2001 SEISMIC DATA PROCESSING REPORT

FOR

NEXUS ENERGY NL

LOCATION: *PEP 131*

VICTORIA

COMPILED BY : ROBERTSON RESEARCH
AUSTRALIA PTY. LTD.

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INTRODUCTION

The 2001 GBA01A seismic processing was awarded to Robertson Research Australia at their Perth office. Field data on 3590's cartridges, survey location, elevation and observers report information on floppy disk were received in good order on the 3rd of September 2001.

This project has 5 lines with total length of 67.92 km. These lines are in PEP 131. This 2001 seismic survey is an extension of the 1999 Yarragon seismic survey. All lines have crooked profile.

ACQUISITION PARAMETERS

SOURCE	3 Vibroseis LRS-315 inline
SOURCE ARRAY LENGTH	26.66 m
ARRAY CENTRE	Between station
SWEEP LENGTH	12 sec
SWEEP FREQUENCIES	8-65 Hz
SOURCE INTERVAL	20 m
NOMINAL FOLD	60
NUMBER OF DATA CHANNELS	120
SPREAD TYPE	Offend
OFFSETS	VP-10-2410 m
GROUP INTERVAL	20 m
GEOPHONE ARRAY	12 geophones inline 1.67 m apart
GEOPHONE TYPE	Sensor GSD 20D 10 Hz
RECORDING INSTRUMENT	I/O system two
RECORD LENGTH	4 seconds
CORRELATION TYPE	Zero Phase
SAMPLE PERIOD	2 msec
RECORDING FILTER	5.5 Hz lo-cut OUT hi-cut
TAPE FORMAT	SEGD

FIELD DATA SUPPORT MATERIAL

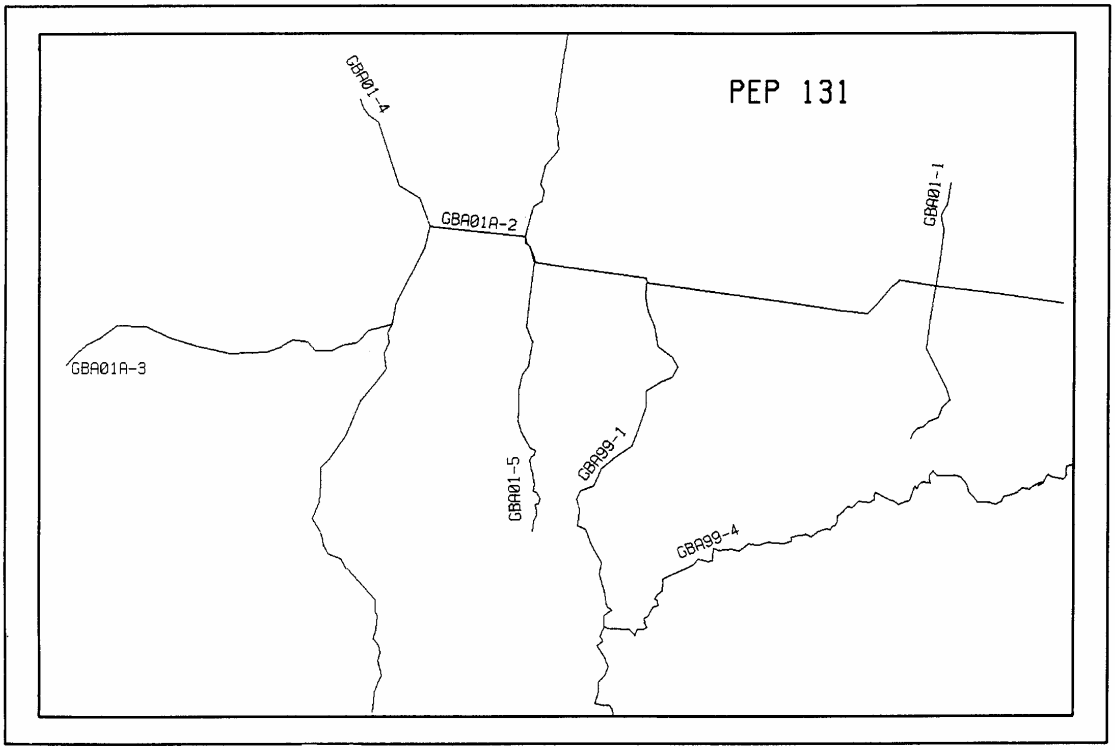
The following support information was provided

a) Observers reports
b) Field data on cartridges
c) Floppy disk containing co-ordinate and elevation.

