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AMITY OIL N.L.
Seismic Data Processing Report
1996 Waggon Creek and Weaber Plains
Seismic Surveys

Robertson

SEISMIC DATA PROCESSING

REPORT FOR

AMITY OIL N.L.

1996 WAGGON CREEK AND WEABER PLAINS SEISMIC SURVEYS

LOCATION : KUNUNURRA WEST AUSTRALIA

PERMIT : EP 386 BONAPARTE BASIN

COMPILED BY : ROBERTSON RESEARCH AUSTRALIA PTY. LTD.

FEBRUARY 1997

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1. INTRODUCTION

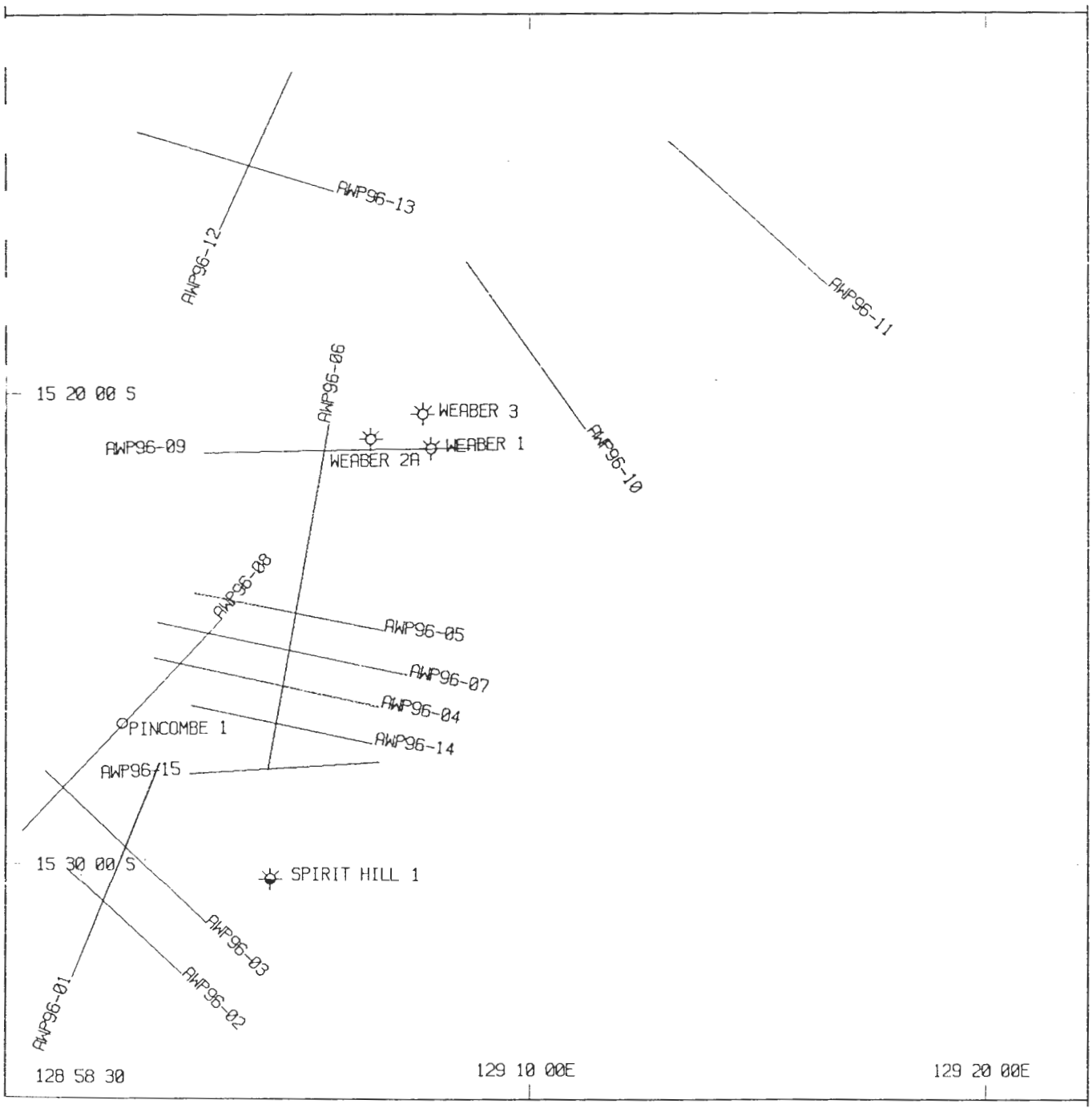
The 1996 Waggon Creek and Weaber Plains Seismic Surveys were acquired by Geosystems Pty Ltd. crew GSC #205 in June 1996 and consisted of 11 Waggon Creek lines and 15 Weaber Plains lines.

