

DATA PROCESSING REPORT

PANGAEA RESOURCES PTY. LTD.

***2013 HIDDEN VALLEY 2D SEISMIC SURVEY
NORTHERN TERRITORY, 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 processed 1390.98km of seismic data for Pangaea Resources Pty. Ltd. from their Hidden Valley 2D Seismic Survey in the Northern Territory, Australia between July 2013 and February 2014. The data were processed through a standard Pre-stack Time Migration processing sequence and was intended to gain a better understanding of the geology of the area.

Line Summary

Line	First Receiver	Last Receiver	GI (m)	Line length (km)
02GA-BT01	1000	3760	40	110.40
PB13-01	1001	3166	20	43.300
PB13-02	1001	7020	20	120.38
PB13-03	1001	3253	20	45.040
PB13-04	1006	7041	20	120.700
PB13-05	1003	9000	20	159.94
PB13-06	1001	1889	20	17.760
PB13-07	1001	8358	20	147.14
PB13-08	1001	1888	20	17.740
PB13-09	524	7445	20	138.420
PB13-10	1001	1851	20	17.000
PB13-11	1001	1412	20	8.22
PB13-12	1001	1855	20	17.080
PB13-13	1001	5082	20	81.62
PB13-14	1001	1823	20	16.440
PB13-15	1001	1569	20	11.36
PB13-16	1037	6109	20	101.44
PB13-17	1001	1344	20	6.86
PB13-20	10079	22527	20	128.34
PB13-24	1001	1915	20	18.28
PB13-26	1001	1530	20	10.58
PB13-28	1001	3648	20	52.94

Acquisition Parameters

Lines PB13-01, 04, 06, 08, 10, 12, 14

Sample Rate	2ms
Record Length	4000ms
No. of Channels	500
Source Array	Vibroseis, 1 x 5-85Hz 12s sweeps
Spread	4980m-5m-x-15m-4980m / 4980m-15m-x-5m-4980m
Group Spacing	20m
V.P. Spacing	10m

Other PB13 lines

Sample Rate	2ms
Record Length	4000ms
No. of Channels	500
Source Array	Vibroseis, 1/2 x 5-85Hz 8s sweeps
Spread	4980m-5m-x-15m-4980m / 4980m-15m-x-5m-4980m
Group Spacing	20m
V.P. Spacing	10m

02GA-BT01

Sample Rate	2ms
Record Length	20000/22000ms
No. of Channels	240
Source Array	Vibroseis, 3 x 12s sweeps 7-56, 12-80 & 8-72Hz
Spread	4780m-20m-x-20m-4780m
Group Spacing	40m
V.P. Spacing	80m

TESTING

True Amplitude Recovery

Time raised to power correction, spherical divergence and dB/sec corrections were tested. A time-power correction of 0.8 was chosen.

Deconvolution

Differing deconvolution gaps and operators were tested, as were various design window options. Using an operator length of 160ms trace by trace spiking deconvolution was compared to a surface consistent spiking deconvolution. On the basis of these tests, a single window surface consistent spiking deconvolution using a 160ms operator length was determined to give a better result than others tested.

Coherent Noise Rejection

After testing it was decided to apply a velocity filter in the FX domain, after surface consistent deconvolution.

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.

Gain

A time/power constant of 1.1 was applied to the data.

Static Computation

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.

Replacement Velocity
5000 m/s

Final Datum
300 m

Phase Conversion

The data were converted from zero to minimum phase.

Deconvolution

Whitening of the spectrum to enhance signal resolution was achieved using a single window Surface Consistent Spiking Deconvolution with a 160ms operator which was picked from test stacks.

FX Velocity filtering

Coherent linear noise with the range of 150 to 5000m/s were rejected through filtering within the FX domain.

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 optimised stacking velocities are achieved.

Velocities were picked at locations 1000m apart. The regional velocity was used as the guide function and 11 velocity panels covering 85% to 115% of the guide velocities for every location. Each panel consisted of 11 trace CDP stacked sections using the 11 differing velocities.

Residual Statics Calculation and Application

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

Pilot or reference traces were formed for a 1500ms time gate following structure by flattening all traces along the autostatics horizon over 11 CDP's.

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 .05.

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 optimised stacking velocities are achieved.

Velocities were picked at locations 500m apart. The first pass velocity was used as the guide function and 11 velocity panels covering 90% to 110% of the guide velocities for every

location. Each panel consisted of 11 trace CDP stacked sections using the 11 differing velocities.

Residual Statics Calculation and Application

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

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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 .05.

Surface Consistent Scaling

Traces were scaled in a surface consistent manner in order to maintain any amplitude responses within the data.

Trim Statics Calculation and Application

CDP consistent residual statics were calculated and applied.

Pilot or reference traces were formed for a 2000ms time gate following structure by flattening all traces along the autostatics horizon over 11 CDP's.

FX Deconvolution

The signal to noise ratio of the stacked sections was improved using FX Deconvolution filtering on offset panels.

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.

Velocity Analysis (3rd 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 optimised stacking velocities are achieved.

Velocities were picked at locations 500m apart. The second pass velocity was used as the guide function and 11 velocity panels covering 90% to 110% of the guide velocities for every location. Each panel consisted of 11 trace CDP stacked sections using the 11 differing velocities.

Normal Moveout Correction

An NMO correction was applied to the data using the DMO velocity. Dynamic corrections are applied to the data using the following formula.

$$T_X^2 = T_0^2 + X^2/V^2$$

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

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.

Static Shift

The data were shifted to final datum.

Deconvolution After Stack

A two window 28ms gap deconvolution was applied to the data.

FX Deconvolution

The signal to noise ratio of the stacked sections was improved using FX Deconvolution filtering .

Bandpass Filter

A time-variant bandpass filter was applied to the data.

Scaling

A time-variant scaling was applied to the final data.

FX Deconvolution

The signal to noise ratio of the stacked sections was improved using FX Deconvolution filtering .

ARCHIVING

A hard drive, PHD/C-170, containing segy files of raw and filtered PSTM stacks and final PSTM enhanced gathers was supplied at the end of the project. Hard drive PHD/C-172 was also provided and contained Pre-processed CDP gathers without NMO and final PSTM gathers with NMO but unmuted, together with a copy of this report.

APPENDIX

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

Velseis Processing utilizes ProMAX 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 multi-CPU linux cluster. Data is viewed via X terminals networked to the main system, each terminal has two high definition monitors to enable accurate representation of the digital data in pixel form.

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.