Edison Spa

Torrente La Vella Prospect, Italy

LAND 2D SEISMIC REPROCESSING

PROCESSING REPORT

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CONTENTS

1.0 INTRODUCTION
- 1.1 Description of Survey
- 1.2 Objectives
- 1.3 Personnel
- 1.4 Contractor/Client Communications
- 1.5 Resources

2.0 PRE-PROCESSING
- 2.1 Reformat
- 2.2 Geometry
- 2.3 Geometry Quality Control
- 2.4 Trace editing

3.0 REFRACTION STATICS MODELLING

4.0 PARAMETER TESTING
- 4.1 Pre Stack Processing
- 4.2 Post Stack Processing

5.0 PRODUCTION PROCESSING PARAMETERS
- 5.1 Parameters
- 5.2 Velocity Control
- 5.3 Quality Control of production processing

6.0 CONCLUSIONS

7.0 DELIVERABLES

LIST OF FIGURES

Figure 1.	Line Location Map
Figure 2.	Example of straight line map : CR-10-84
Figure 3a	Shot records, before noise edit : CR-10-84
Figure 3b	Shot records, after noise edit : CR-10-84
Figure 4	First break picking, shot domain CR-10-84
Figure 5a	3D Refraction Static QC
Figure 5b	Refraction Static seismic intersection QC
Figure 6a.	Shot records, before gain recovery CR-10-84
Figure 6b.	Shot records, after gain recovery CR-10-84
Figure 7a	Instantaneous amplitude before correction CR-10-84
Figure 7b.	Instantaneous amplitude after correction CR-10-84
Figure 8a.	Stack, before Surface Consistent Amplitude correction CR-10-84
Figure 8b.	Stack, after Surface Consistent Amplitude correction CR-10-84
Figure 9.	Stack with Surface Consistent DBS CR-10-84
Figure 10.	Stack with Spectral Whitening CR-10-84
Figure 11.	Velocity Stack (with 1st Pass velocities) CR-10-84
Figure 12.	Residual Statics Stack (2 passes velocities/Residual statics) CR-10-84
Figure 13.	PSTM Stack-Raw CR-10-84
Figure 14.	PSTM Stack-Final filtered and Scaled CR-10-84

APPENDICES.

<u>A. Acquisition parameters</u>
<u>B. Line Listing</u>

1.0 INTRODUCTION

1.1 Description of Survey

This report covers the processing of approximately 30 kms of onshore 2D seismic data from the Torrente La Vella prospect in Italy. This reprocessing project covers 8 lines from two different data vintages acquired in 1981 and 1984. The prospect covers an area known as Cretagna. The elevations encountered, range from 0 to 500m.

Please refer to Appendix A for details of acquisition parameters. Figure 1 shows a location map for the lines, and Appendix B contains a more detailed list of the lines.

1.2 Objectives

The main objectives were to obtain overall improvements to amplitude anomalies located around 1000ms TWT. Geological framework shows the carbonate platform dipping towards South-West and terrigenous sequences above (clays and sands) where target is located. Lines lay in two main directions, SW to NE (Dip) and NW to SE (strike).
It was essential to design a processing sequence that focused mainly to amplitude preservation.

1.3 Personnel

The following personnel were involved in the project:

For Edison Spa. :

Stefano Carbonara.	-	Senior Geophysicist

For GGS-Spectrum. Ltd :

Roger Oldfield	-	Processing Manager
Chris Benson	-	Team Leader
Kirit Tailor	-	Senior Geophysicist

1.4 Contractor/Client communications.

Processing status reports were provided weekly via e-mail.

In order to review tests and make decisions on processing parameters, a client area was set up on GGS-Spectrum’s Tarantella servers. Tarantella is a third party software package that allows rapid access to applications running on remote processing systems via the internet utilising

sophisticated compression algorithms. This allowed the client to access the relevant GGS-Spectrum processing centre using a standard web browser and review all tests and data.
Progress of test results, and test decision was made by reference to a status spreadsheet provided by GGS-Spectrum.

1.5 Resources.

Hardware.
All processing was performed on Hewlett-Packard Exemplar V-Class mainframe computers, located in GGS-Spectrum's Houston offices.

These systems are accessed from Spectrum's offices world-wide.

Software.