Processing was conducted by Robertson Research Australia at their Perth office. Final filming was completed in October 1996.

Most of the testing for these lines was done on line AWC96-03N as this was an urgent line, however testing was repeated throughout both surveys due to the diverse nature of the area.

On the high resolution Waggon Creek survey, another 8 lines from the 1987 and 1988 vintages were reprocessed.

1.1 LINE LOCATION MAP (a)



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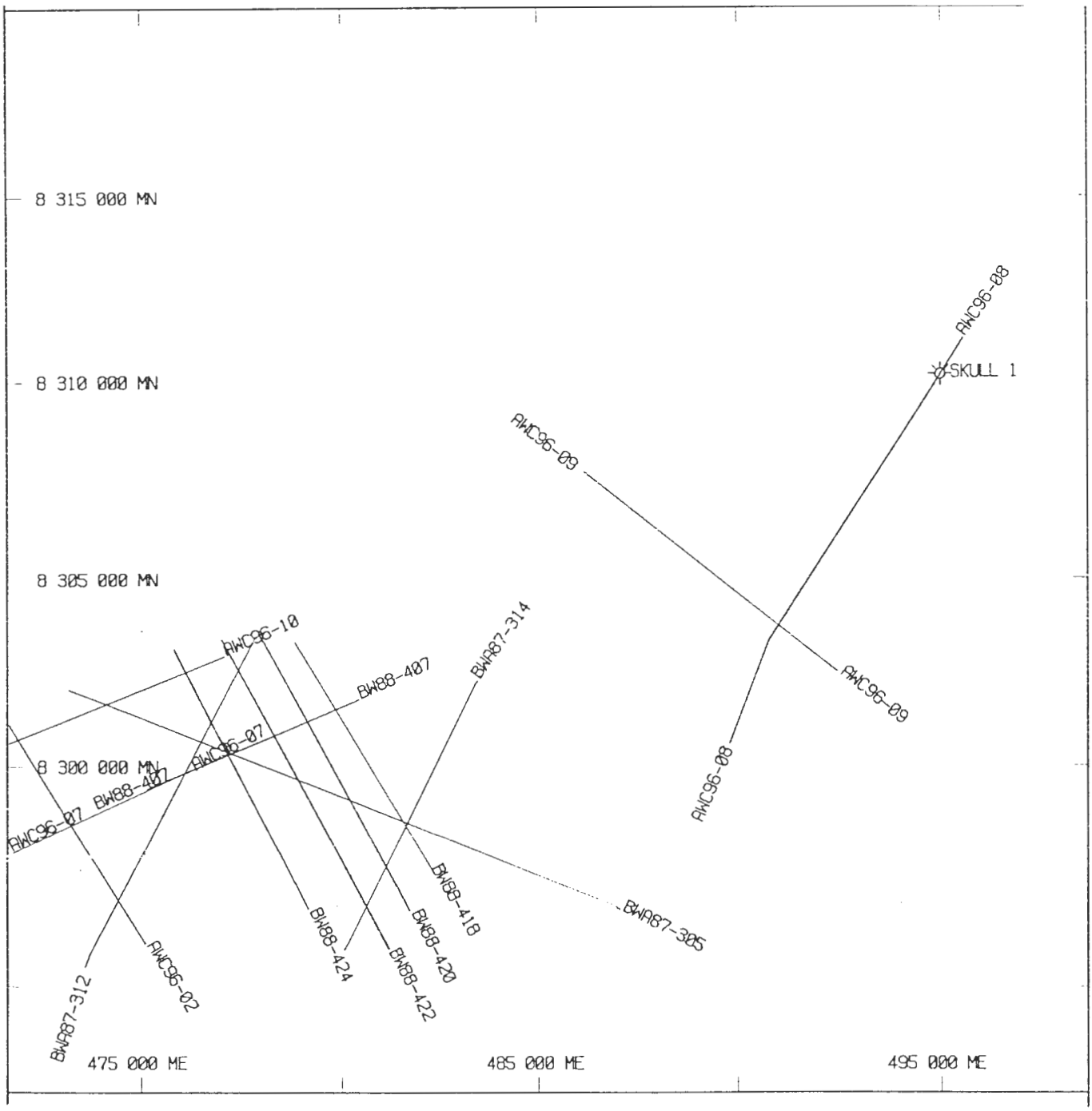
1.1 LINE LOCATION MAP (b)