LINE SUMMARY

LINE	VP RANGE	STN RANGE	LENGTH
GBA01A-1	501 – 242	500 - 122	7.58
GBA01A-2	987 – 220	986 - 100	17.74
GBA01A-3	571 – 220	573 - 100	9.48
GBA01A-4	1037 – 224	1036 - 100	18.74
GBA01A-5	100 – 744	100 - 818	14.38
		TOTAL:	**67.92 Km**

LINE LOCATION MAP



PROCESSING TECHNIQUES AND PARAMETER VERIFICATION

Testing was carried out on line GBA01A-5.An overall test sequence was established during the processing of this survey. A comprehensive suite of tests was conducted which included true amplitude recovery, deconvolution, FK filter, DMO, mute, post-stack filter, scaling, F-X Decon, Tau-p filter and migration.
The adjustment and fine tuning of the parameters to achieve the final processing sequences was discussed between Ian Reid on behalf of Nexus Energy and representatives of Robertson Research.

TRANSCRIPTION

Field data recorded in SEGD format were transcribed to Robertson internal format. 120 data channels recorded at 2 ms sample rate were output at 4 seconds record length and resampled to 4 ms..

REFRACTION STATICS

Refraction first breaks were picked using Green Mountain Refraction Statics Delay Time method, which estimates the refractor velocities to model the weathering thickness. Weathering velocity was assumed to average to a constant of 800 m/s. As no uphole survey was conducted, we have to average the raw statics value at the line intersections.
Seismic reference datum of 0 m above sea level and a variable replacement velocity was used, as computed by Green Mountain package. The refractor velocities average around either 2500 m/s or the faster 3600 m/s. These changes in refractor velocities seem to coincide with the change in the depth of the basement.

AMPLITUDE COMPENSATION

Application of a synthetic gain curve of $At + 20(B) \log(t) + C$ was applied on test shot records where A=6 and C=107. The value of A and C were derived from trace analysis of near, mid and far trace of shot record. The value B was then varied from 0 to 2. A final value of B=0 was chosen.

DECONVOLUTION

Gap deconvolution testing was conducted on this dataset. This included trace by trace deconvolution and surface consistent deconvolution. These comparisons were made on a stack panel with residual statics applied. In the final analysis, surface consistent spiking deconvolution of 4 ms with operator length of 120 ms and white noise of 0.5% was selected.

VELOCITY ANALYSIS

First pass velocity analysis was based on Constant Velocity Stack panels at approximately 2km intervals with velocity range of 1700 – 6000 m/s.
Final velocity analysis was performed by an interactive velocity analysis program, located at approximately 0.5 km intervals. Each analysis comprised 20 CDPs stacked with 13 velocity functions with adjustable 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 with NMO corrections, and stack panels of the 13 velocity functions plus a picked velocity stack panel.

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 weight 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.

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.
The picked outer mute was overlaid on top of NMO gathers displays at velocity locations. These displays were used as velocity quality control as well as for picking a spatial variant mute if required.

Picked mute	OFFSET :	90	100	870	2410 m
	TIME :	0	100	600	1200 ms

F-K FILTER

Velocity filter designed in the shot domain to tackle ground roll noise problem was tested. At 1200 m/s velocity filtering the stack test still looks noisy and at 2400 m/s the stack test looks just starting to smear. To make use of the 2400 m/s velocity filter the shot gathers has NMO applied using first pass velocity, and removed after FK was applied.

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.

The final filter selected :

Time (ms)	Filter (Hz)
0	10-14-60-68
1000	10-14-60-68
3000	6-10-50-58

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. A constant DMO velocity of 1800 m/s was used. This translates to a maximum dip of +/- 11 ms per trace for CDP interval of 10 m on 60 equal offsets.

Robertson's DMO program applies 2-D convolution operators to map the data accurately from non-zero to zero offsets. The convolution is conveniently implemented by the summation method, applied to traces in common offset order. This procedure also achieves 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.

FINITE DIFFERENCE (F.D.) MIGRATION

The migration method uses the technique of downward continuation in order to map reflectors to their true time position. Depth step of 12 ms was used.