GeoCenter SeisUP™
2D / 3D data processing software.

GGS-Spectrum SPA™
GGS-Spectrum's proprietary batch processing software. In use as individual modules linked into SeisUp, or by transferring data to run directly under the Spa system.

Renegade™
2D/3D Geometry generation/QC, refraction statics modelling/QC software.

2.0 PRE-PROCESSING

2.1 Reformat

Phase 1: The scope of work was to copy and reformat to SEG-Y the original SEG-C format tapes (Lines CR-1-81, CR-2-81, CR-3-81, CR-4-81). These tapes had been read in 1998 with a poor recovery rate between 0 and 70%. Special treatment and cleaning was needed before copying. However, due to the extensive damage to the tapes no additional data could be extracted for lines CR-3-81 and CR-4-81. Moreover, only a few additional shots were extracted for the other two lines. It was however decided to use all available data for lines CR-1-81 and CR-2-81 and progress to Phase 2 of the project. Lines CR-3-81 and CR-4-81 were not taken any further.
The 1984 data (Lines CR-5-84, CR-6-84, CR-7-84, CR-8-84, CR-9-84, CR-10-84) were received in SEGY Format. The data were extracted from these and reformatted to SeisUp internal format in the UK. Data was then electronically transferred to disk areas on the system in Houston.

2.2 Geometry

Geometry information was supplied from hardcopy observers reports. Navigation information was available as hardcopy.

Considerable manual entry of co-ordinate and elevation information was necessary. This was accomplished using spreadsheets in order to interpolate values where complete listings were unavailable. QC checks on the data were then run to identify and correct for spurious values.

Straight line geometry was used and adequate for all vintages, due to the nature of acquisition in this area.
All lines started at cmp 1
The final results were checked using maps created from the geometry dataset, see the figures below for some examples.

Figure 2. line map for Line : CR-10-84

2.3 Geometry Quality Control

After assigning the straight line geometry to the trace headers, the following checks were made:

Each shot was displayed interactively, with LMO corrections applied to flatten a prominent refractor. These were checked for geometry position errors using SeisUp's QC tool.
A brute stack was run to view the stack result. This was checked for geometry errors, areas of noise, and any short records. The brute stack was re-run after any corrections, and again after all trace editing was completed.

2.4 Trace Editing

Trace editing was applied as a two-stage process. Manual trace editing was employed to edit out dead / excessively noisy traces. Automatic editing of spikes, and noise bursts was then carried out. Some of the raw shot data was contaminated with spikes. See Figure 3a and Figure 3b

3.0 REFRACTION STATICS

Initial brute stacks used field statics correction. A replacement velocity of 2000m/sec was used. The final processing datum was set at 0m (M.S.L.).

Comparisons of field statics, versus initial refraction statics showed that refraction modelling could produce some significant improvements to stack quality.

To gain good statics control for the survey, first breaks from the production records were picked, and refraction model based statics were derived using Renegade's Seismic Studio software package. 2D statics solutions for individual lines were obtained initially. Once all lines were completed, they were combined into a 3D solution, and the revised statics output, applied, and compared to the 2D version at the first pass velocity stack stage.

The methodology is reviewed below.

<u>First break picking</u>

First breaks were picked in a semi-automatic manner using the interactive display within SeisUp. Both shot domain and common offset domains were used for picking, which helped to avoid cycle skips. In addition, selected common offset displays with pick times were displayed to check for consistency both within, and between lines at intersection locations. All the vintages were straightforward to pick. The leading trough was picked.

The final set of SEG-Y shots with picked times and geometry information were transferred to the Seismic Studio statics software.

<u>Refraction Modelling</u>
Seismic Studio statics modelling involves 3 main stages: -

1) QC of picking and "branch point" assignment.
2) Derivation of refractor velocities and delay times.
3) Derivation of near-surface model and calculation of statics.

In practice, this tends to be an iterative process; the statics derived can be applied to the first breaks to flatten them, and this often makes it much easier to spot areas of mis-picking. Similarly, at step (2) the delay time deviation and pick-error terms can be used to identify poorly picked shots or receivers, or geometry errors, which can be corrected interactively.