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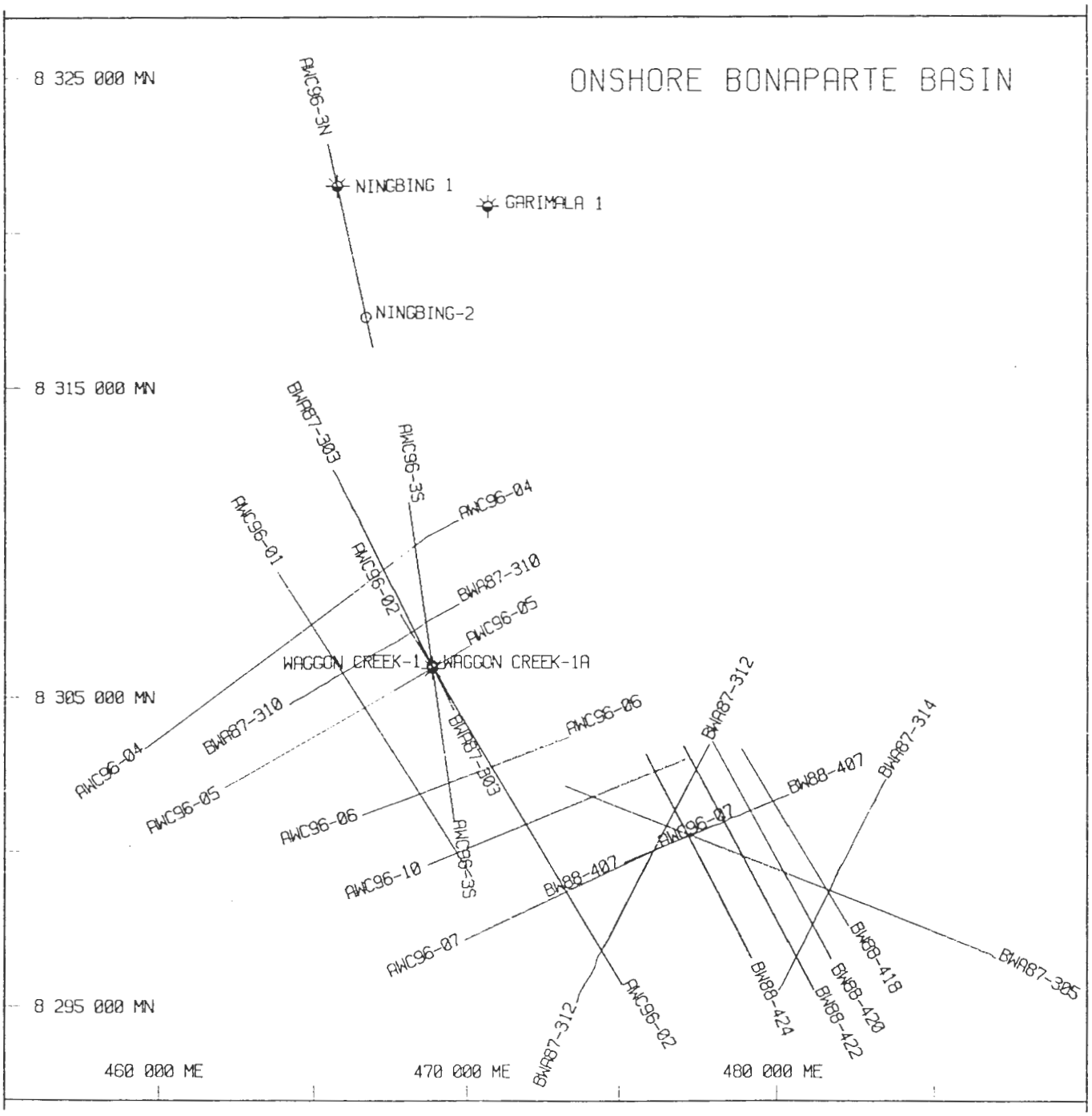
1.1 LINE LOCATION MAP (c)



