DATA PROCESSING REPORT

ORIGIN ENERGY

2008 BOGANDILLA 2D SEISMIC SURVEY

SURAT BASIN
QUEENSLAND

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Integrated Seismic Technologies

Disclaimer

This report has been prepared in good faith and with all due care and diligence. It is based on the seismic and other geophysical data presented and referred to, in combination with the author's experience with the seismic technique, and as tempered by the geological and stratigraphic evidence presented in various forms and through discussions with client representatives.

As such, the report represents a collation of opinions, conclusions and recommendations, the majority of which remain untested at the time of preparation. In the light of these facts it must be clearly understood that Velseis Pty. Ltd., its proprietors and employees cannot take responsibility for any consequences arising from this report.

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Introduction

Velseis Pty Ltd acquired and processed a single line of 2D land seismic data for Origin Energy from April 2008 to June 2008.

Line summary for processed line

Line Name	Group Interval (m)	Shot Interval (m)	First SP	Last SP	Length (km)
Bogandilla	10.0	10.0	100	519.5	4.2

Acquisition Parameters

Vintage	**2008 Bogandilla**
Acq Company	Velseis Pty Ltd
Date Acquired	April-May 2008
Sample Rate (ms)	1
Record Length (ms)	4000
Group Int (m)	10
Shot Int (m)	10
Spread Description	Fixed receiver array, 4.2km in length
Geophone	10
No. of Groups	421
Geophone array	6 in line
Filter	0.8 Nyquist
Near Offset (m)	5
Far Offset (m)	various (up to 4195)
Source Type	Envirovibe
Sweep frequencies (Hz)	10-100
Sweep duration (ms)	10000
Number of sweeps per source point	1
Number of vibes	2
Move-up (m)	0
Distance pad to pad (m)	6
CDP Fold	421

Processing Sequence

Reformat

Input data was reformatted to ProMAX internal data format.

Trace Edit

Bad and noisy traces were removed from shot records interactively.

Geometry

Geometry information was assigned to trace headers. Information assigned to each trace includes source, receiver and CDP location along with offsets and CDP fold.

The coordinates are referenced to GDA-94, Zone 55.

Static Computation

Refraction statics were calculated from first break picks, using a datum elevation of 244m and a replacement velocity of 2900m/s.

Spherical Divergence Correction

A spherical divergence correction was applied. The spherical spreading factor used is [1/distance], with 2dB/second exponential correction.

Air Blast Attenuation

An air blast attenuation filter was applied, with the following parameters:

Velocity: 338 m/s
Maximum air blast envelope width: 150 ms
Air blast enhancement filter: 10-20-60-70 Hz
Amplitude threshold ratio: 1.5

Gain

A removable AGC was applied, using a 500ms operator.

F-K Fan Filter

A double-sided F-K fan filter was applied, using the following parameters:

Panel width:	50 traces
Time length of filter:	500ms
Fan filter freq-speed pairs:	5Hz – 100m/s
	90Hz – 2000m/s

Note that versions of the final stacks without this pre-stack F-K filter were also produced.

Gain removal

The previous 500ms AGC was removed.

Minimum Phase Filter

A minimum phase filter was applied.

Deconvolution

Surface consistent spiking deconvolution was applied.
A 120ms operator length was used. The white noise level applied was 0.1%.

Spectral Whitening

Spectral whitening was applied to all traces.

The parameters were as follows:

Operator length:	1000ms
Number of panels:	8
Extent of zero padding:	25%
Spectrum:	10-100 Hz

Velocity Analysis (1st Pass)

Velocities were picked using the ProMAX interactive velocity picking package (IVA). IVA uses velocity spectra, moved out gathers and stacked panels to assist in a careful interpretation of stacking velocities. As the velocity function is altered, revised gathers and stacks are produced until optimized stacking velocities are achieved.

Velocities were picked at regular intervals of 100 CDPs.

Residual Static Calculation and Application

Surface consistent residual statics were calculated and applied using Maximum Power Autostatics.

Pilot or reference traces were formed for a 500ms time gate following structure by flattening all traces along the autostatics horizon over a smash of 7 CDPs.

These traces are summed to form a single pilot trace. Each trace from the active CDP is time shifted relative to the pilot trace and summed with it. The power of the stack is measured for each time shift. This shift-power trace is then summed with other traces having the same shot and receiver in their respective domains.

After the shift spectra has been calculated for the entire line and summed in the Receiver/Shot domains, time shifts are picked at the maximum of the power shift spectra and stored as Static Values.

The pilot stack is updated and the process repeated for a number of iterations.

In this case, calculations were conducted for at least 8 iterations or until the RMS of the change in the computed statics was less than .05ms.

Velocity Analysis (2nd Pass)

Velocities were picked again at regular intervals of 100 CDPs.

Residual Static Calculation and Application (2nd Pass)

Surface consistent residual statics were calculated and applied using Maximum Power Autostatics.