Ranges of offsets were picked between 300 – 800m, which covered the main refractor seen in the area. For the majority of the area, the weathering layer is shallow, and sometimes non-existent. The refractor velocity was estimated to be 2000m/sec. As a single layer model was to be used in order to achieve a 3D solution, the different refractor velocities for lines in this region had to be carefully smoothed through.

Delay times and refractor velocities were then derived using Renegade's "Residual Velocity Correction" (RVC) option. A constant weathering velocity of 900m/sec was used for the weathered layer. The base of weathering elevations was smoothed over 1500m, and the weathering velocities were then updated. The statics are then derived as follows; Downward continue from surface to base of weathering, and then to the final datum using the replacement velocity.

The static solution derived was then applied to the first-breaks in shot and common-offset domain to re-check the picking. When a satisfactory 2-D statics solution was complete, this was output, applied to the data, and stacked to compare with field correction statics.

For a 3D solution, the individual 2D solutions were merged into a new 3D project area. Maps of each velocity and elevation attribute were utilised to check intersections for differences to both depths and velocities. Base of weathering elevation, and refractor velocities were smoothed to tie data at the intersections, with weathering velocities re-calculated, and checked. This procedure was run either for individual intersections, or larger areas as appropriate. Statics were re-calculated and output. Data was also re-stacked to compare with the 2D solution. The majority of lines showed improvements to the stack quality.

As a final check, a visual mis-tie analysis was made using final stack sections. This confirmed that data mis-ties were within a +/-10msec range.

The statics were applied to the data in two stages. Firstly, the static is split into two components by calculating the mean and differential static for each cmp gathers. The differential statics are applied to reference the gathers to the surface. This is used for velocity analysis and NMO application. Prior to stacking, a 500msec bulk shift is applied in order to prevent data being cropped from the top of the section. The remaining mean static value to place the data from surface to final datum is then applied.

Figure 4. Shows an example of first break picking.
Figure 5a. Shows the 3D statics map QC
Figure 5b Shows the statics seismic intersection QC

4.0 PARAMETER TESTING

4.1 PRE STACK PROCESSING

4.1.1 Gain Recovery

The purpose of gain recovery was to produce spatially and temporally balanced amplitudes on each shot record, correcting for spherical divergence, and amplitude/time decay. A regional velocity function was used.

A tv^2 spherical divergence correction was found to achieve balanced amplitudes.

Figure 6a, Example of raw shot records for CR-10-84
Figure 6b, Example of raw shot records and gain recovery applied CR-10-84

4.1.2 Surface Consistent Amplitude Correction

As the primary objective of processing was amplitude preservation, a surface consistent approach was essential.
Before we can interpret amplitudes in recorded data, we have to compensate for near surface and acquisition-related effects, such as source strength and receiver coupling variations, preferably in the early stages of the processing. These variations influence all common-midpoint based processing, since traces with different sources and receivers are combined in a CMP stack. This degrades the quality of the stack and could lead to biased AVO trends, particularly when related to slowly varying near-surface conditions.
The surface consistent amplitude corrections involve three stages. In the first stage instantaneous mean amplitude is computed for each input trace within a given design window. In the second stage the amplitudes are decomposed into Source, Receiver, CMP and offset terms in a best-fit sense by using Gauss-Seidel algorithm. Two colour plots are generated outputting the average instantaneous amplitudes before and after the surface consistent solution. The below figures give examples of these displays. The amplitude plot after the surface consistent solution is smoother then before. However, as the name "best-fit" indicates the solution is the best under the given conditions. The corrected amplitude will not be perfectly flat in general because the equation system is over-determined ie it is not possible to completely satisfy every point. The final stage is the application of the surface consistent gain computed in the second stage.
Stacks of before and after application of the surface consistent amplitude were produced for comparison. These showed significant improvements in correcting the amplitude anomalies due to the near surface effects.

Apply Source and Receiver terms only.