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1.2 PROCESSING SEQUENCE DIAGRAM

TRANSCRIPTION (GEOSYSTEMS TO ROBERTSON INTERNAL FORMAT)
|
AMPLITUDE RECOVERY
|
CDP SORT
|
DECONVOLUTION
|
GREEN MOUTAIN REFRACTION STATICS
|
VELOCITY ANALYSIS (APPROX. 2.0 KM INTERVALS)
|
SURFACE CONSISTENT RESIDUAL STATICS
|
D.M.O.
|
VELOCITY ANALYSIS (APPROX. 1.0 KM INTERVALS)
|
NORMAL MOVEOUT CORRECTION
|
OUTER TRACE MUTE
|
PRE-STACK EQUALISATION
|
FLOATING DATUM TO FINAL DATUM (MEAN SEA LEVEL)
|
COMMON DEPTH POINT STACK
|
F.D.MIGRATION
|
BAND PASS FILTER
|
SCALING

1.3 FINAL DISPLAYS

Final stacks and Migration stacks were filmed at the following scale.:-

Vertical scale : 10 cm/sec Horizontal scale 1 : 10000

For the Waggon Creek survey a extra film for migration were filmed at

Vertical scale : 20 cm/sec Horizontal scale 1 : 10000

1.4 ARCHIVE DATA

The following data was archived in SEGY format.

A. Raw Stacks
B. Final Stacks
C. Migration Stacks

There is a description block separating each data set which contains the line number and a description of the data which follows.

All tapes were produced in SEGY 2.3 gB format.
The time of first sample is -200 ms.

A total of 4 exabyte archived stack tape was done. One for each of the area for the 1996 survey and one each for the 1987 and 1988 vintages.

1.5 DATA DISPOSITION

To Amity Oil in Perth,

1. Films and Prints
2. Exabyte archive of stacked data
3. Return of Observers logs and supporting documents
4. All field tapes

1.6 LINE SUMMARY WAGGON CREEK

1996 SURVEY

Line	VPs	CDPs
AWC96-01	100 - 1270	1 - 2341
AWC96-02	1498 - 100	1 - 2797
AWC96-03N	100 - 767	1 - 1340
AWC96-03S	1138 - 100	1 - 2075
AWC96-04	1354 - 100	1 - 2511
AWC96-05	100 - 997	1 - 1812
AWC96-06	808 - 100	1 - 1429
AWC96-07	100 - 800	1 - 1401
AWC96-08	684 - 100	1 - 1171
AWC96-09	106 - 488	1 - 787
AWC96-10	1004 - 100	1 - 1809

REPROCESSING

BWA87-305	107 - 607	1 - 997
BWA87-312	103 - 286	1 - 617
BWA87-314	356 - 102	1 - 495
BWA88-407	200 - 677	1 - 955
BWA88-418	800 - 245	1 - 1111
BWA88-420	239 - 903	1 - 1327
BWA88-422	959 - 221	1 - 1477
BWA88-424	200 - 815	1 - 1231

1.6 LINE SUMMARY WEABER PLAINS

Line	VPs	CDPs
WP96-01	100 - 558	1 - 917
WP96-02	410 - 112	1 - 599
WP96-03	100 - 529	1 - 862
WP96-04	100 - 550	1 - 901
WP96-05	101 - 483	1 - 772
WP96-06	100 - 790	1 - 1381
WP96-07	602 - 100	1 - 1005
WP96-08	100 - 666	1 - 1133
WP96-09	618 - 100	1 - 1037
WP96-10	101 - 502	1 - 804
WP96-11	100 - 518	1 - 837
WP96-12	168 - 492	1 - 663
WP96-13	499 - 100	1 - 800
WP96-14	100 - 464	1 - 729
WP96-15	469 - 100	1 - 740

