL1648) from production stack cube with crossline interpolation applied:

- No exponential gain
- Exponential gain: 3 db/sec
- Exponential gain: 3 db/sec and hold constant below 3sec

Confirmed on 17 August 2005: Apply an exponential gain of 3 db/sec and hold constant below 3sec to the whole Raw Stack Cube prior SEGY archived.

4.16 Deconvolution After Stack (DAS)

Selected the same test cube (IL2590-2768, XL389-1000) from production stack cube with crossline interpolation applied:

- No DAS
- DAS: 48 ms gap, 180 ms operator length, 1 window from WB+200 ms, 2000 ms window length

Selected whole line IL2304, 2598 & 3296 from production stack cube with crossline interpolation applied:

- No DAS
- DAS (trace by trace): 48 ms gap, 180 ms operator
- DAS (15 trace rolling mix): 48 ms gap, 180 ms operator

The test cube was loaded into OmegaVu for reviewing; selected inlines appended with 500 ms autocorrelations were compared.
Confirmed on 22 August 2005: Not to apply DAS to the whole survey.

4.17 Time Variant Spectral Shaping (TVSS)

Selected the same test cube (IL2590-2768, XL389-1000) from production stack cube with crossline interpolation applied:

- No TVSS
- TVSS: 9 automated filters & beta factor of 0.5

Selected whole line IL2304, 2598 & 3296 from production stack cube with crossline interpolation applied:

• No TVSS
• TVSS: 9 automated filters & beta factor of 0.5
Selected portion of IL3296 (XL1601-2600) from production stack cube with crossline interpolation applied:
• No TVSS
• TVSS: 9 automated filters & beta factor tests of 0.3, 0.4, 0.5, 0.6
The test cube was loaded into OmegaVu for reviewing; selected inlines were compared.
Confirmed on 22 August 2005: Apply TVSS to the whole survey.

4.18 Filter Tests

Selected a portion of stack from IL2598 (XL381-1000) with crossline interpolation/TVSS applied:
• No filter (applied AGC 2000 ms)
• Filter high-cut tests: out-30, 40, 50, 60, 70, 80, 90, 100, 110, 125 Hz
• Filter low-cut tests: 2, 3, 4, 5, 6, 7, 8 Hz - out
Confirmed on 22 August 2005: Final time variant filter (TVF) was picked as [time(ms)/freq(Hz)]:
WB+0 / 6-80, WB+2000 / 6-70, WB+3500 / 5-60, WB+5000 / 4-55

4.19 Scaling Tests

Selected a portion of stack from IL2598 (XL381-1000) with crossline interpolation/TVSS/TVF applied:
• Raw stack
• AGC scaling tests: AGC 2000, 1500, 1000, 500 ms gate
• RMS scaling tests: RMS 2000, 1500, 1000, 500 ms gate
Selected whole line IL2304, 2598 & 3296 from production TVSS cube with TVF applied:
• Raw stack
• AGC 1000 ms gate
• RMS 1000 ms gate
Confirmed on 22 August 2005: Apply AGC 1000 ms to Final Migrated Stack volume.

4.20 Angle Mutes / Stacks

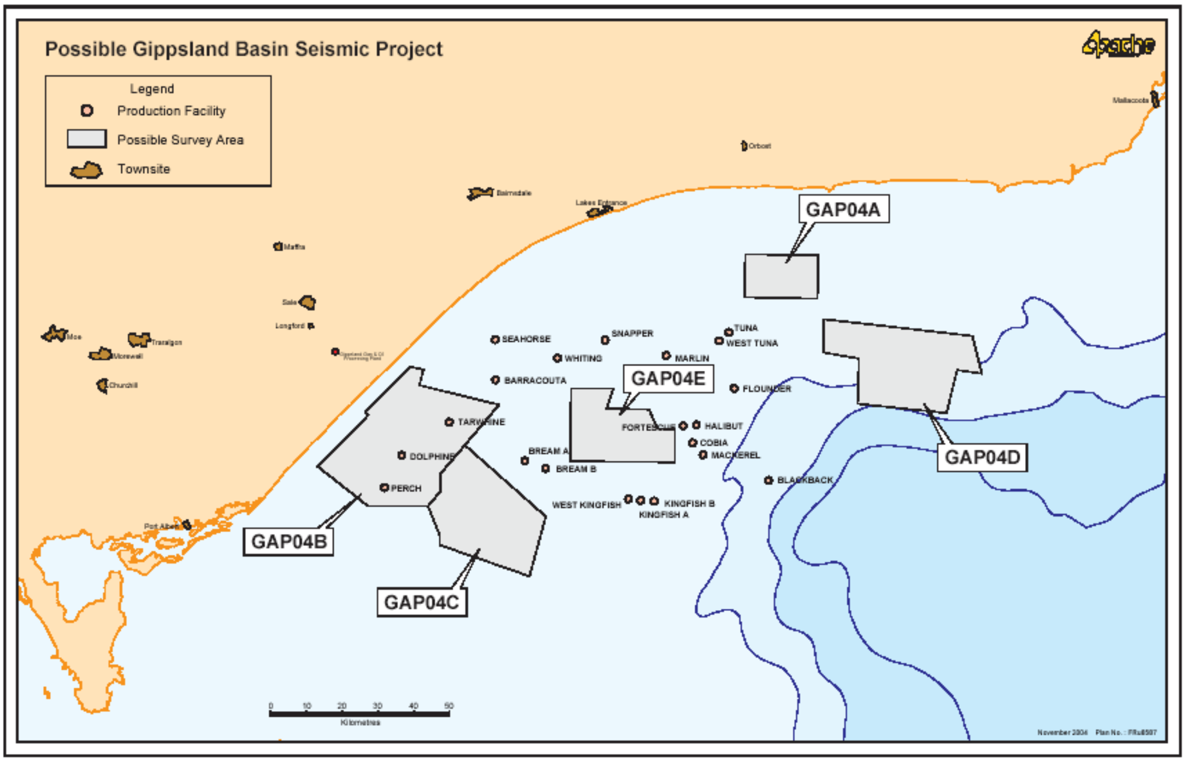
Selected a few final PSTM/Radon NMO-CMP gathers with various water bottom levels:
• Angle (5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60 deg) & final outer mutes overlay
• Angle 0-14 deg & final outer mutes overlay
• Angle 14-28 deg & final outer mutes overlay
• Angle 28-42 deg & final outer mutes (adjusted to suit this angle range) overlay
• Angle 0-14 deg & final outer mutes applied
• Angle 14-28 deg & final outer mutes applied
• Angle 28-42 deg & final outer mutes (adjusted to suit this angle range) applied
Selected whole line IL1152 & 1648 CMP gathers from production Radon for the following stacks with & without TVSS applied:
• Full offset (final outer mutes applied)
• Angle 0-14 deg & final outer mutes applied
• Angle 14-28 deg & final outer mutes applied
• Angle 28-42 deg & final outer mutes (adjusted to suit this angle range) applied
Confirmed on 29 August 2005: Produce 3 near/mid/far angle stack volumes (without TVSS) for final deliverables as per contract.

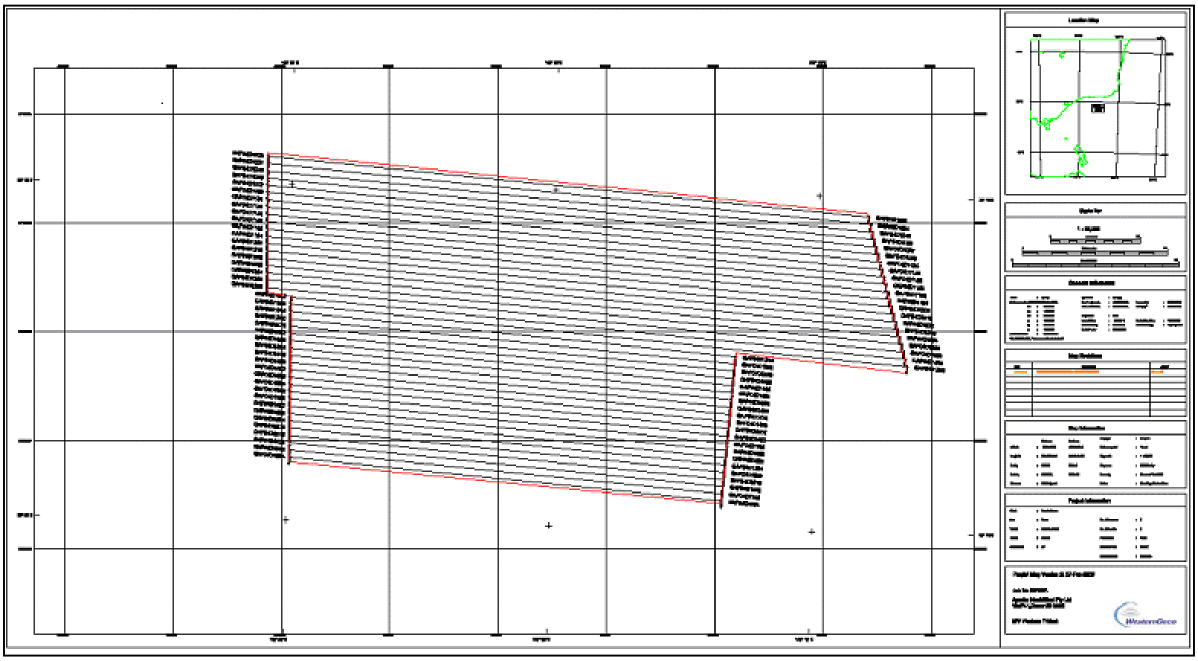
5.0 Personnel

Perth Personnel	
Paul Tredgett ptredgett@perth.westerngeco.slb.com	Senior Processing Supervisor
Tony DeLorenzo delorenzo1@perth.westerngeco.slb.com	Processing Supervisor
Sharon Tan stan3@perth.westerngeco.slb.com	Project Leader
Richard Patenall rpatenall@perth.westerngeco.slb.com	Geo-Support Geophysicist
BSOC Representatives	
Ian Reid ian.reid@bassoil.com.au	General Manager, Exploration

6.0 Appendices

6.1 Map of Survey Location





6.2 Acquisition Parameters

General

Client	Apache Energy Northwest Pty Ltd
Contractor	WesternGeco
Vessel	M/V Western Trident
Location	Oscar 3D, VIC/P41, Gippsland Basin, Australia
Total km^2 acquired	493
Date shot	17 February - 1 March 2005

Recording

Recording type	MSX
Recording medium, format	3590B cartridge, SEGD 8058, Revision 1
Record length	5120 ms
Sample rate	2 ms
Low cut filter	2 Hz, 12 dB/octave
High cut filter	206 Hz, 264 dB/octave

Source

Source type	Tuned sleevegun array
Number of source arrays	2
Source array separation	50 m
Shotpoint interval	18.75 m flip/flop (37.5 m/array)
Array volume per source	3000 cu in
Operating pressure	2000 psi
Source depth	7 m
Number of sub-arrays/source	4
Sub-array separation	6 m
Number of airguns/sub-array	8
Sub-array length	15.1 m
Nominal CMP fold	64

Streamer

Streamer type	MSX solid streamer
Number of streamers	8
Group length	17.75 m
Number of hydrophones/group	14
Group interval	12.5 m
Hydrophone sensitivity	13.8 v / bar
Streamer length	4800 m
Streamer depth	8 m
Streamer separation	100 m
Number of groups/streamer	384
Nearest offset (nominal)	238 m

Navigation

Primary navigation system	Cnav
Secondary navigation system	Fugro Multifix 4
Tertiary navigation system	Trinav GPS 2.6