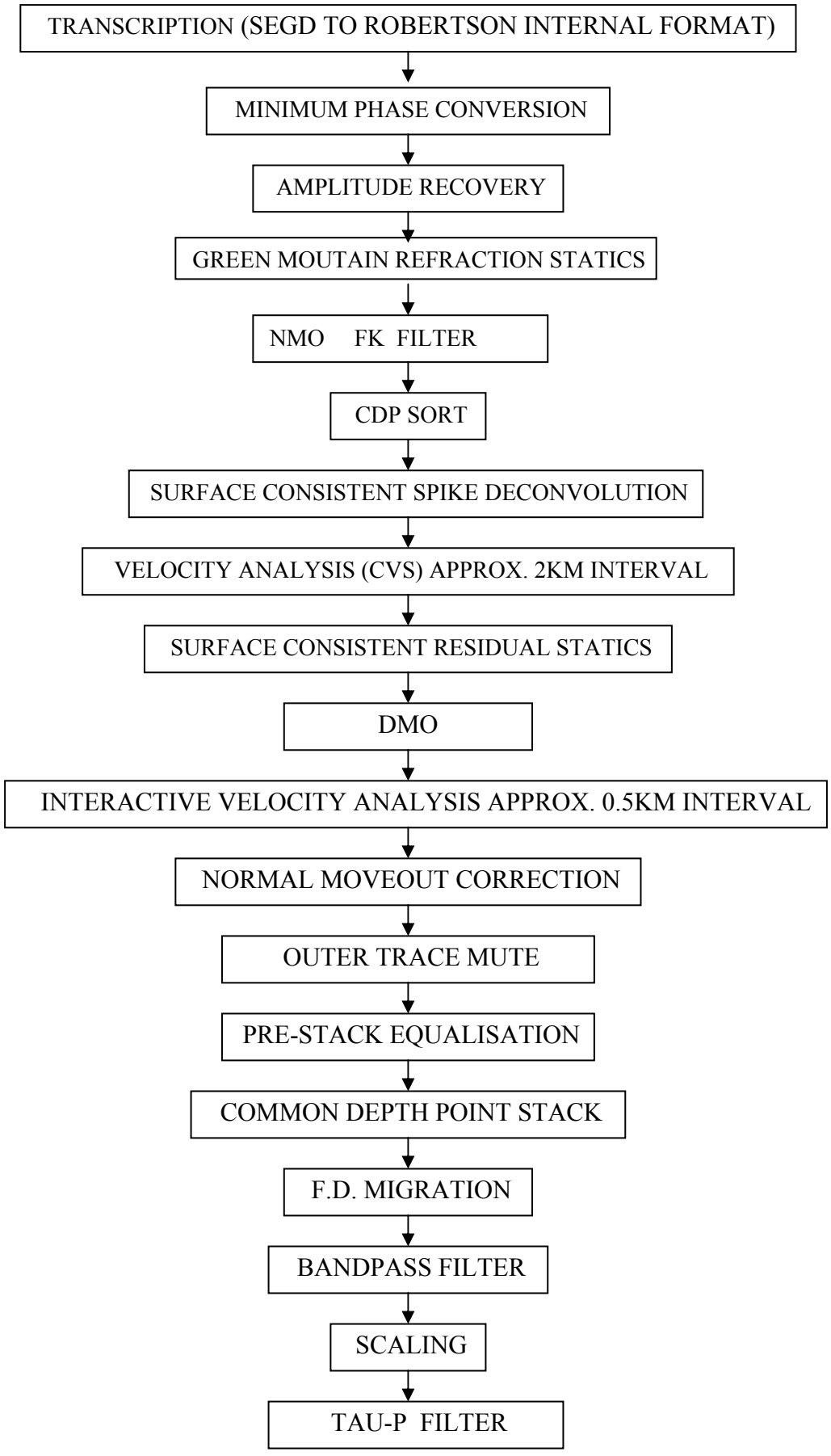
Trials with varying percentages 80%, 90%, 100% and 110% of the stacking velocity were tested on line GBA01A-5.

The migration with 90% smoothed stacking velocities was selected.

TAU-P FILTER

This is a time variant multi-channel dip and coherency filter. It attenuates random noise and enhances coherent signal within a specified dip angles. Filtering is done in the Tau-P domain. Option of mixback is by specifying a percentage of the unfiltered input data mixed with output data.