Figure7a– Instantaneous amplitude, before Surface consistent correction CR-10-84
Figure7b – Instantaneous amplitude, after Surface consistent correction CR-10-84
Figure8a– Stack, before Surface consistent Amplitude correction CR-10-84
Figure8b – Stack, after Surface consistent Amplitude correction CR-10-84

4.1.3 Surface Consistent Deconvolution

Deconvolution can be formulated as a surface-consistent spectral decomposition. In such a formulation, the seismic trace is decomposed into the convolutional effects of source, receiver, offset, and the earth's impulse response. This accounts for variations in wavelet shape due to near-source and near-receiver conditions and source-receiver separation. Decomposition is followed by inverse filtering to recover the earth's impulse response.
In practice, Surface Consistent Deconvolution is performed in two phases. Phase one of the process computes log power spectra of each input trace and stores spectra in each component. After the whole line has run through, Gauss-Seidel matrix inversion equations are used to separate the log spectra into each component. These log spectra are written to a file and used in the second phase to build deconvolution filters using the components and applies them to the input traces. For this dataset only the source and receiver component was used. DBS tests were then run using various operator lengths and gaps. The tests showed that the spiking operator with 2% added white noise gave the best result in terms of improved resolution. This was used in production.

Surface Consistent DBS
Operator length = 120 msec
Spiking.
White noise = 2%

Figure 9 Stack , after Surface consistent DBS CR-10-84

4.1.4 Spectral Whitening

To further improve the resolution, spectral whitening tests were performed. The various tests adjusted the amplitude spectra in different frequency ranges. The best result was observed with the10-50Hz whitening range. This corresponded to the bandwidth of the signal. The following parameters were chosen:

Length of gate in Hz :	10
Centre frequency for start of gate:	15 Hz
Centre frequency for end of gate	45 Hz
Frequency range to whiten:	10-50Hz

Figure 10 Stack , after Spectral Whitening CR-10-84

4.1.5 First Pass Velocity Analysis

An initial pass of the velocities was carried out prior to residual statics, at 500m intervals, see section 5.2.1 for details of the analyses made. Statics were applied to correct the data to a near surface floating datum, and all velocities referenced to this floating datum.

A combination of constant velocity stacks, semblance displays, and gather displays were used in the analyses. Picks were made for the main horizons seen, and intermediate picks to round and smooth the velocity curve. The velocity field was checked using iso-velocity plots, producing an initial velocity stack and also stacking the whole line using 90%, 95%, 105% and 110% of the picked velocities.

Figure 11 Velocity Stack CR-10-84 (using 100% final picked velocities)

4.1.6 Residual Statics

- Surface consistent residual statics

Surface consistent residual statics are calculated and applied in order to remove short wavelength static anomalies. The methodology used was for statistical cross-correlation of the cmp traces to produce guide peaks. The surface consistent components are then solved for, and residual statics for source and receiver terms output.

For the initial pass of residual statics, the maximum static value was limited to 24ms. Statics values were broadly +/-10msec, but up to 20msec in some places. Tests were run on different vintages to check the 2 main input variables i.e. window length and smash rate. These tests showed that stack with smash rate of 11 traces and a shallow window (800-2500ms), in the main area of data, gave a superior result. The smash rate was reduced where very steeply dipping data was encountered, and the maximum static value was reduced where cycle skipping was seen. Graphical displays of static versus receiver source/station location were used to QC results, as well as stack displays.

4.1.7 Second pass Velocity Field

The second pass velocity analysis was made at 500m intervals. Analyses over areas of poor quality data were skipped to avoid introducing erroneous functions. Extra functions were also added as required to ensure all good quality data areas were covered.

Variable velocity stacks, semblance and gather displays were used. Velocity picks were either updated, if present from the initial pass, or inserted.

Iso-velocity plots were again utilised to check final velocity fields

4.1.8 Second pass Residual Statics

The second pass residual statics using same method as used in the first pass, except with a maximum shift limit of 12ms and smash rate of 9 traces. In general, stacks showed only minor improvements in the second pass of residuals.

Figure 12. Residual Statics Stack (2 passes of velocities/Residual statics correction) CR-10-84

4.1.9 Pre-stack Time Migration

Migration is a process that attempts to reconstruct an image of the original reflecting structure from energy recorded on input seismic traces. Prestack migration is a direct process that moves

each sample to all the possible reflection positions, and invokes the principles of constructive and destructive interference to recreate the actual image. An alternate description of the migration process starts by selecting an output migrated sample. All input traces are searched to find energy that contributes to the output sample. This second description is the basis of Kirchoff migration. This method was used for this dataset due to the algorithm's superior handling of steep dips, lateral and vertical velocity variations.
Data was initially split into common offset planes with the minimum common offset plane being 60m. The common offset increment was set to 120m. Empty offset bins were filled using a nearest neighbour strategy. In this the current bin is expanded by a maximum 50% to search for a trace to borrow. This method proved quite effective in filling the empty bins whilst preserving the original character of the data.
The first pass of PSTM was used to produce migration gathers for velocity analyses every 500m. These velocities were then picked and used for the second iteration of PSTM. Following this, velocity analyses were again generated at an interval of 500m which were to be used for stacking the pre-stack migrated gathers.