6.3 Acquisition Line Listing

No.	Seq	Dir	Sail-Line	FGSP	LGSP	No. Of Shots	Full Fold CMP Km (per ssl)
1	021	94.66	GAP04D1008J1021	1001	2912	1912	35.850
2	019	94.66	GAP04D1008P1019	1001	2912	1912	35.850
3	017	94.66	GAP04D1024P1017	1003	2920	1918	35.963
4	015	94.66	GAP04D1040P1015	1005	2927	1923	36.056
5	013	94.66	GAP04D1056P1013	1007	2935	1929	36.169
6	011	94.66	GAP04D1072P1011	1009	2943	1935	36.281
7	009	94.66	GAP04D1088P1009	1011	2951	1941	36.394
8	007	94.66	GAP04D1104P1007	1013	2959	1947	36.506
9	005	94.66	GAP04D1120P1005	1015	2967	1953	36.619
10	003	94.66	GAP04D1136P1003	1017	2975	1959	36.731
11	023	94.66	GAP04D1152J1023	1019	2983	1965	36.844
12	047	94.66	GAP04D1152J2047	1019	2090	1072	20.100
13	001	94.66	GAP04D1152P1001	1019	2983	1965	36.844
14	022	274.42	GAP04D1168P1022	2863	893	1971	36.956
15	020	274.42	GAP04D1184P1020	2870	895	1976	37.050
16	018	274.42	GAP04D1200P1018	2878	897	1982	37.163
17	016	274.41	GAP04D1216P1016	2886	899	1988	37.275
18	014	274.41	GAP04D1232P1014	2894	901	1994	37.388
19	012	274.41	GAP04D1248P1012	2902	903	2000	37.500
20	010	274.41	GAP04D1264P1010	2910	905	2006	37.613
21	008	274.41	GAP04D1280P1008	2918	907	2012	37.725
22	006	274.41	GAP04D1296P1006	2926	909	2018	37.838
23	004	274.41	GAP04D1312P1004	2933	982	1952	36.600
24	002	274.41	GAP04D1328P1002	2941	983	1959	36.731
25	024	274.48	GAP04D1344P1024	2434	985	1450	27.188
26	026	274.48	GAP04D1360P1026	2434	987	1448	27.150
27	028	274.48	GAP04D1376P1028	2434	989	1446	27.113
28	030	274.48	GAP04D1392P1030	2434	991	1444	27.075
29	032	274.48	GAP04D1408P1032	2434	993	1442	27.038
30	036	274.48	GAP04D1424J1036	2434	995	1440	27.000
31	034	274.48	GAP04D1424P1034	2434	995	1440	27.000
32	038	274.48	GAP04D1440P1038	2434	997	1438	26.963
33	040	274.48	GAP04D1456P1040	2434	999	1436	26.925
34	042	274.48	GAP04D1472P1042	2434	1001	1434	26.888
35	044	274.48	GAP04D1488P1044	2434	1003	1432	26.850
36	048	274.48	GAP04D1504J1048	2434	1005	1430	26.813
37	046	274.48	GAP04D1504P1046	2434	1005	1430	26.813

38	049	94.65	GAP04D1520J1049	1135	2562	1428	26.775
39	025	94.65	GAP04D1520P1025	1135	2562	1428	26.775
40	027	94.65	GAP04D1536P1027	1137	2562	1426	26.738
41	029	94.65	GAP04D1552P1029	1138	2562	1425	26.719
42	031	94.65	GAP04D1568P1031	1140	2562	1423	26.681
43	033	94.65	GAP04D1584P1033	1142	2562	1421	26.644
44	037	94.65	GAP04D1600J1037	1144	2562	1419	26.606
45	035	94.65	GAP04D1600P1035	1144	2562	1419	26.606
46	039	94.65	GAP04D1616P1039	1146	2562	1417	26.569
47	041	94.65	GAP04D1632P1041	1148	2562	1415	26.531
48	043	94.65	GAP04D1648P1043	1150	2562	1413	26.494
49	045	94.65	GAP04D1664P1045	1152	2562	1411	26.456
						Total (per ssl) =	**1536.450**
						Total (x16 ssl) =	**24583.200**

6.4 Field Tape Listing and Supporting Data

A set of original field tapes (292 x 3590B media) for Oscar 3D survey (VIC/P41) was sent to Kestrel Information Management in Melbourne for permanent storage on 11 October 2005.

Address: Kestrel Information Management
582-600 Somerville Road
Sunshine West
Victoria 3020

Attention: Diana Giordano (Account Manager)

The following supporting data were included in the same shipment:
1) 1 x 3590B tape with Omega edits
2) 1 x 3590B tape with navigation data in P1/90 format
3) 1 x 3590B tape with navigation data in P2/94 format
4) 1 x CD with digital obs logs, tape log
5) 1 x CD with navigation VSE records

Line Name	DIR	Field Tapes	FSP	LSP	FFile	LFile	Recorded Date
GAP04D1152P1001	94.66	V30665-V30671	932	2993	4	2066	17/02/2005
GAP04D1328P1002	274.41	V30672-V30678	2941	973	40	2008	17/02/2005
GAP04D1136P1003	94.66	V30679-V30685	1017	2975	117	2075	17/02/2005
GAP04D1312P1004	274.41	V30686-V30692	2933	972	60	2021	17-18/02/2005
GAP04D1120P1005	94.66	V30693-V30699	1015	2977	107	2070	18/02/2005
GAP04D1296P1006	274.41	V30700-V30706	2926	906	24	2044	18/02/2005
GAP04D1104P1007	94.66	V30707-V30713	1013	2962	33	1982	18/02/2005
GAP04D1280P1008	274.41	V30714-V30720	2918	897	54	2076	19/02/2005
GAP04D1088P1009	94.66	V30721-V30727	1011	2961	39	1989	19/02/2005
GAP04D1264P1010	274.41	V30728-V30734	2910	895	43	2051	19/02/2005
GAP04D1072P1011	94.66	V30735-V30741	1009	2945	44	1980	19-20/02/2005
GAP04D1248P1012	274.41	V30742-V30748	2902	893	61	2070	20/02/2005
GAP04D1056P1013	94.66	V30749-V30755	1007	2945	39	1979	20/02/2005
GAP04D1232P1014	274.41	V30756-V30762	2894	898	49	2045	20/02/2005

GAP04D1040P1015	94.66	V30763-V30769	1005	2937	69	2002	20-21/02/2005
GAP04D1216P1016	274.41	V30770-V30776	2886	889	39	2037	21/02/2005
GAP04D1024P1017	94.66	V30777-V30784	1003	2930	44	1964	21/02/2005
GAP04D1200P1018	274.42	V30785-V30791	2878	892	29	2015	21/02/2005
GAP04D1008P1019	94.66	V30792-V30798	1001	2921	43	1963	22/02/2005
GAP04D1184P1020	274.42	V30799-V30806	2870	885	39	2024	22/02/2005
GAP04D1008J1021	94.66	V30807-V30813	1001	2916	33	1948	22/02/2005
GAP04D1168P1022	274.42	V30814-V30820	2863	887	61	2034	22/02/2005
GAP04D1152J1023	94.66	V30821-V30827	1019	2993	89	2064	23/02/2005
GAP04D1344P1024	274.48	V30828-V30832	2434	975	19	1479	23/02/2005
GAP04D1520P1025	94.65	V30833-V30837	1135	2565	80	1510	23/02/2005
GAP04D1360P1026	274.48	V30838-V30842	2434	983	64	1515	23/02/2005
GAP04D1536P1027	94.65	V30843-V30847	1137	2572	83	1518	24/02/2005
GAP04D1376P1028	274.48	V30848-V30852	2434	979	38	1494	24/02/2005
GAP04D1552P1029	94.65	V30853-V30857	1138	2564	64	1490	24/02/2005
GAP04D1392P1030	274.48	V30858-V30862	2434	985	80	1526	24/02/2005
GAP04D1568P1031	94.65	V30863-V30867	1140	2572	74	1506	24-25/02/2005
GAP04D1408P1032	274.48	V30868-V30872	2434	983	40	1491	25/02/2005
GAP04D1584P1033	94.65	V30873-V30877	1142	2564	32	1454	25/02/2005
GAP04D1424P1034	274.48	V30878-V30882	2434	992	65	1507	25/02/2005
GAP04D1600P1035	94.65	V30883-V30887	1144	2570	63	1487	25/02/2005
GAP04D1424J1036	274.48	V30888-V30892	2434	985	41	1491	26/02/2005
GAP04D1600J1037	94.65	V30893-V30897	1144	2572	38	1468	26/02/2005
GAP04D1440P1038	274.48	V30898-V30902	2434	995	49	1488	26/02/2005
GAP04D1616P1039	94.65	V30903-V30907	1146	2565	42	1461	26/02/2005
GAP04D1456P1040	274.48	V30908-V30912	2434	989	39	1486	27/02/2005
GAP04D1632P1041	94.65	V30913-V30917	1148	2572	33	1458	27/02/2005
GAP04D1472P1042	274.48	V30918-V30922	2434	992	50	1486	27/02/2005
GAP04D1648P1043	94.65	V30923-V30927	1150	2564	58	1472	27/02/2005
GAP04D1488P1044	274.48	V30928-V30932	2434	993	41	1484	28/02/2005
GAP04D1664P1045	94.65	V30933-V30937	1152	2572	32	1453	28/02/2005
GAP04D1504P1046	274.48	V30938-V30942	2434	1002	37	1469	28/02/2005
GAP04D1152J2047	94.66	V30943-V30946	1019	2092	53	1126	28/02/2005
GAP04D1504J1048	274.48	V30947-V30951	2434	998	66	1502	28/02/2005-1/03/2005
GAP04D1520J1049	94.65	V30952-V30956	1135	2572	39	1477	1/03/2005

6.5 Data Processing Flow

<u>Oscar 3D, VIC/P41: Final Data Processing Flow</u>

```
                              Conversion
                                  |
                     Navigation & Seismic Data Merge
                       Deterministic Designature
                                  |
                           Resample to 4 ms
                              Trace Edits
                          Amplitude Recovery
                            Low Cut Filter
                                  |
  First Pass--------←-----------Swell Noise Attenuation (SWATT)
Velocity Analysis (1x1km grid)    |
        |                  Tau-p Linear Noise Attenuation
        |--------------→-------------------------K-Filter
        |                         |
        |                Deconvolution Before Stack (DBS)
        |                    Tidal Static Correction
        |                       Trace Reduction
        |                         Trace Edits
        |                         |
        |                 3D Grid Definition (PreStack)
        |                         |
        |                     Common Offset Sort
        |                         |
        |----------------→----3D Bin Regularisation by Interpolation
                                  |
  Second Pass--------←----------Targeted PSTM Velocity Lines
Velocity Analysis (500x500 m grid)  |
        |                         |
        |----------------→-------3D PreStack Time Migration (PSTM)
                                  |
 Third (Final) Pass-----←----------------3D CMP Sort
Velocity Analysis (500x500 m grid)  |
        |-----------------→--------Radon Multiple Attenuation
        |                         |
        |----------------→---------Normal Moveout Correction
                             |    |
                             |  Gun/Cable Static------→Archive: Raw PSTM/RADON NMO-CMP Gathers
                             |    Correction              (1 x Lacie hard disk, returned to WG)
                             |----→----Outer Mute / Stack
                             |          3D F-K Footprint Removal
                             |          Crossline Interpolation
                             |          3D Grid Definition (PostStack)
                             |          Gun/Cable Static Correction
                             |           |        |
                             |           |  Exponential Gain
                             |           |  Polygon Select Of Input Area→Archive: Raw PSTM Stk  Vol
                             |           |                                  (5 x DVDs)
                             |  Time Variant Spectral Shaping (TVSS)
                             |  Time Variant Filter (TVF)
                             |  Scaling (AGC 1000 ms)
                             |  Polygon Select Of Input Area----→Archive: Final PSTM Stack Volume
                             |                                      (5 x DVDs)
                    Near / Mid / Far Angle Stack Volumes (0-14, 14-28, 28-42 deg)
                    Crossline Interpolation
                    3D Grid Definition (PostStack)
                    Gun/Cable Static Correction
                    Time Variant Filter (TVF)
                    Exponential Gain
                    Polygon Select Of Input Area------------------→Archive: Filtered PSTM Angle Stack Volumes
                                                                      (5 x DVDs per volume)
```

6.6 Coefficients of Zero Phasing Filter Operator

Time coefficients for the zero phasing filter derived from source signature, are as follows:

