DATA PROCESSING REPORT

LAKES OIL N.L.

WOMBAT 3D SEISMIC SURVEY
GIPPSLAND BASIN
VICTORIA, AUSTRALIA

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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 Processing Pty. Ltd., its proprietors and employees cannot take responsibility for any consequences arising from this report.

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INTRODUCTION

Velseis Processing Pty. Ltd. processed 30km^2 of 3D seismic data from the Wombat 3D Seismic Survey for Lakes Oil N.L. from February 2008 to May 2008.

Acquisition Parameters

Area	Gippsland Basin, Victoria
Surface Area (Sq km)	30
No. Source Points	2,233

Acquisition contractor:	Terrex
Live patch:	10 lines x 96 channels in each
Number of Channels:	960
Sweep frequencies:	Varisource: 5-100Hz, 5-60Hz
Sweep length:	8 seconds
Source interval:	40 m
Group interval:	40 m
Fold:	3000%
Bin size:	20m inline, 20m crossline
Record Length:	4 secs
Sample Rate:	2 msecs

TESTING

Amplitude Recovery

A series of spherical divergence and gain recovery tests were produced in order to compensate for amplitude decay due to wavefront spreading and inelastic attenuation.
The following functions were tested:

1. No Gain - raw record
2. Spherical Divergence
3. Spherical Divergence plus 1dB/sec
4. Spherical Divergence plus 2dB/sec
5. Spherical Divergence plus 3dB/sec
6. Time * Power constant 1.5
7. Time * Power constant 2.0
8. Time * Power constant 2.4

Function #7 was chosen to best balance amplitudes down and across the record.

Deconvolution Before Stack

An initial set of velocity analyses were produced. These velocities were picked then used to stack all of the following deconvolution and brute stack methods.

1. No Deconvolution
2. Spiking Deconvolution with 80ms operator
3. Spiking Deconvolution with 160ms operator
4. Spiking Deconvolution with 240ms operator
5. Surface Consistent Spiking Deconvolution
6. Surface Consistent Spiking Deconvolution with Spectral Whitening

It was felt the Surface Consistent Spiking Deconvolution did a good job of shaping and deconvolving the wavelet, while producing a stack with stable phase. Events were more clearly defined and continuous.

PROCESSING PARAMETERS

Reformat
Input is reformatted to ProMAX internal data format.

Trace Edit
Remove bad or noisy traces from shot records interactively.

Geometry
Assign geometry information to trace headers. Information assigned to each trace includes source, receiver and CDP locations along with offsets, elevations and CDP fold. The data were gridded into bins that were 20m wide within inlines and 20m wide within crosslines.

Gain Recovery
True Amplitude Recovery using a time power constant of 2 .

Phase Conversion
The data were converted from zero to minimum phase.

Deconvolution
Whitening of the spectrum to enhance signal resolution was achieved using a Surface Consistent Spiking Deconvolution with a 160 ms operator which was picked from the autocorrection of a shot record. The power spectrum was decomposed into shot, receiver, and offset components, however only the shot and receiver portions were applied within the deconvolution with 0.1% white noise added.

Linear Noise Removal
Removal of linear noise is performed in the Radial Domain.

Datum Statics
Statics calculated with a single layer refraction method.

For this refraction method, first breaks were picked on a refractor corresponding to the base of weathering and then tied to upholes.

Replacement Velocity	Final Datum
1800 m/s	0 m

Cross-spread Sorting
The data were sorted into individual cross-spread gathers.

3D Velocity Filtering
Cross-spread gathers were filtered in the FKXKY Domain in order to attenuate linear noise with velocities between 0 & 1500m/s in a true 3D sense.

TFD Noise Removal
Noise is attenuated in the Time-Frequency Space by comparing amplitude levels to adjacent traces and reducing high and spurious values. A relatively high threshold multiplier value was used so that only very high amplitudes were attenuated and good reflection data was passed through the process without attenuation.

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 on a 1000m x 1000m grid. Each panel consisted of 9 CDPs stacked using 11 velocity functions centred around the regional velocity function.

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 time gate following structure by flattening all traces along the autostatics horizon, chosen using main seismic events over 5x5 CDP bins.

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 3 iterations or until the RMS of the change in the computed statics was less than .05, using a maximum static shift of +/-20ms.

Velocity Analysis (2nd 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 on a 1000m x 1000m grid. Each panel consisted of 9 CDPs stacked using 11 velocity functions centred around the 1st pass velocity functions.

Trim Static Calculation and Application
A pass of CDP consistent residual statics were undertaken to optimize stack response and account for any unresolved residual static.

Common Reflection Surface Processing
CRS ZO Search is used to find the dip and azimuth reflections in a zero offset (stacked) volume; CRS Stack constructs zero offset volumes or regularized CMP gathers with signal-to-noise enhancements.

Shift to Final Datum
The data were shifted from a floating datum to the final datum of 0m ASL.

Resample
The data were resampled from 2ms to 4ms sample rate.

Kirchhoff Prestack 3D Time Migration
A Kirchhoff Prestack 3D Time Migration was used to move data to their correct subsurface locations. Stacking velocities were smoothed for PSTM and the following parameters were used in the PSTM:

Number of offset bins:	28
Max migration aperture:	1800m
Stretch mute applied:	10%
Max dip limit:	No limit
Anti-alias:	Not applied
Record length:	4 seconds
Sample rate:	4ms

Velocity Analysis (Final)
Velocities were picked using PSTM'd gathers input to 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 on a 500m x 500m grid. Each panel consisted of 9 CDPs stacked using 11 velocity functions centred around the 2^{nd} pass velocities.

Normal Moveout Correction
An NMO correction was applied to the data using PSTM velocities, allowing a PSTM stack volume to be generated.

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

$$Tx=\sqrt{(T0^2+X^2/V^2)}$$

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

Mute
A mute was applied to eliminate refractors and stretch caused by normal moveout corrections. The mute applied was a 30 percent stretch mute.

Stack
Add traces within a common midpoint gather. The post stack trace was scaled by the square root of the sum of fold for each sample in the trace.

Deconvolution After Stack
Whitening of the spectrum to enhance signal resolution was achieved using a 2 window, 24ms Gapped Deconvolution with 480 ms operatorss.

FXY Deconvolution
An FXY deconvolution was applied to remove random noise and increase the signal to noise ratio.

Frequency Filter
The following Butterworth zero phase bandpass filter was applied to the data to remove high and low frequency noise.

Time (ms)	Frequency (Hz)
0	10-90

Amplitude Balance (AGC)
500ms AGC scaling windows were used to calculate and apply scalars to the data.

ARCHIVING

1. DVD-519 containing raw and filtered migrations in SEGY format and the processing report

2. LTO/C -039 containing DBS gathers with no NMO applied.

APPENDIX

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

Velseis Processing utilizes ProMAX 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 112 CPU 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.

The overall efficiency of the system enabled processing to be completed within the allotted time frame.

Plots were generated via a 300 dpi laser plotter. This was used to generate paper plots for QC purposes as well as the ability to provide final filmed copies.

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