4.1.10 Final NMO Mute

A final nmo mute was derived by interactively picking time and space variant mute functions for selected gathers. A final mute was chosen which gave the optimal stack.

4.1.11 Statics (Bulk Shift)

Before the data was set from surface to final datum, a bulk shift of 500msec was applied. This avoided the data being cropped as the time scale is shifted to negative numbers. Data is set to the final datum of 0metres.

4.1.12 Stack

The data was stacked using normalisation/compensation scaling of the form 1/SQRT(N), where N is the stacking fold.

Figure 13 PSTM Stack-Raw CR-10-84

4.2 POST STACK PROCESSING

4.2.1 Post Stack Noise Attenuation.

To improve the S/N of the stacked data, FX-deconvolution tests were produced. The FX-Deconvolution was successful in supressing the random noise particulary in the shallow part of the section. Tests using various derivation windows and filter lengths were produced and the below optimal parameters were chosen.

The filter derivation window for the FX deconvolution was kept at 10 traces with filter length of 4 traces. 10% addback of original data was used.

4.2.2 Bandpass Filter

Two filter scans were run, to determine hi-cut and lo-cut filter points. From this the following time-variant bandpass filter was applied to all data;

10-90 Hz Start of Data to 700ms
10-80 Hz 900-1200 ms
10-70 Hz 1400-1800 ms
10-50 Hz 2000-2400 ms
10-40 Hz 2600-end of data

Filters merge over 200 ms time window. The time specified above are based on machine time starting at 0ms.

4.2.5 Final Scaling

The below time-variant balance was selected for final scaling. This was used to balance amplitudes across the data zone, and also reduced the amplitudes slightly at the top of the section.

The general trace balance windows used were:

0 – 500msec, 250 – 750msec, 500 – 1500msec, 1000 – 2000msec, 1500 – 2500msec,
2000-4000ms, 3000-5000ms and 4000-600ms.

Following the above scaling, a constant 10db scalar was applied to the data to bring the values in the visual range.
Again, the time specified above refer to machine time starting at 0ms.

Figure 14 PSTM Stack-Final filter and scaling CR-10-84

5.0 PRODUCTION PARAMETERS

5.1 Processing Parameters.

Processed by	GGS-Spectrum Ltd
Date	June 2007
Processing record length	6000ms(1984 data) 7000ms(1981)
Processing sample rate	4 msec
Input Format	SEG-Y copy tape. (Original field format - SEG-C)
Reformat	Internal Format
Geometry	Geometry build from hardcopy support data. Straight line geometry
Trace editing	Remove noisy traces, and bad records. Despike, Noise burst edit.
Gain Recovery	Spherical divergence. Regional velocity function used in above algorithm. TV**2 Function
Surface Consistent Amplitude Correction	Derivation window: Ntr: 150-2500ms Ftr: 800-2500ms
Surface Consistent Deconvolution	Spiking Operator = 120 ms Design Window: Ntr 250-2500ms Ftr: 800-2500ms Apply Window : Whole trace
Renegade Refraction Statics	3D. 1 Layer Model, Using replacement Velocity 2000 m/sec. Datum = 0 m. Data set to surface.
Common Mid Point Gather	Sort to common midpoint gathers CMP Size = 15 m
Velocity analysis 1.	500m analyses intervals. CVS, semblance, and gather displays
Residual Statics 1.	Surface consistent maximum power autostatics. Window for cross-correlation, 800 - 2500ms Trace smash = 11, Iterations = 6, Max static shift = 24 msec