	Coefficients		Coefficients		Coefficients		Coefficients		Coefficients		Coefficients
1	0.000694357	91	-0.0025247	181	0.0120337	271	-0.0805515	361	0.00599496	451	-0.0028381
2	-0.00219574	92	0.00638742	182	0.0135619	272	0.135954	362	0.00350092	452	-0.005011
3	0.00583011	93	0.00663555	183	0.0021281	273	0.124708	363	0.00169097	453	-0.0075675
4	0.00594792	94	0.00278493	184	-0.00342117	274	-0.140092	364	-0.00501822	454	-0.0032162
5	0.00315448	95	-0.00483749	185	0.00536758	275	-0.0163955	365	0.000575189	455	-0.0014539
6	-0.00124261	96	-0.00060708	186	0.0152194	276	-0.0447667	366	0.00101432	456	-0.0017245
7	0.00268215	97	0.00564486	187	0.0106669	277	0.108249	367	0.00108184	457	-0.0056105
8	0.0050555	98	0.00491002	188	-0.00145423	278	0.0448023	368	-0.00429778	458	-0.0049938
9	0.00648851	99	-0.00157659	189	-0.00267195	279	-0.0695524	369	-0.00608676	459	-0.0012491
10	0.00254824	100	-0.00660912	190	0.00918101	280	-0.0537138	370	-0.00120193	460	-0.0001039
11	0.000601862	101	0.00132103	191	0.0145368	281	-0.0145593	371	-0.0020018	461	-0.0017372
12	0.0040559	102	0.00436475	192	0.00553361	282	0.0696961	372	-3.91E-05	462	-0.0055381
13	0.00771515	103	0.00334264	193	-0.00610902	283	0.00637913	373	-0.00715149	463	-0.0022709
14	0.0134819	104	-0.00685131	194	-0.00118486	284	-0.0398765	374	-0.00221164	464	-0.0001949
15	0.005978	105	-0.00494218	195	0.0103162	285	-0.0588806	375	-0.00401123	465	0.00148076
16	0.00697063	106	0.000856206	196	0.0109093	286	0.00234215	376	-0.00123908	466	-0.0030295
17	0.0101585	107	0.00470361	197	-0.00293826	287	0.0280074	377	-0.00667797	467	-0.0035573
18	0.0155376	108	-0.00166359	198	-0.0108578	288	-0.0062151	378	-0.00883753	468	-0.0011181
19	0.0107514	109	-0.00899781	199	-0.00164755	289	-0.0341981	379	-0.0078261	469	0.00153153
20	0.00751973	110	-0.00407457	200	0.00726987	290	-0.0405732	380	-0.010051	470	0.000798
21	0.00794266	111	0.00122441	201	0.00105212	291	0.00282221	381	-0.0026655	471	-0.0037895
22	0.0133845	112	0.00378074	202	-0.017922	292	0.00295967	382	-0.0064431	472	-0.0021479
23	0.0154758	113	-0.00738931	203	-0.0226789	293	-0.0141001	383	-0.0043627	473	-0.0005587
24	0.00887452	114	-0.00829545	204	-0.0153165	294	-0.0291979	384	-0.0094553	474	0.00296509
25	0.008553	115	-0.0047337	205	-0.00978953	295	-0.0206483	385	0.00042512	475	-0.0014945
26	0.00871465	116	0.00379243	206	-0.0217522	296	-0.00296228	386	-0.0059135	476	-0.0027897
27	0.017265	117	-0.00147124	207	-0.0321288	297	-0.0113601	387	-0.0049699	477	-0.0022439
28	0.0124612	118	-0.00939235	208	-0.0238129	298	-0.0221421	388	-0.0054774	478	0.0015344
29	0.0102251	119	-0.00946406	209	-0.00658464	299	-0.0206888	389	-0.0086927	479	0.0020176
30	0.00682034	120	-0.00246131	210	-0.00245726	300	-0.00807495	390	0.00239208	480	-0.0023975
31	0.0133038	121	0.00337808	211	-0.019821	301	-0.00642415	391	-0.0112905	481	-0.0023306
32	0.0163962	122	-0.00650429	212	-0.0291872	302	-0.0205063	392	-0.0019993	482	-0.0017658
33	0.0121698	123	-0.010348	213	-0.022133	303	-0.0242912	393	-0.0107358	483	0.0034033
34	0.00904568	124	-0.0106496	214	-0.00597478	304	-0.0112392	394	-0.002674	484	-0.0003525
35	0.00799903	125	0.00209317	215	-0.00945123	305	0.00101593	395	-0.0030839	485	-0.001618
36	0.0168367	126	-0.00166428	216	-0.0201233	306	-0.00670005	396	-0.0104476	486	-0.0034196
37	0.0150893	127	-0.00732478	217	-0.0181413	307	-0.022561	397	-0.0038582	487	0.0009119
38	0.0130795	128	-0.0146444	218	0.00153841	308	-0.0181163	398	-0.0119966	488	0.0023456
39	0.0069653	129	-0.00558033	219	0.0136295	309	0.00196811	399	0.00079708	489	-0.0009408
40	0.0125193	130	0.00131993	220	0.000326315	310	0.016066	400	-0.0097549	490	-0.0022707
41	0.0167057	131	-0.00310916	221	-0.0128671	311	0.00591235	401	-0.0068389	491	-0.0031788
42	0.0160008	132	-0.0107175	222	-0.0085459	312	-0.00557939	402	-0.0096303	492	0.002849
43	0.0106222	133	-0.0150567	223	0.0131171	313	-0.00048187	403	-0.0074652	493	1.87E-05
44	0.00802158	134	0.000400624	224	0.0137639	314	0.015792	404	-0.002262	494	-0.0004859
45	0.0147479	135	-0.00223077	225	-0.00114528	315	0.017253	405	-0.0109117	495	-0.0047476
46	0.016767	136	-7.48E-05	226	-0.0113831	316	0.000905881	406	-0.0069063	496	-0.000472

47	0.0153237	137	-0.0202844	227	0.00534728	317	-0.008084	407	-0.0117467	497	0.0012166
48	0.0079872	138	-0.0029877	228	0.0232487	318	0.00423132	408	-0.0034211	498	-0.0002184
49	0.0103858	139	-0.00658322	229	0.0158763	319	0.0237237	409	-0.0066643	499	-0.0025604
50	0.015062	140	0.00942223	230	-0.00259125	320	0.0229848	410	-0.0087653	500	-0.0050145
51	0.0173142	141	-0.0146607	231	-0.00346275	321	0.00784815	411	-0.0096469	501	0.0009322
52	0.0120224	142	-0.0088915	232	0.02391	322	-0.00246793	412	-0.008634	502	-0.0008943
53	0.00744428	143	-0.00805358	233	0.0338253	323	0.00545128	413	-0.0033076	503	3.17E-05
54	0.0114406	144	0.00457748	234	0.0184567	324	0.0112368	414	-0.0073415	504	-0.0063425
55	0.0157917	145	0.00626033	235	-0.00454372	325	0.00450787	415	-0.0081472	505	-0.0024262
56	0.01604	146	-0.0164762	236	0.0120601	326	-0.00906029	416	-0.009663	506	-0.0011013
57	0.00878575	147	-0.00127293	237	0.0427606	327	-0.00891488	417	-0.0050242	507	7.60E-05
58	0.00768679	148	-0.0105089	238	0.047587	328	0.00288935	418	-0.003815	508	-0.0026941
59	0.0119991	149	0.0193832	239	0.0164098	329	0.00807916	419	-0.0064303	509	-0.006332
60	0.0162356	150	-0.0180653	240	-0.0024508	330	0.00168947	420	-0.008609	510	-0.0012007
61	0.0129251	151	-0.00848448	241	0.0275364	331	-0.00737054	421	-0.007245	511	-0.0017171
62	0.00646266	152	-0.0145809	242	0.0617225	332	-0.00146944	422	-0.0035067	512	0.0028477
63	0.00786495	153	0.00190296	243	0.0576793	333	0.00615101	423	-0.0034243	513	-0.0031121
64	0.012687	154	0.0067227	244	0.0082723	334	0.00848493	424	-0.006772	514	-0.0007522
65	0.0155536	155	-0.0151631	245	0.00245212	335	-0.00131607	425	-0.0075437	515	0.0009957
66	0.00910733	156	-0.00657866	246	0.0371088	336	-0.00341004	426	-0.0049345	516	0.0057645
67	0.00521648	157	-0.0124614	247	0.0836043	337	0.00245499	427	-0.0016932	517	0.0018641
68	0.00792438	158	0.0135763	248	0.0582269	338	0.00893042	428	-0.0033036	518	-0.0061491
69	0.013524	159	-0.00601718	249	0.00278142	339	0.00567425	429	-0.0066675	519	-0.0002779
70	0.0131401	160	-0.00465796	250	0.00367712	340	-0.00271074	430	-0.0061538	520	0.0009428
71	0.00567161	161	-0.0164009	251	0.0459681	341	-0.00049566	431	-0.0033763	521	0.0036914
72	0.00449486	162	0.00364614	252	0.0957591	342	0.00518799	432	-0.0010427	522	-0.0037627
73	0.00814612	163	0.0037241	253	0.051142	343	0.0102432	433	-0.0048133	523	-0.0035172
74	0.0139592	164	-0.00097803	254	-0.00081879	344	0.00198525	434	-0.0062747	524	-0.001035
75	0.00905909	165	-0.0118227	255	-0.0023428	345	-0.00119597	435	-0.0055428	525	0.002485
76	0.00359945	166	-0.00744073	256	0.0483554	346	0.00102827	436	-0.0012903	526	0.0017473
77	0.00331916	167	0.0053843	257	0.0638729	347	0.00930012	437	-0.0019328	527	-0.0018223
78	0.00952763	168	0.00448894	258	0.0169408	348	0.00871649	438	-0.0053859	528	-0.0021403
79	0.0121742	169	-0.0037423	259	-0.0374081	349	0.00162995	439	-0.0067059	529	2.80E-05
80	0.00531345	170	-0.0115821	260	0.0256482	350	0.000202083	440	-0.0047015	530	0.004759
81	0.00163638	171	-0.00033659	261	0.074223	351	0.00421876	441	-0.0012226	531	-0.00089
82	0.0027898	172	0.00737144	262	-0.273273	352	0.0119818	442	-0.004123	532	-0.0017989
83	0.0108275	173	0.00572657	263	-0.568311	353	0.0066085	443	-0.0063876	533	-0.002111
84	0.00821065	174	-0.00626635	264	-0.11064	354	0.00283318	444	-0.0075636	534	0.0032126
85	0.00271465	175	-0.00525141	265	0.118087	355	-0.00013316	445	-0.0030415	535	0.003271
86	-0.00134181	176	0.00592061	266	-0.223467	356	0.00759814	446	-0.002435	536	-0.0008553
87	0.00438281	177	0.0124382	267	0.260794	357	0.00869834	447	-0.0047007	537	-0.0017224
88	0.00940808	178	0.00475229	268	0.239797	358	0.00442406	448	-0.0075459	538	-0.0006276
89	0.00494117	179	-0.00463795	269	-0.203221	359	-0.00078694	449	-0.0060833	539	0.0059126
90	-0.00057294	180	0.00067589	270	0.044445	360	-0.00087937	450	-0.0019985	540	0.0010273

6.7 List of Final Deliverables

Summary of SEGY archived data (5 sec trace length, 4 ms sample rate) to various medias, bin centre XY-coordinates, final velocities & final processing report sent to BSOC office in Melbourne is as follows:

No.	Process & Filename	First Inline	Last Inline	Format	Media Type & No.	Date Sent
1	**Raw PSTM Stack Volume**	**1990**	**3362**	**SEGY**	**5 x DVD**	**22 Aug 2005**
	OSCAR_RAWSTK_IL1990_2250				DVD001	
	OSCAR_RAWSTK_IL2251_2505				DVD002	
	OSCAR_RAWSTK_IL2506_2770				DVD003	
	OSCAR_RAWSTK_IL2771_3070				DVD004	
	OSCAR_RAWSTK_IL3071_3362				DVD005	
2	**Final PSTM Stack Volume**	**1990**	**3362**	**SEGY**	**5 x DVD**	**25 Aug 2005**
	OSCAR_FINALSTK_IL1990_2250				DVD006	
	OSCAR_FINALSTK_IL2251_2505				DVD007	
	OSCAR_FINALSTK_IL2506_2770				DVD008	
	OSCAR_FINALSTK_IL2771_3070				DVD009	
	OSCAR_FINALSTK_IL3071_3362				DVD010	
3	**4 Sets of Stacking/Migration Velocities**				**1 x CD**	**1 Sept 2005**
	BSOCformat_Oscar3D_FinalMigVels_500m	1922	3440	BSOC	CD001	
	BSOCformat_Oscar3D_FinalStkVels_500m	1922	3440	BSOC	CD001	
	WGformat_Oscar3D_FirstPassMigVels_1km	961	1720	WG VELF	CD001	
	WGformat_Oscar3D_FirstPassStkVels_1km	961	1720	WG VELF	CD001	
	2 Sets of Stacking/Migration Velocities				**1 x CD**	**29 Sept 2005**
	WGformat_Oscar3D_FinalMigVels_500m	961	1720	WG VELF	CD003	
	WGformat_Oscar3D_FinalStkVels_500m	961	1720	WG VELF	CD003	
4	**Filtered PSTM Angle Stack Volumes**	**1990**	**3362**	**SEGY**	**5 x DVD per vol**	**6 Sept 2005**
	OSCAR_ANGSTK00_14_IL1990_2250				DVD011	
	OSCAR_ANGSTK00_14_IL2251_2505				DVD012	
	OSCAR_ANGSTK00_14_IL2506_2770				DVD013	
	OSCAR_ANGSTK00_14_IL2771_3070				DVD014	
	OSCAR_ANGSTK00_14_IL3071_3362				DVD015	
	OSCAR_ANGSTK14_28_IL1990_2250				DVD016	
	OSCAR_ANGSTK14_28_IL2251_2505				DVD017	
	OSCAR_ANGSTK14_28_IL2506_2770				DVD018	
	OSCAR_ANGSTK14_28_IL2771_3070				DVD019	
	OSCAR_ANGSTK14_28_IL3071_3362				DVD020	