2. ACQUISITION PARAMETERS WAGGON CREEK

Source	3 Vibroseis in line
Source Array	10m Pad to Pad standing VP's
Array Centre	Centred on stations
Number of Sweeps	2 sweeps per VP
Sweep Length	5 sec
Sweep Frequencies	10 - 120 Hz
Cosine Taper	0.20 s
Source Interval	10 m
Fold	120
No. Data Channels	240
Spread Type	Split Spread
Offsets	1195 - VP - 1195 m
Group Interval	10 m
Geophone Array	1 x 6 series in line at 1.67 m
Geophone Type	Sensor SM4 10 Hz super phones
Recording Instrument	GEOCOR IV
Record Length	4 seconds (Correlated)
Correlation Type	Zero Phase
Sample Period	2 ms
Tape Format	Geosystems 16 bit integer

2. ACQUISITION PARAMETERS WEABER PLAINS

Source	3 Vibroseis in line
Source Array	10m Pad to Pad 10 m moveups
Array Centre	Centred on stations
Number of Sweeps	2 sweeps per VP
Sweep Length	8 sec
Sweep Frequencies	10 - 100 Hz
Cosine Taper	0.20 s
Source Interval	20 m
Fold	120
No. Data Channels	240
Spread Type	Split Spread
Offsets	2390 - VP - 2390 m
Group Interval	20 m
Geophone Array	1 x 6 series in line at 3.3 m
Geophone Type	Sensor SM4 10 Hz super phones
Recording Instrument	GEOCOR IV
Record Length	4 seconds (Correlated)
Correlation Type	Zero Phase
Sample Period	2 ms
Tape Format	Geosystems 16 bit integer

3. FIELD DATA AND SUPPORT MATERIAL

The following support information was provided.

a) Observers' Reports
b) Floppy disks containing co-ordinate and elevation information
c) Uphole plots
d) Chaining maps and intersecting diagrams

4. PROCESSING TECHNIQUES AND PARAMETER VERIFICATION

Testing was carried out on line AWC96-03N.
An overall test sequence was established during the processing of this survey. A comprehensive suite of tests was conducted which included true amplitude recovery, FK filtering, deconvolution, mutes, post-stack filter, scaling, FX Decon, Tau-p filtering, spectral enhancement and migration.
The adjustment and fine tuning of the parameters to achieve the final processing sequences was discussed between Greg Irwin on behalf of Amity Oil and representatives of Robertson Research, namely Alex Tan and Mick Curran.

4.1 TRANSCRIPTION

Field data recorded in Geosystems 16 bit integer format were transcribed to Robertson internal format.

4.2 REFRACTION STATICS

Refraction first breaks were picked using Green Moutain Refraction statics Delay Time method which estimate the refractor velocities to model the weathering thickness. Weathering velocities were gathered from upholes recorded along the line. These upholes were used as calibration points. Processing seismic datum was sea level and variable replacement velocity estimated by Green Moutain was used.

4.3 FK FILTERING

FK filtering was tested on the area but it was decided that it was not needed.

4.4 AMPLITUDE COMPENSATION

A synthetic gain recovery curve was tested and selected for each survey. Synthetic gain recovery of $0t + 10 \log(t)$ was applied to 4 seconds.

4.5 DECONVOLUTION

Extensive deconvolution testing was conducted on this dataset. This included predictive deconvolution and surface consistent deconvolution. These comparisons were made on a stack panel with residual statics applied. In the final analysis, band limited spiking surface consistent deconvolution yielded the best overall result, particularly in terms of resolution.

4.6 VELOCITY ANALYSIS

First pass velocity analysis was performed by using constant velocity stack panels of 21 traces over a velocity scan of 1500 to 5000 m/s at increments of 100 m/s at approximately 2.0 kilometre intervals.

Final velocity analysis was performed by "OMNIVEL" analyses, located at approximately 1.0 kilometre intervals. Each analysis comprised 15 CDPs stacked with 9 velocity functions with up to +/-4 percent variation on the central input function which is derived from the first pass velocity analysis. A contoured power display based on the power of stack of the inner 3 CDPs and a display of the central CDP gather both raw and with NMO corrections from each of the 9 velocity functions are used to interpret the optimum velocity function.