Velocity analysis 2.	500m average, analyses intervals. VVS, semblance, and gather displays
Residual Statics 2.	Surface consistent maximum power autostatics. Window for cross-correlation, 800 - 2500msec. Trace smash = 9, Iterations = 6, Max static shift = 12 ms
Kirchoff Pre-stack time Migration	Common offset planes 60m and then increment by 120m.1st iteration using 100% smooth stacking velocities.2nd iteration using 100% smooth final migration velocity field picked from 1st iteration Pstm gathers. Aperture 8000m, Maximum Dip = 90 degree.
Normal Moveout Correction	Using 500m final velocity grid.
Mute	Outer trace mute: Offset(m) Time(ms) 0 0 133 0 163 400 1065 750 1200 800
Statics application	Bulk shift of 500msec applied.
Statics application	Data set to final Datum. Replacement vel. = 2000ms^{-1}, Datum = 0m
Output	Output to SEG-Y (IBM) 32FLT format (without application of Nmo Mute)
Stack	Normalisation – sqrt of fold
Output	Output to SEG-Y (IBM) 32FLT format
F-X Deconvolution	10 Trace x 512msec window, 4 Trace Filter 10% Data Addback.
Bandpass Filter	Zero phase bandpass filter. Time (ms) Frequency (Hz)

	start – 700	10 – 90
	900 – 1200	10 – 80
	1400 – 1800	10 – 70
	1400 – 1800	10 – 50
	1400 – 1800	10 – 40
	Filter merge zone 200ms. Times from machine time 0ms.	
Post-stack scaling	RMS Gain	
	Gates: 0-500ms, 250-750ms, 500-1500ms, 1000-2000ms, 1500-2500ms, 2000-4000ms, 3000-5000ms, 4000-6000ms Times from machine time 0ms.	
Constant Gain	10dB	
Output	Output to SEG-Y (IBM) 32FLT format	

5.2 VELOCITY CONTROL

5.2.1 Initial velocity field

Velocities were picked on a 500m grid, using Geocenter's "SeisUp" interactive velocity picking software 'GEOVEL', utilising constant velocity stacks, function gathers and contoured semblance plots.

Each analysis comprised the following :

i) Each analysis panel comprised 11 adjacent cmps. The central cmp is displayed unstacked, with and without NMO applied.
ii) The 11 CMPs stacked together using each of the CVS functions. Constant velocities from 1500m/sec to 6000m/sec, at 100m/sec increments were used.
iii) Contoured semblance spectra produced from the central cmp.
iv) A stack was produced using the picked NMO function. Also percentage stacks were produced to fine tune the velocity picks
v) Iso-velocity plots are generated and checked for pick consistency to give smooth variations in the velocity field.

5.2.2 Final velocity field

Velocities were picked on a 500m grid, with a CVS display.

Each analysis comprised the following :

i) Each analysis panel comprised 11 adjacent cmps. The central cmp is displayed unstacked, with and without NMO applied.
ii) The 11 CMPs stacked together using each of the CVS functions. Constant velocities from 1500m/sec to 6000m/sec, at 100m/sec increments were used.
iii) Contoured semblance spectra produced from the central CMP.
iv) A stack was produced using the picked NMO function. Also percentage stacks were produced to fine tune the velocity picks.
v) Iso-velocity plots created and checked in a similar manner as for the 500m velocities.

5.2.3 Migration Velocity Field

The migration velocity field was derived by picking velocities from PSTM Gathers generated from the 1st iteration of PSTM. The velocities were on a grid of 500m. Prior to running the 2nd iteration of PSTM, the final 500m migration velocity field was smoothed. Iso-velocity plots were also generated to check the final migration field.

5.3 QUALITY CONTROL OF PRODUCTION PROCESSING

At every stage of production, quality control was carried out by GGS-Spectrum in accordance with the 'GGS-Spectrum Data Processing Procedures Manual', and as laid down in the contract. The Manual ensures that the data were processed according to Spectrum's quality management system, conforming to quality control standard ISO9002 and always utilising the optimum parameters.

5.3.1 Quality control of field data

All irregularities in the support data were identified, evaluated and where appropriate geometry changes, and trace edits were made.