	OSCAR_ANGSTK28_42_IL1990_2250 OSCAR_ANGSTK28_42_IL2251_2505 OSCAR_ANGSTK28_42_IL2506_2770 OSCAR_ANGSTK28_42_IL2771_3070 OSCAR_ANGSTK28_42_IL3071_3362				DVD021 DVD022 DVD023 DVD024 DVD025	
5	**Bin Center XY-Coordinates** Oscar3D_Bin_Center_XY_modUKOOA_Format	**1990**	**3362**	**ascii file** (in modified UKOOA P1/90)	**1 x CD** CD002	**7 Sept 2005**
6	**Raw PSTM/RADON NMO-CMP Gathers** OSCAR_PSTMRADON_NMOCMP_IL0995_1044 OSCAR_PSTMRADON_NMOCMP_IL1045_1094 OSCAR_PSTMRADON_NMOCMP_IL1095_1144 OSCAR_PSTMRADON_NMOCMP_IL1145_1194 OSCAR_PSTMRADON_NMOCMP_IL1195_1244 OSCAR_PSTMRADON_NMOCMP_IL1245_1294 OSCAR_PSTMRADON_NMOCMP_IL1295_1344 OSCAR_PSTMRADON_NMOCMP_IL1345_1394 OSCAR_PSTMRADON_NMOCMP_IL1395_1444 OSCAR_PSTMRADON_NMOCMP_IL1445_1494 OSCAR_PSTMRADON_NMOCMP_IL1495_1554 OSCAR_PSTMRADON_NMOCMP_IL1555_1614 OSCAR_PSTMRADON_NMOCMP_IL1615_1681	**995**	**1681**	**SEGY**	**Lacie hard disk** (Returned to WesternGeco on 30 Sept 2005)	**22 Sept 2005**
7	**Final Processing Report** Final_Processing_Report_Oscar.pdf	**N/A**	**N/A**	**Adobe Acrobat**	**1 x CD** CD004 and bound hard copy	**18 Oct 2005**

6.8 *PostStack / PreStack Data Load Sheet*

PostStack Data Load Sheet

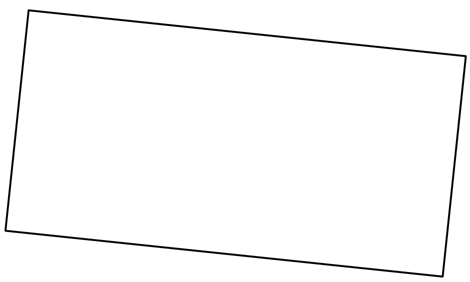
Project:	AS19	
Area:	Oscar 3D, VIC/P41	
Client:	Bass Strait Oil Company	
Data:	3D PreSTM Stack Volume	
Projection System:	UTM South	
Spheroid:	GRS80	
Datum:	GDA94	
Central Meridian:	147 degrees East	
Tape Number:	Raw PSTM Stack Volume	Media: 5 x DVDs (DVD001-005)
	Final PSTM Stack Volume	Media: 5 x DVDs (DVD006-010)
	Filtered PSTM Angle Stack Volumes	Media: 15 x DVDs (DVD011-025)

Number of Inlines:	1373	
Number of Crosslines:	3294	
Total number live traces:	3785373	
Inline spacing (interval):	12.500	m
Crossline spacing (interval):	12.500	m
Record Length:	5.000	secs
Sample Rate:	4	ms
Azimuth: (from due North clockwise)	95.785	degrees

Trace Header Byte Locations		**Bytes**
Trace Number	Integer	1
Inline	Integer	9
Crossline	Integer	13
CMP	Integer	21
Cell Center X-Coordinates	Integer	73
Cell Center Y-Coordinates	Integer	77
Cell Center X-Coordinates	Real	81
Cell Center Y-Coordinates	Real	85
Inline	Integer	197
Crossline	Integer	201
Water bottom time at midpoint	Integer	205

Inline = 1990
Crossline = 409
X = 656929.56
Y = 5776257.86

Inline = 1990
Crossline = 3702
X = 697882.43
Y = 5772108.85



Inline = 3362
Crossline = 409
X = 655200.91
Y = 5759195.19

Inline = 3362
Crossline = 3702
X = 696153.78
Y = 5755046.19

PreStack Data Load Sheet

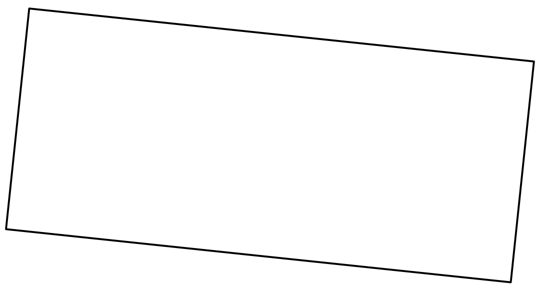
Project:	AS19	
Area:	Oscar 3D, VIC/P41	
Client:	Bass Strait Oil Company	
Data:	3D PreSTM CMP Gathers	
Projection System:	UTM South	
Spheroid:	GRS80	
Datum:	GDA94	
Central Meridian:	147 degrees East	
Tape Number:	Raw PSTM/RADON NMO-CMP Gathers	Media: 1 x portable Lacie hard disk (returned to WesternGeco)

Number of Inlines:	687	
Number of Crosslines:	3294	
Total number live traces:	approx. 120,000,000	
Inline spacing (interval):	25.000	m
Crossline spacing (interval):	12.500	m
Record Length:	5.000	secs
Sample Rate:	4	ms
Azimuth: (from due North clockwise)	95.785	degrees

Trace Header Byte Locations		**Bytes**
Inline	Integer	9
Crossline	Integer	13
CMP	Integer	21
Offset distance	Integer	37
Water depth at source	Integer	61
Cell Center X-Coordinates	Integer	73
Cell Center Y-Coordinates	Integer	77
Cell Center X-Coordinates	Real	81
Cell Center Y-Coordinates	Real	85
Inline	Integer	197
Crossline	Integer	201
Water bottom time at midpoint	Integer	205

Inline =995
Crossline =409
X =656929.56
Y =5776257.86

Inline = 995
Crossline = 3702
X = 697882.43
Y = 5772108.85

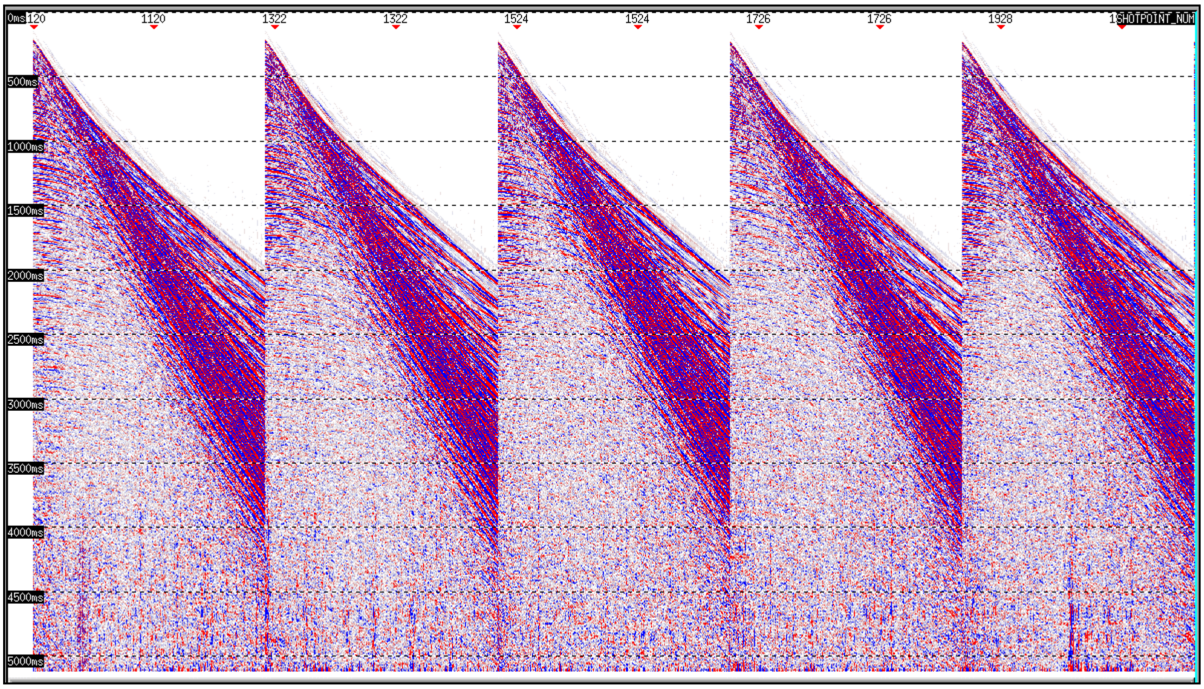


Inline =1681
Crossline =409
X =655200.91
Y =5759195.19

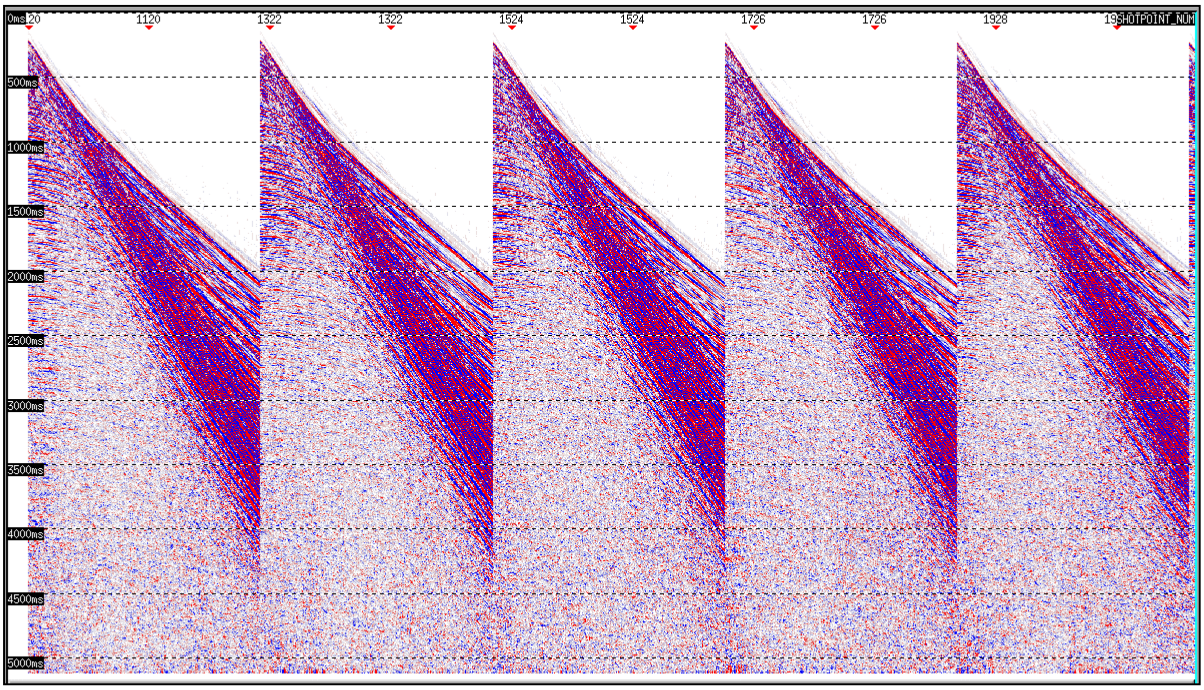
Inline = 1681
Crossline = 3702
X = 696153.78
Y = 5755046.19