Pilot or reference traces were formed for a 500 ms time gate following structure by flattening all traces along the autostatics horizon over 7 CDPs.

In this case, calculations were conducted for at least 8 iterations or until the RMS of the change in the computed statics was less than .05.

F-K DMO

F-K DMO was applied, using absolute offset binning. The DMO stretch factor used was 0.6.

Velocities Analysis (Final Pass)

Velocities were picked again on DMO gathers at regular intervals of 50 CDPs.

Normal Moveout

An NMO correction was applied to the data using velocities picked on the first DMO volume. A 20% stretch mute was used.

Dynamic corrections are applied to the data using the following formula.

$$TX^2 = T0^2 + X^2/V^2$$

TX = time at offset X
T0 = time at zero offset
X = offset of the trace
V = velocity at time T

CDP Trim Statics

Trim statics application is the process of aligning traces within a gather by correlating them with a pilot trace, then applying appropriate shifts to each trace. Traces with a required shift greater than a pre-set maximum value are killed. The pilot trace came from the DMO stack created with DMO velocities, and a maximum shift was 12ms.

Gain

An AGC with a 500ms operator length was applied after move out.

CDP Stack

Traces within a common midpoint gather were added. The post stack trace was scaled by the square root of the sum of fold for each sample in the trace.

Pre-migration F-X Deconvolution

Prior to migration, F-X deconvolution was applied to reduce the level of noise. A horizontal window of ten traces and a time window of 500ms were used.

Steep Dip Explicit Time Migration

Steep Dip Explicit Time Migration was applied using a velocity scale of 100%, and a maximum dip of 50 degrees.

F-X Deconvolution

A Wiener Levinson F-X deconvolution was applied, using a 10 trace horizontal window and a 1000ms vertical window.

Eigenvector Filter

An eigenvector filter was applied, using the following parameters:

Horizontal window width: 120 traces
Eigenimage pass range: 0-40%

Final Bandpass Filter

A final time-varying Ormsby zero phase bandpass filter was applied to the data to remove high and low frequency noise. The corner frequencies are as follows:

0-500ms: 10-15-80-90 Hz
1000-1500ms: 8-10-60-70 Hz
2000-4000ms: 8-10-45-55 Hz

Archiving

A two-volume set of DVDs (DVD-496) has been produced, containing the following:

IN SEG-Y FORMAT:

Main output stacks (ie with pre-stack F-K, without post-stack F-K):
Unfiltered Final Stack
Unfiltered Migrated Stack
Filtered Final Stack
Filtered Migrated Stack

Filtering test stacks:
Unfiltered Final Stack, without pre-stack F-K, without post-stack F-K
Filtered Final Stack, without pre-stack F-K, without post-stack F-K
Unfiltered Migrated Stack, without pre-stack F-K, without post-stack F-K
Filtered Migrated Stack, without pre-stack F-K, without post-stack F-K
Unfiltered Migrated Stack, without pre-stack F-K, with post-stack F-K
Filtered Migrated Stack, without pre-stack F-K, with post-stack F-K
Unfiltered Migrated Stack, with pre-stack F-K, with post-stack F-K
Filtered Migrated Stack, with pre-stack F-K, with post-stack F-K

Decimation tests and offset restriction tests as requested (filtered and unfiltered versions):
Stack 2: Final stack, decimated to 10m source and 10m receiver interval, 3km max offset
Stack 3: Final stack, decimated to 20m source and 10m receiver interval, 3km max offset
Stack 4: Final stack, decimated to 40m source and 10m receiver interval, 3km max offset
Stack 5: Final stack, decimated to 20m source and 20m receiver interval, 3km max offset
Stack 6: Final stack, decimated to 40m source and 40m receiver interval, 3km max offset
Stack 7: Final stack, decimated to 40m source and 10m receiver interval, 1.5km max offset

Gathers:
CDP gathers with NMO applied (2nd pass vels), statics applied, with no pre-stack F-K
CDP gathers with NMO applied (2nd pass vels), statics applied, with pre-stack F-K

(Note: The client requested gathers without DMO applied. For this reason, NMO was applied using 2nd pass velocities, not DMO velocities.)

IN ASCII FORMAT:

2nd pass stacking velocities
DMO stacking velocities
Source and receiver refraction statics
Source and receiver residual statics

IN PDF FORMAT:
This processing report

Appendix

These data were processed by Velseis Pty. Ltd., Brisbane, Australia.

Velseis Processing utilizes ProMAX 2D/3D processing software. This is a totally interactive system allowing the user to view data processing at each stage, producing a final result of the highest quality.

The software executes on a quad processor Sparc 20 Sun workstation and a 32 node, dual CPU/node Linux cluster. Data is viewed via X terminals networked to the main system, each terminal has a high definition monitor to enable accurate representation of the digital data in pixel form.

Velseis Processing is committed to offering a premium product, the software development undertaken by ProMAX resulting in processing algorithms that are state of the art.