4.7 RESIDUAL STATICS

Robertson's NEBULA package was used to determine surface-consistent residual statics. A pilot trace is cross correlated with each data trace and the cross correlation functions are summed for each shot and station. The peak of each summed cross correlation is used to determine the static for each shot and receiver. The shifts from anomalous cross correlations are given a low weighting in the decomposition. The pilot trace is formed by summing adjacent traces; the number of traces summed, and the individual weights assigned to them is kept constant. Three iteration passes are used with statics generated in previous iterations being applied to the data for the current iteration. The pilot trace correlation is started from alternate ends of the line on successive iterations in order to ensure penetration of a reasonable pilot trace into poor signal-to-noise areas.

4.8 MUTING TRIALS

Mutes were selected by inspecting a series of stacked panels with increasing offsets included into each successive panel. An outer trace mute was applied to the data to remove any high amplitude noise at earlier times on the record and over-stretched moveout reflectors. The mute has a 60 ms taper.

4.9 FILTER TRIAL

A suite of filter sets was applied to a panel of stacked CDPs with only one set of filters on each panel. Filtering was performed in the frequency domain by applying a cosine-squared function. The cosine-squared cut-off filters are described by four frequencies F1, F2, F3 and F4. A time variant filter was selected from the series of filter trials.

4.10 SPECTRAL ENHANCEMENT

Post stack spectral enhancement trials were performed using results from the filter trials as a guide to determining what frequency range to try and whiten. There appeared to be some advantage in parts but not enough to warrant use in production.

4.11 DMO

DMO was used primarily in correcting velocity distortion due to the dipping events in the area, but also useful as a scattered noise reduction technique.

Robertson's DMO program applies 2-D convolution operators to map the data accurately from non-zero to zero offset in the manner described by Deregowski and Rocca (1981). The convolution is conveniently implemented by the summation method, applied to traces in common offset order. This procedure also achives the desirable partial migration, whereby traces with common mid-points, but different source-receiver offsets, relate to the same subsurface locations after DMO for all dips.

4.12 FINITE DIFFERENCE (F.D.) MIGRATION

The migration method uses the technique of downward continuation in order to map reflectors to their true time position. As some dips are greater than 15 degrees, the second order solution was used. The depth step was 32 ms.
Trials with varying percentages of the stacking velocity were tested.

5. SUMMARY OF THE PROCESSING PARAMETERS

1. Transcribe Geosystem data into Robertson internal format.

2. Amplitude recovery Gain (dB) : 0.0t + 10.0 log(t)
(where t = time in seconds)

3. CDP Sort

4. Band limited surface consistent spiking deconvolution
Frequencies: : 10 - 120 Hz
Operator Length : 120 ms
White Noise : 0.5%
Design Windows : 100 - 1600 ms at near offset
550 - 2000 ms at far offset

5. Floating datum computation using Refraction statics.

6. Velocity analysis using CVS panel
Frequency of analyses : 2.0 km intervals
Velocity range : 2000 to 5500 m/s
Number of CDP/analysis : 21

7. Surface consistent residual statics
Number of traces summed into pilot : 7
Maximum allowable static shift ± 25 ms

8. Dip-moveout.
Partial pre-stack migration
120 equal offset ranges

9. Velocity analysis using 'OMNIVEL'
Frequency of analyses : 1 km intervals
Velocity range : 2000 to 6000 m/s
Number of CDP/analysis : 15
Number of 4% increment panels per analysis : 9

10. NMO correction using second pass velocity functions as annotated.

11. Outer trace mute

Offset (m)	:	30	100	400	800	1195 m
Time (ms)	:	0	100	200	400	600 ms

12. Pre-stack scaling
AGC gate of 800 ms

13. Floating datum to final datum correction. New time origin of -200 ms
Final datum : mean sea level

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14. Common depth point stack

15. F.D. Migration
Wave-equation method
100% smoothed stacking velocities
32 ms depth step

16. Band Pass Filter

Application Time (ms)	Freq (Hz)
250	10/14 - 88/95
550	10/14 - 78/85
1400	10/14 - 58/65
2400	10/14 - 48/55

17. Time variant scaling
Dual window AGC with lengths of 500 and 200 ms
Equalisation applied 50%

6. CONCLUSIONS AND ACKNOWLEDGEMENTS

Overall the processing of this project proceeded in a smooth and timely manner with good communication and co-operation between Robertson Research and Amity Oil. Robertson Research Australia would like to thank Greg Irwin for his co-operation and immediate replies to queries.

Mick Curran
ROBERTSON RESEARCH AUSTRALIA

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