7.0 Enclosures

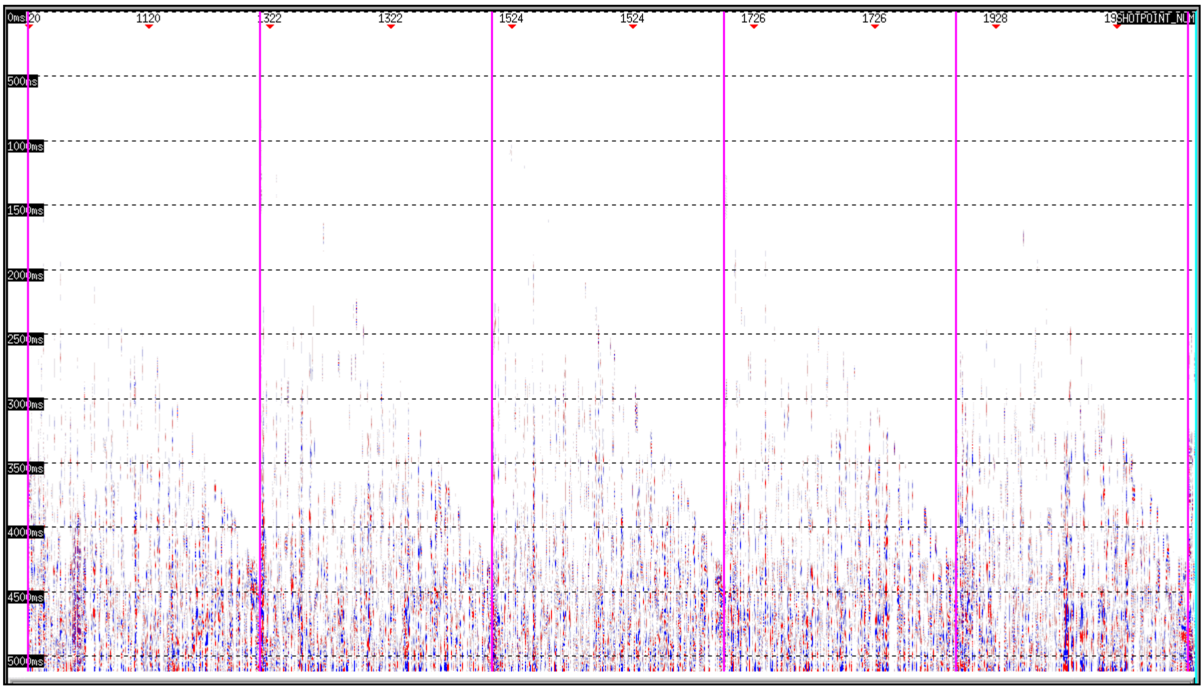
7.1 Shot records before SWATT applied



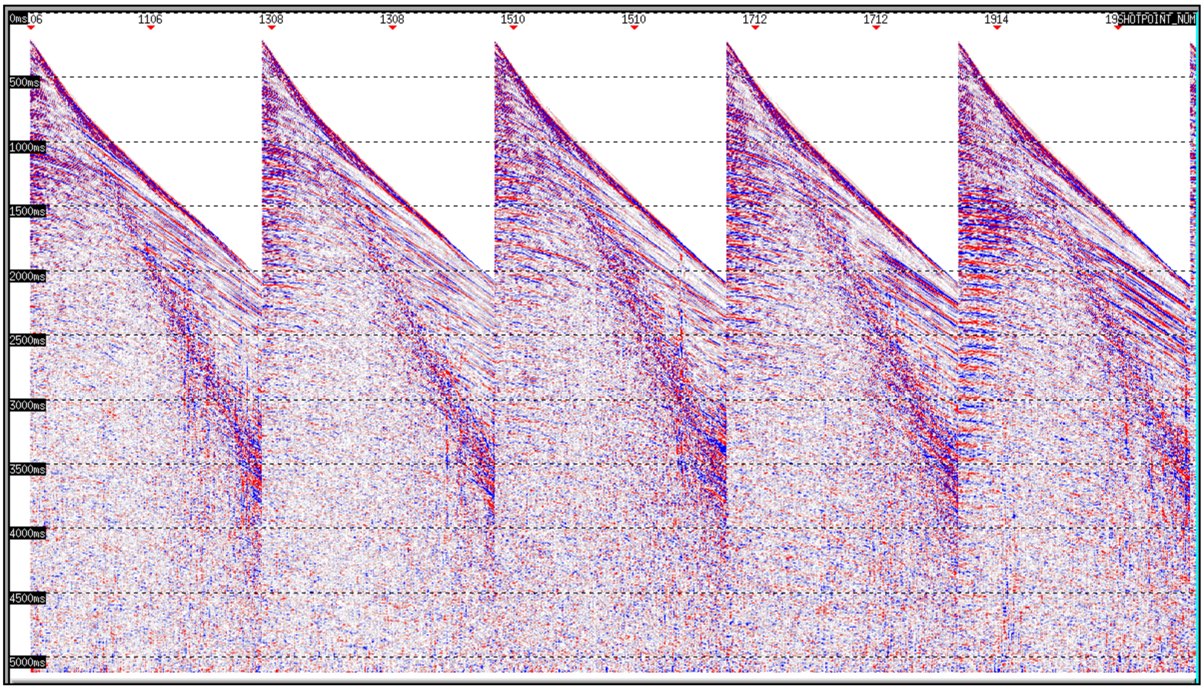
7.2 Shot records after SWATT applied



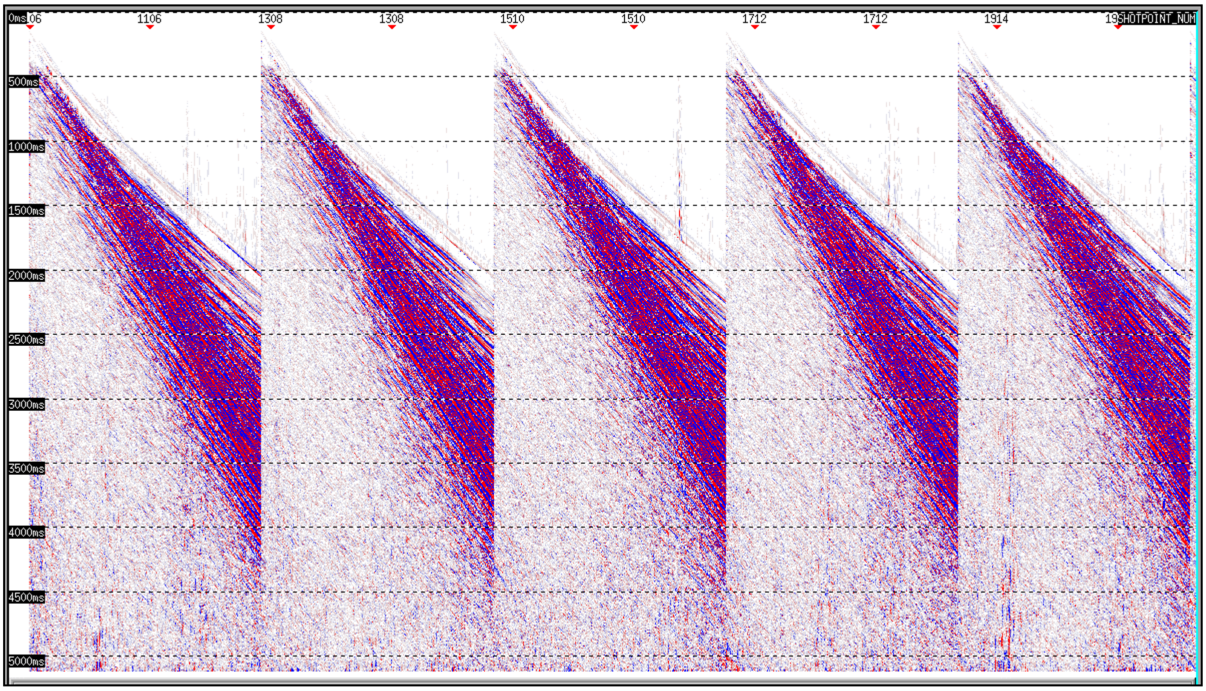
7.3 Shot records SWATT difference plot



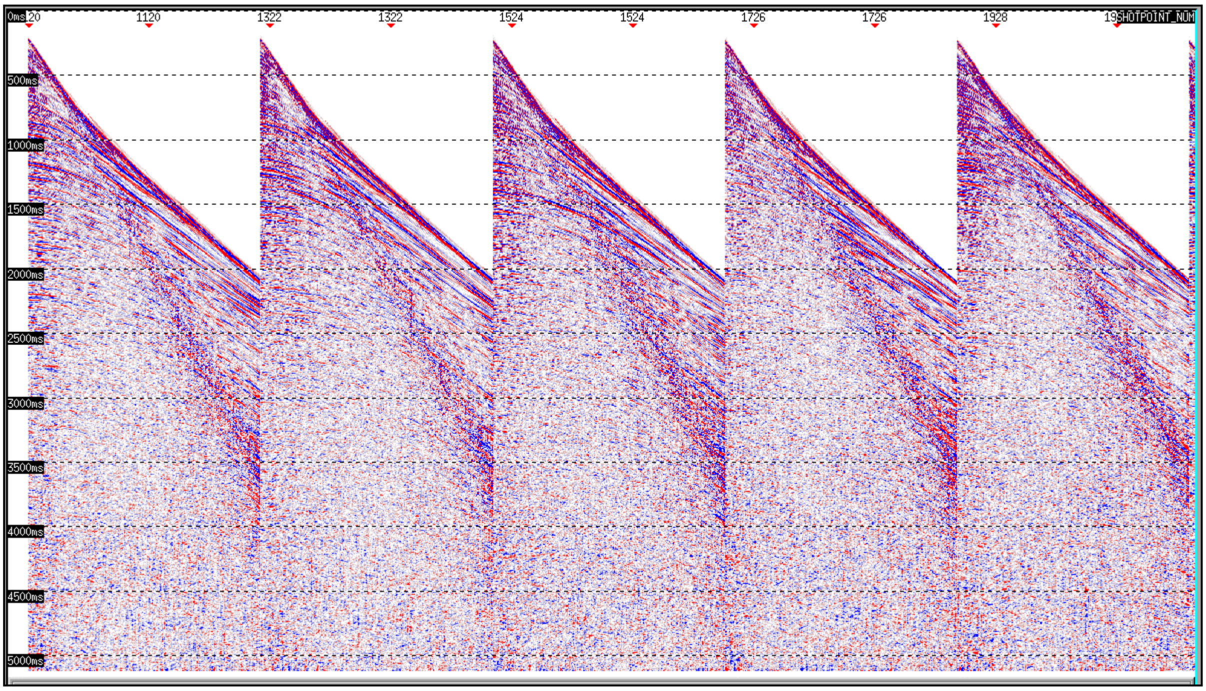
7.4 Shot records with Tau-p linear noise attenuation (LNA) applied



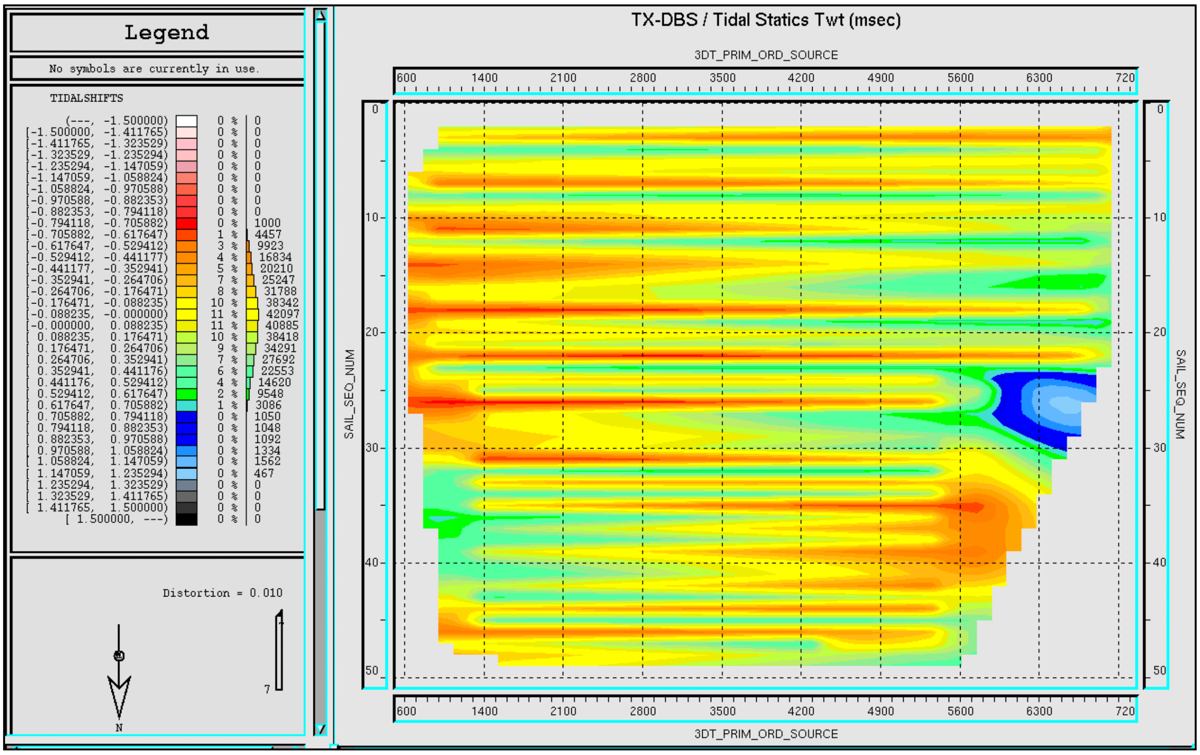
7.5 Shot records Tau-p LNA difference plot