PROCESSING SEQUENCE DIAGRAM



SUMMARY OF THE PROCESSING PARAMETERS

1. Transcribe SEGD data into Robertson internal format and resample to 4 ms.

2. Phase conversion : Convert from zero to minimum phase

3. Application of synthetic gain curve of 6.0t + 107 to 4.0 seconds

4. Statics – floating datum correction using refraction statics

5. FX Filter
   Velocity filter of 2400 m/s after normal moveout.

6. CDP Sort : Nominal fold 60

7. Surface Consistent Spike deconvolution

Operator Length	: 120 ms
Gap	: 4 ms
White Noise	: 0.50%
Design windows	: 100 – 2000 & 1600 - 3500 ms @ near offset
	: 700 – 2400 & 2000 - 3700 ms @ far offset

8. Velocity analysis using CVS panel

Frequency of analyses	: 2 Km intervals
Velocity range	: 1700 to 6000 m/s
Number of CDP/analysis	: 20

9. Surface consistent residual statics
   Number of pilot traces : 7
   Max static shift +/- 25 ms

10. DMO correction
    Constant velocity used: 1800 m/s
    60 offsets planes

11. Interactive velocity analysis using 'FIVA'

Frequency of analyses	: 0.5 Km intervals
Velocity range	: 1700 to 6000 m/s
Number of CDP/analysis	: 20

    Number of 2% increment panels per analysis :13

12. NMO correction - velocity functions referenced to surface.

13. Outer trace mute

Offset (m)	:	90	100	870	2410
Time (ms)	:	0	100	600	1200

14. Scaling – 800ms AGC gates

15. CDP Trim Static
7 trace weighted pilot
maximum shift +/-10 ms

16. Common depth point stack – nominal fold of 60

17. F.D. Migration
Wave- equation method – 2nd order solution
12 ms depth step
90% smoothed stacking velocity

18. Bandpass Filter

Application Time (ms)	Freq (Hz)
1000	10- 14 -- 60 - 68
3000	6 - 10 -- 50 - 58

19. Scaling
Dual window AGC with lengths of 1000 and 400 ms
50% application

20. Tau-P Filter
17 trace transform
Dip-cut filter of +/- 5 ms per trace
Addback 75%

FINAL DISPLAYS

Vertical scale : 10 cm/sec Horizontal scale 1 : 20000

Final stack and Migrated stack displays on paper and digital cgm+ format on exabyte and CD-ROM.

ARCHIVE DATA

The following data was archived in SEGY format for all lines:

A. Raw Stack
B. Raw Migration
C. Final Filtered Stack
D. Migrated Filtered Stack

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

All exabytes were produced in SEGY 5.0 GB format.
The time of first sample for stacked data is -200 ms.

Final Stacking velocities in Western format on floppy disks..

DATA DISPOSITION

To Nexus Energy,

1. Paper prints of final section.
2. Exabyte archives of stacked data.
3. Return of Observers logs and survey data on floppy disk
4. All field tapes (cartridges)
5. One exabyte and one CD-ROM of cgm + files
6. Floppy disk of stacking velocities

ARCHIVE LISTING

Line	CDP	SP	DESC
GBA01A-1	1-605	242-501	MIGSTK
GBA01A-2	1-1596	987-220	MIGSTK
GBA01A-3	1-781	571-220	MIGSTK
GBA01A-4	1-1657	1037-224	MIGSTK
GBA01A-5	1-1281	100-747	MIGSTK
GBA99A-1	1-2068	2137-950	MIGSTK
GBA99A-4	1-1484	101-1045	MIGSTK
GBA01A-1	1-605	242-501	FINSTK
GBA01A-2	1-1596	987-220	FINSTK
GBA01A-3	1-781	571-220	FINSTK
GBA01A-4	1-1657	1037-224	FINSTK
GBA01A-5	1-1281	100-747	FINSTK
GBA99A-1	1-2068	2137-950	FINSTK
GBA99A-4	1-1484	101-1045	FINSTK
GBA01A-1	1-605	242-501	RAWMIG
GBA01A-2	1-1596	987-220	RAWMIG
GBA01A-3	1-781	571-220	RAWMIG
GBA01A-4	1-1657	1037-224	RAWMIG
GBA01A-5	1-1281	100-747	RAWMIG
GBA99A-1	1-2068	2137-950	RAWMIG
GBA99A-4	1-1484	101-1045	RAWMIG
GBA01A-1	1-605	242-501	RAWSTK
GBA01A-2	1-1596	987-220	RAWSTK
GBA01A-3	1-781	571-220	RAWSTK
GBA01A-4	1-1657	1037-224	RAWSTK
GBA01A-5	1-1281	100-747	RAWSTK
GBA99A-1	1-2068	2137-950	RAWSTK
GBA99A-4	1-1484	101-1045	RAWSTK

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 Nexus Energy. Robertson Research Australia would like to thank Ian Reid for their co-operation and immediate replies to queries.

Alex Tan
ROBERTSON RESEARCH AUSTRALIA