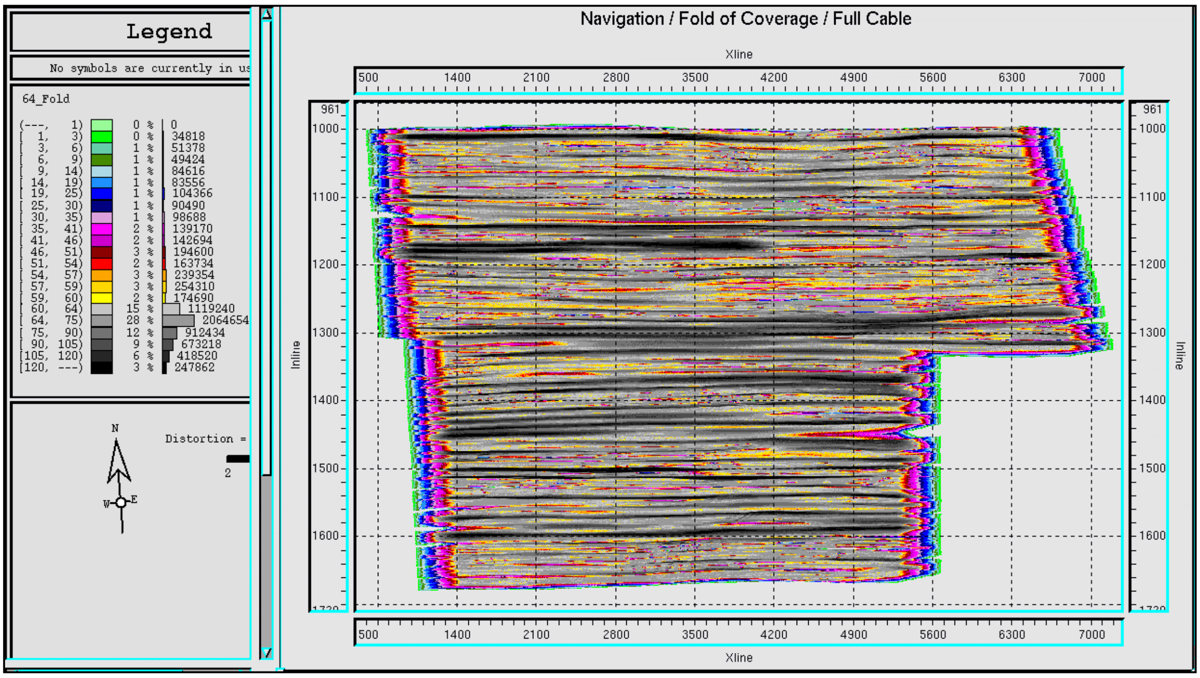
7.6 Shot records with DBS applied



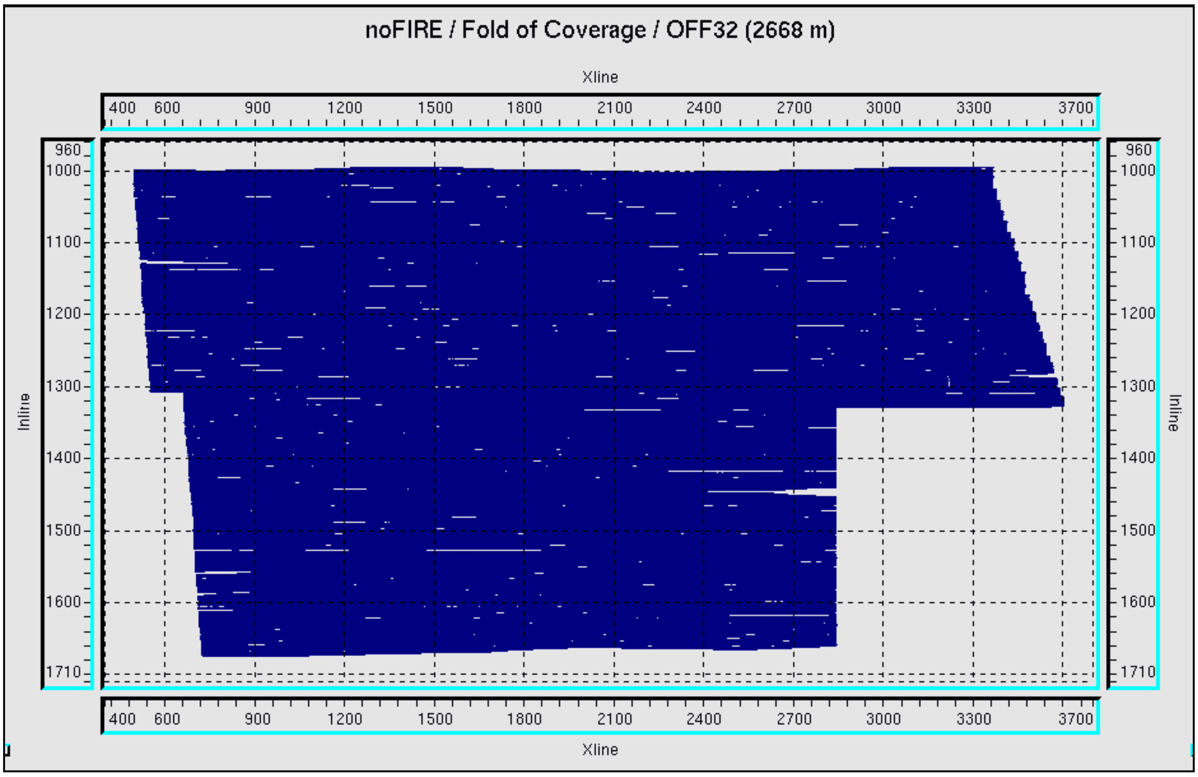
7.7 Tidal static plot



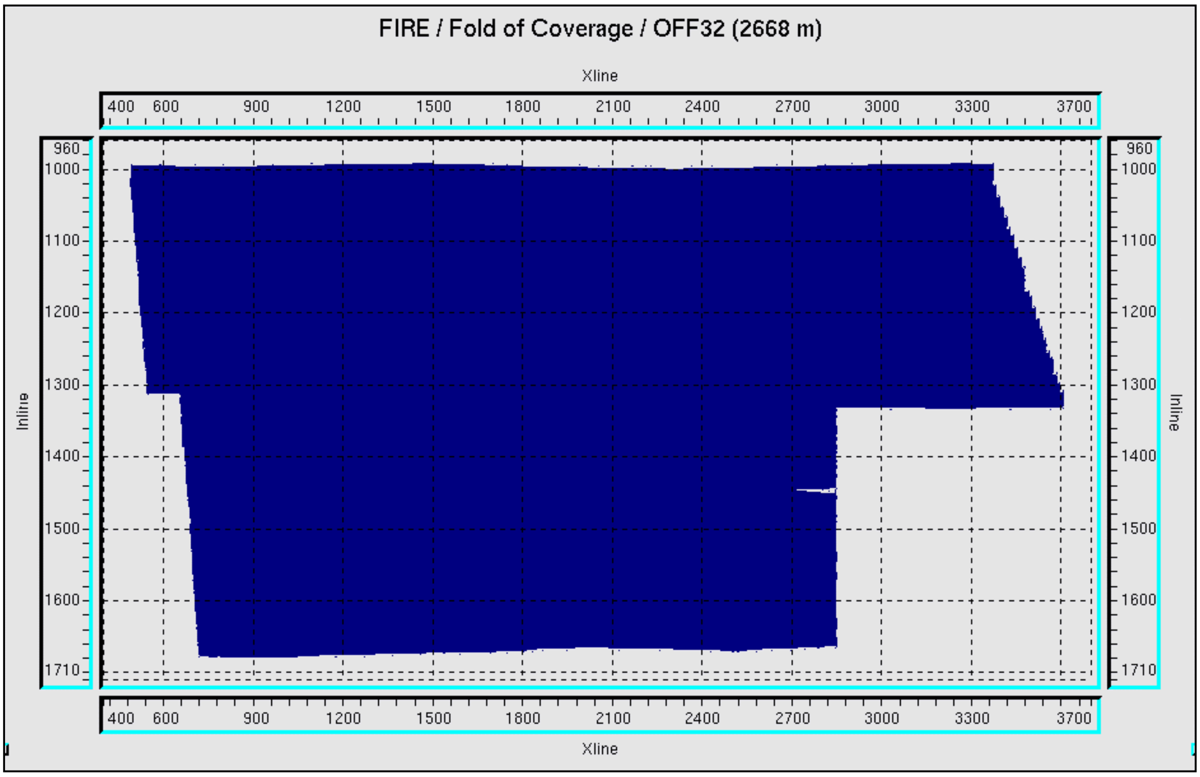
7.8 Fold of coverage plot



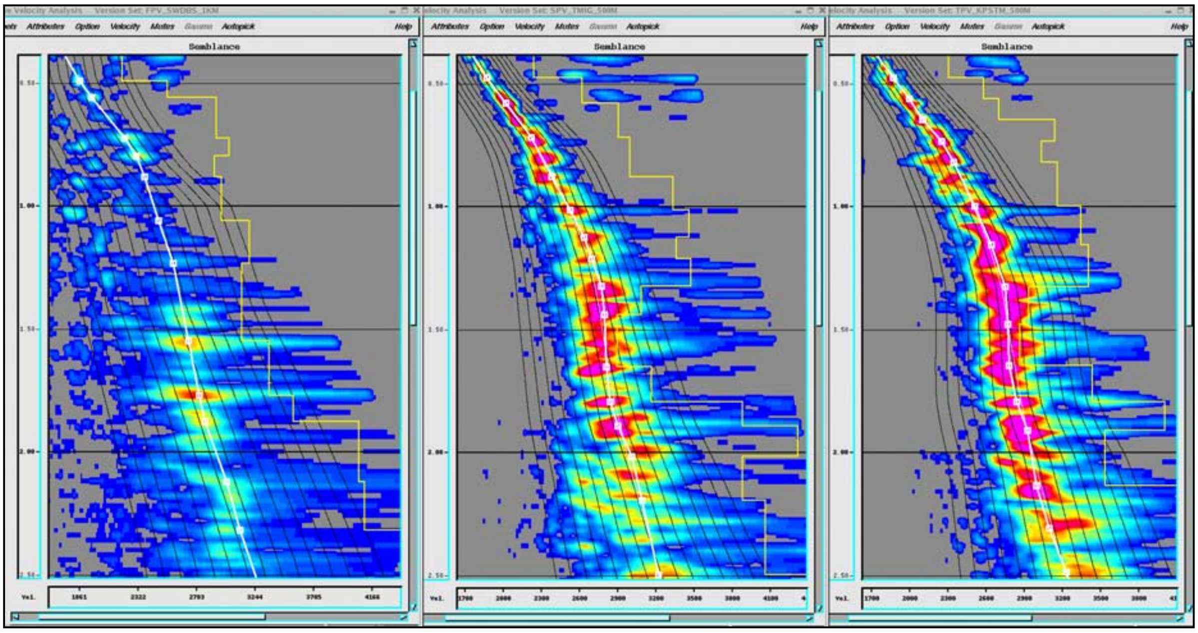
7.9 Fold of coverage plot before 3D bin regularisation by interpolation



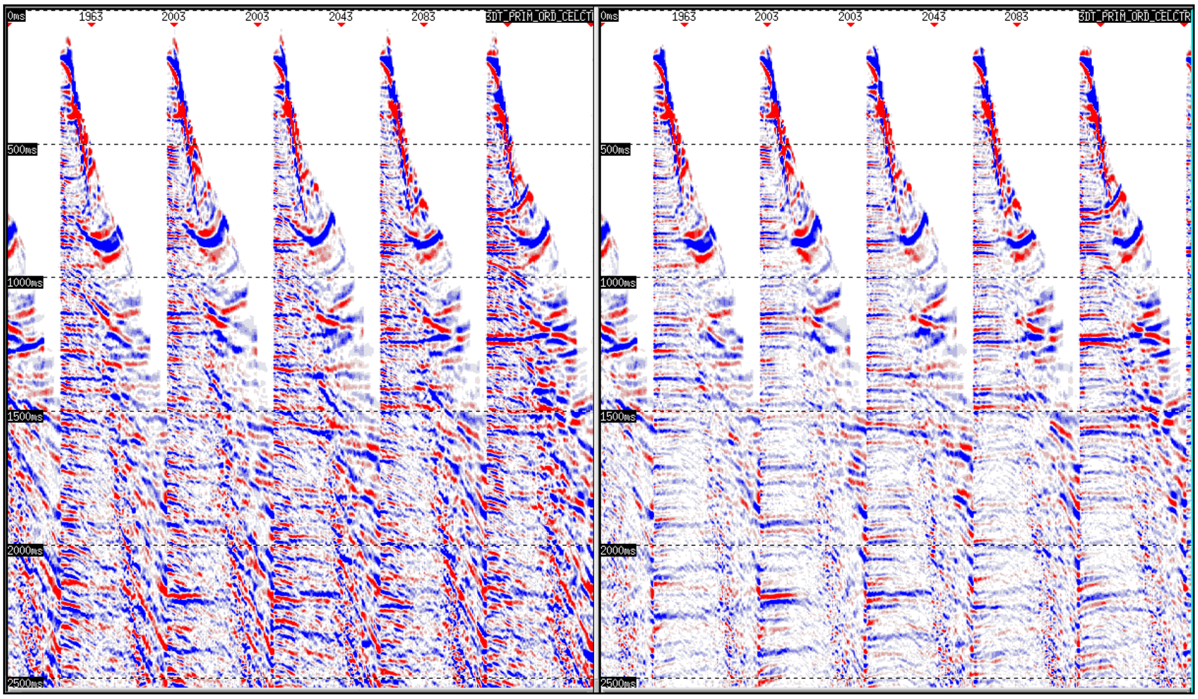
7.10 Fold of coverage plot after 3D bin regularisation by interpolation



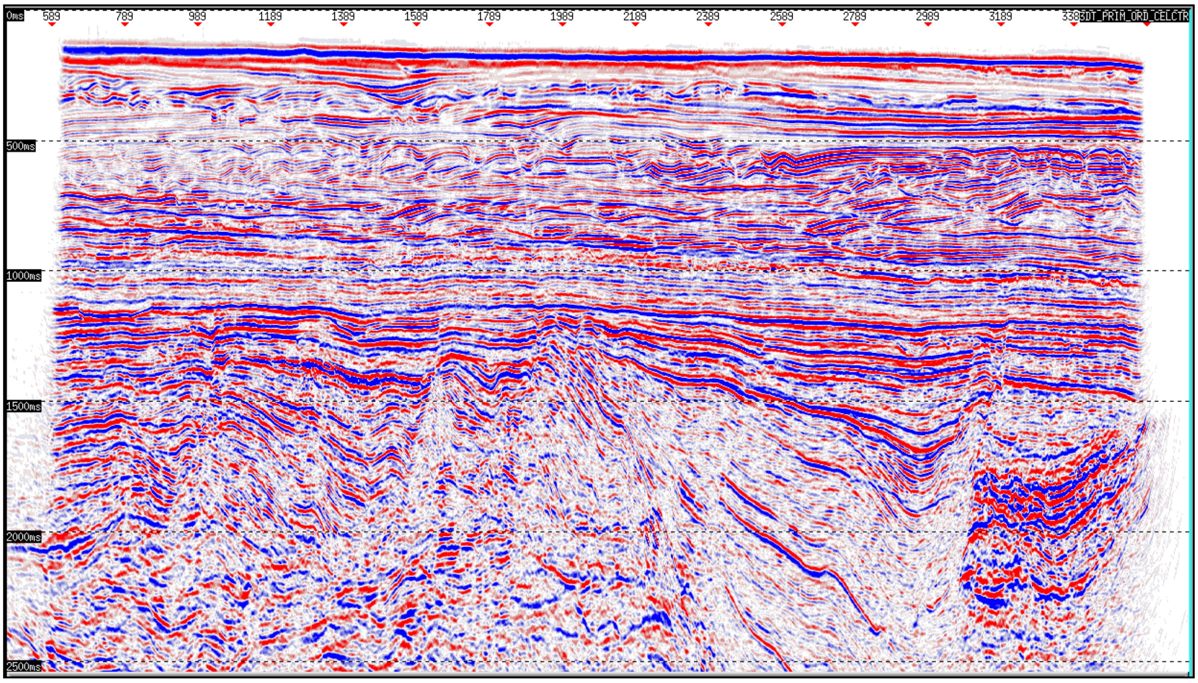
7.11 Sample of first pass, second pass, third pass velocity trends



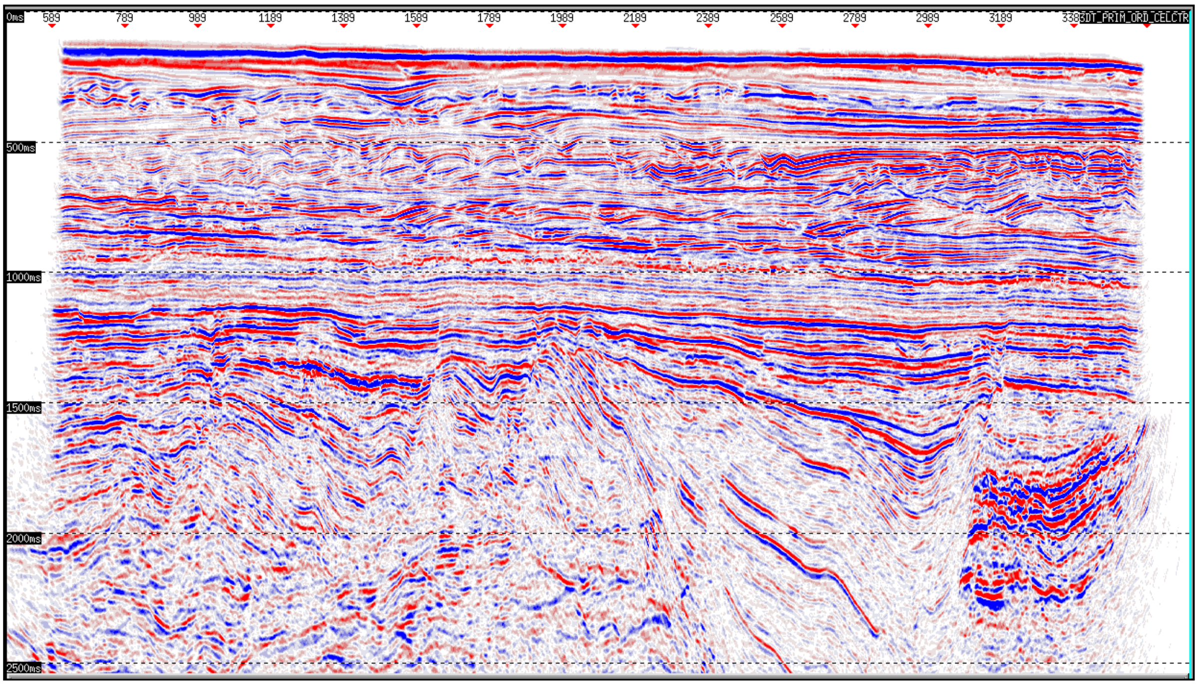
7.12 NMO-CMP gathers before (L) & after (R) Radon multiple attenuation



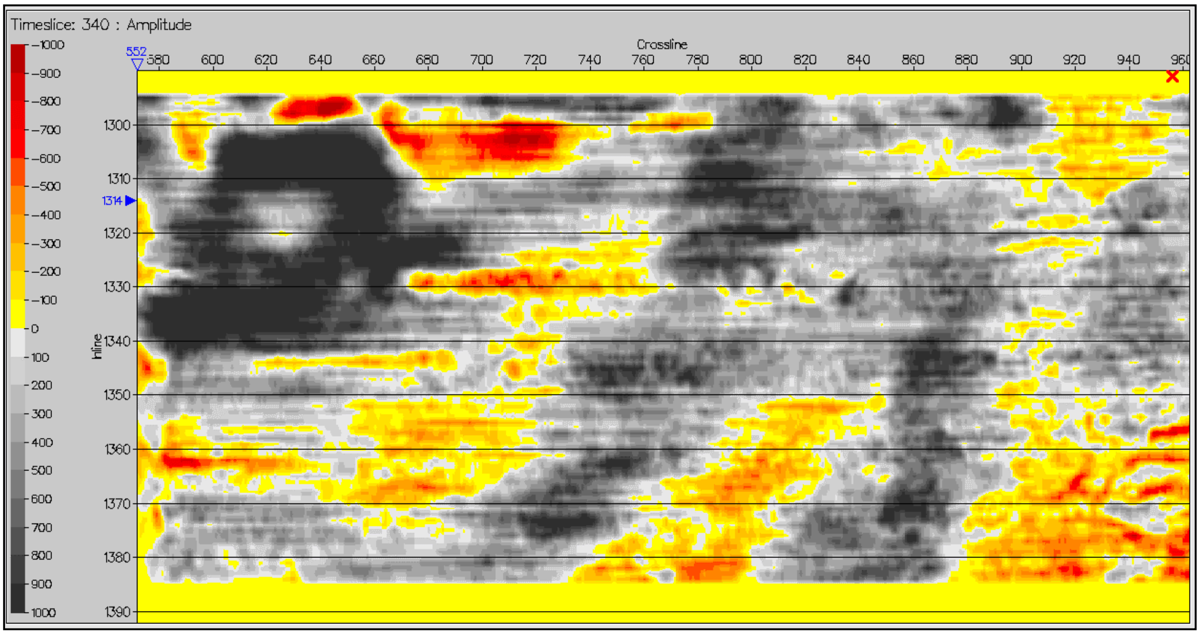
7.13 Stack before Radon multiple attenuation



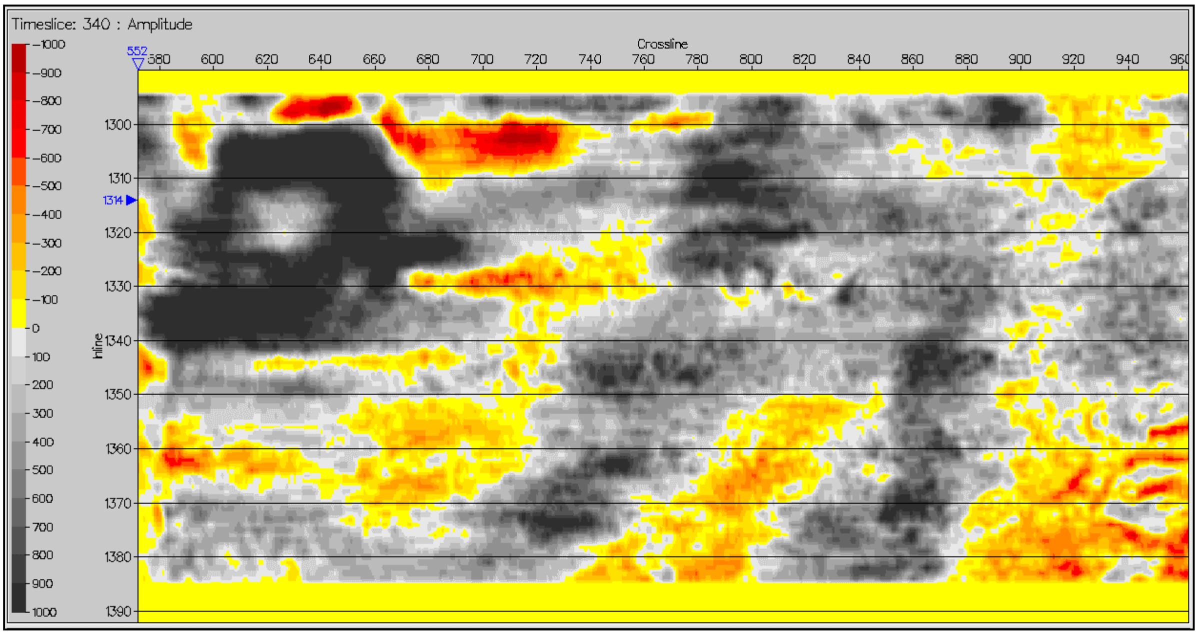
7.14 Stack after Radon multiple attenuation



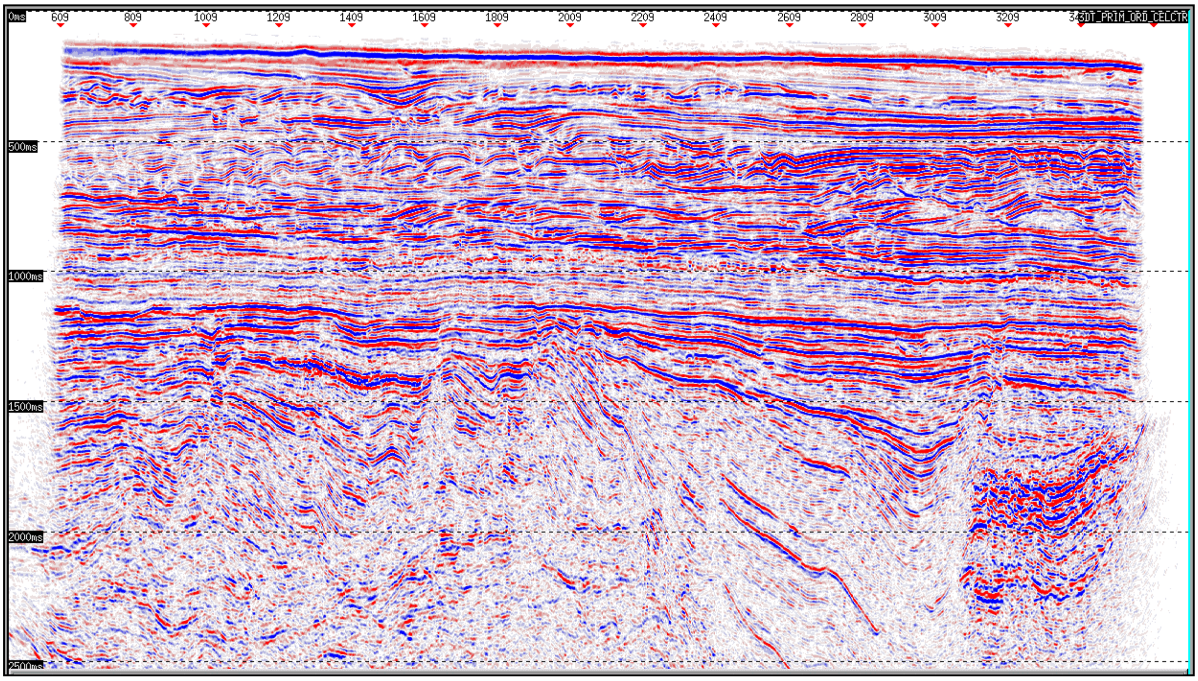
7.15 Stack before 3D F-K footprint removal (time slice 340 ms)



7.16 Stack after 3D F-K footprint removal (time slice 340 ms)

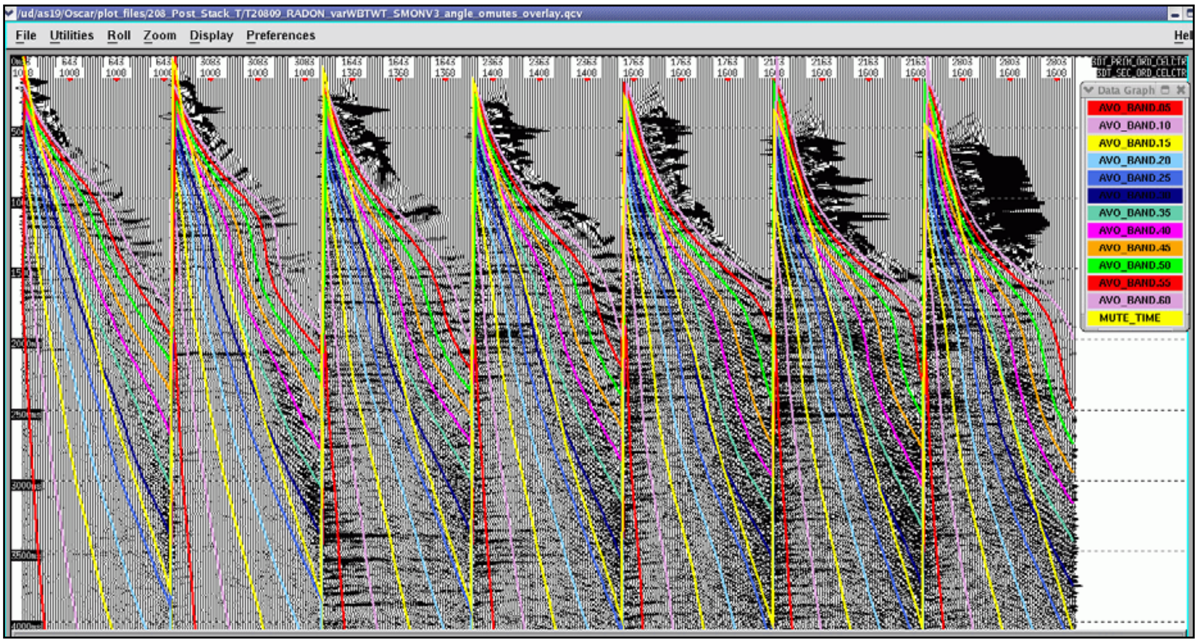


7.17 *Stack with time variant spectral shaping (TVSS) applied*

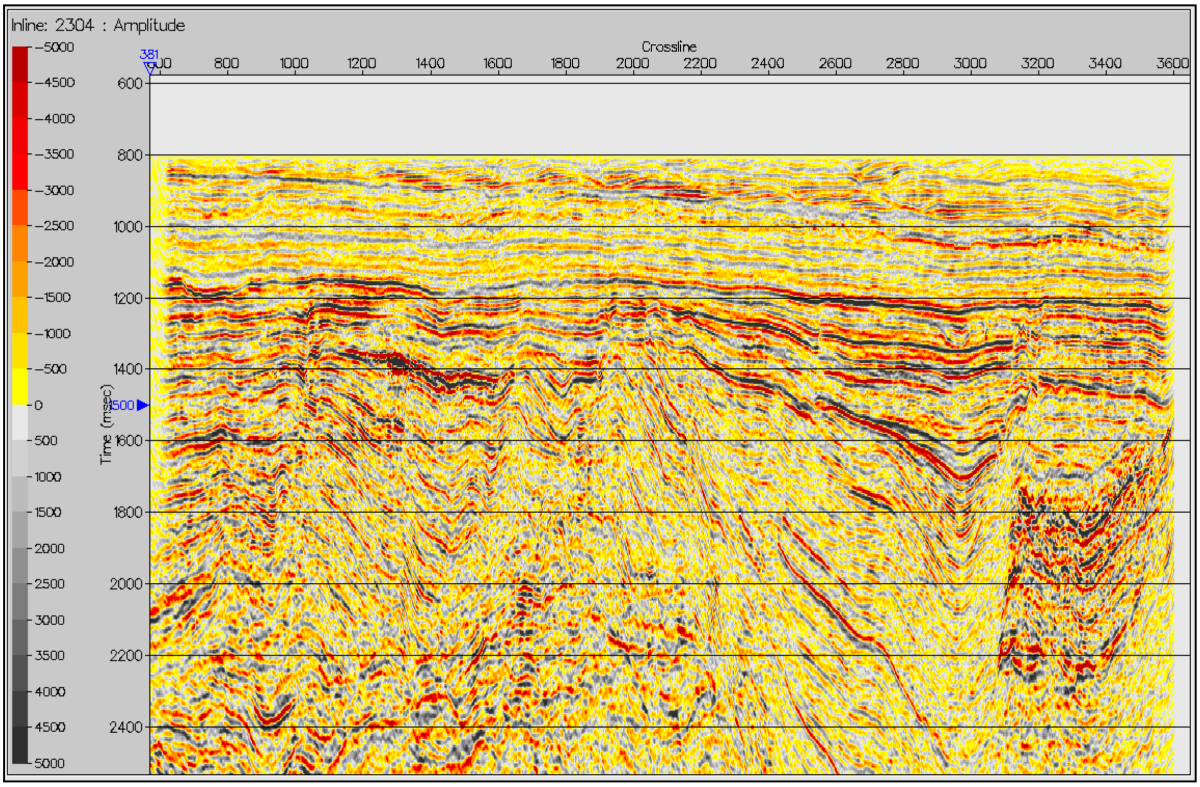


7.18 *Final NMO-CMP gathers overlaid with angle & final outer mute patterns*

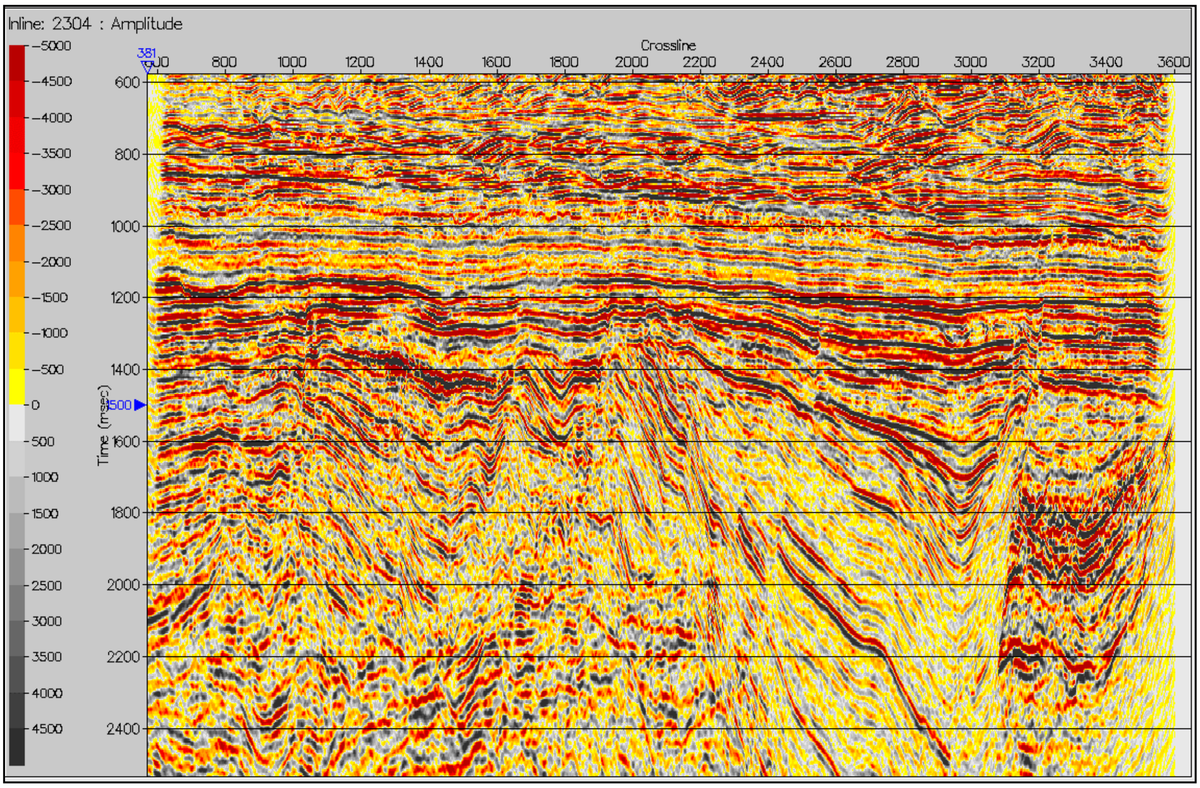
(angle 5-60 deg with every 5 deg increment)



7.19 Near angle (0-14 deg) stack



7.20 Mid angle (14-28 deg) stack



7.21 Far angle (28-42 deg) stack