5.3.2 Quality control during production

i) Shot record displays.
Selected records were displayed at the time of reformatting as a check on the process and to provide initial data quality checks and evaluation.

ii) Geometry QC and Trace editing.
See section 3.3 for details of QC displays used for geometry verification.

iii) Brute stack.
This was to check the geometry and trace editing, and to check for any further anomalies, for example spikes, short records, sync errors. The stack is re-run and re-checked until all anomalies are resolved.

iv) Refraction statics stack.
Check on effectiveness of static solution derived from the EGRM solution.

v) Surface Consistent Amplitude/DBS stack
Produced to check effectiveness of Amplitude/DBS parameters.

vi) Initial pass Velocity Stack.
Check the effectiveness of picked velocity field.
Iso-velocity plots of the velocity field are checked for consistency.

vii) First pass Residual statics stack.
Check on effectiveness of the residual statics

viii) Final pass Velocity Stack.
Check the effectiveness of the final 500m velocity field.
Iso-velocity plots of the velocity field are checked for consistency.

ix) Second pass Residual statics stack.
Check on effectiveness of the residual statics

x) PSTM Stack
Check on effectiveness of the migration and velocities

xi) Final filtered/scaled migration.

Migrated stack with all post stack processing, and final filtering and scaling.

5.3.3 Quality control of final products

i) Once written, the media is loaded and read to ensure all directories, and files can be accessed.

6.0 Conclusions

A single processing sequence has been developed which produces a uniform dataset from the various data vintages. A processing sequence has been designed to ensure amplitude preservation allowing the amplitude anomalies in the target zone to be investigated in detail. The dataset can also be utilised for further amplitude sensitive processing work such as AVO.

Resolution and continuity have been improved against the original processing.

Use of refraction modelling and statics provided considerable improvements to the medium and long wavelength static solution when compared to the field statics available for the original processing. Tying the refraction model in a 3D sense, as opposed to tying statics values, has resulted in a final dataset where line to line data mis-ties have been minimised, or eliminated.

Overall structural imaging has been significantly improved by the re-processing. The final migrated results are limited by the nature of the acquisition, the small line lengths and low fold. Some form of 3D solution would be required to gain any further improvement to the imaging of the sub-surface in this region.

7.0 Deliverables.

Final Products delivered.

A copy of the following products were output to 3490's :

Item.	Description.
1	Raw PSTM Stack (SEGY Format)
2	PSTM with post stack processing and balance (SEGY format)
3	Raw PSTM Gathers(with Nmo but no mute) (SEGY format)

A copy of the following products were output to CD-ROM:

4	Stacking Velocity (ESSO V2 format)
5	CGM Files of Raw PSTM Stack
6	CGM Files of PSTM with post stack processing and balance
7	Final Processing Report

2 copies of the following paper sections were produced at a scale of 1:12,500 10cm/sec:

8	Raw PSTM Stack
9	PSTM with post stack processing and balance

2 copies of the following sepia transparent sections were produced at a scale of 1:12,500 10cm/sec

10	Raw PSTM Stack
11	PSTM with post stack processing and balance

A paper copy of the following:

12	Final Processing Report

Appendix A

ACQUISITION PARAMETERS

1981

Contractor	RIG	Recording System	DFSIV
Sample Rate	2 ms	Record Length	7 s
Low Cut Filter	12 Hz	High Cut Filter	124 Hz
Notch Filter	50 Hz	Fold	1000%
Spread Type	Symmetrical Split	Trace/SP	60
Group Interval	30 m	SP Interval	90 m
Geophone Pattern	RET 48*60	Geophone Type	10 Hz
Energy Source	Dynamite	Source Pattern	Single
Source Depth	33 m	Source Charge	4 Kg
Minimum Offset	15 m	Maximum Offset	885 m

1984

Contractor	Siag	Recording System	DFSV
Sample Rate	2 ms	Record Length	6 s
Low Cut Filter	12 Hz	High Cut Filter	128 Hz
Notch Filter	50 Hz	Fold	700%
Spread Type	Symmetrical Split	Trace/SP	60
Group Interval	30 m	SP Interval	120 m
Geophone Pattern	RET 24*50	Geophone Type	14 Hz
Energy Source	Dynamite	Source Pattern	Single
Source Depth	23 m	Source Charge	7 Kg
Minimum Offset	15 m	Maximum Offset	885 m

Appendix B
Line Listing

Data Vintage	Line Number	Number of Channels	First Shotpoint	Last Shotpoint
1981	CR-1-81	60	125	233
1981	CR-2-81	60	300	392
1984	CR-5-84	60	102	144
1984	CR-6-84	60	100	203
1984	CR-7-84	60	100	212
1984	CR-8-84	60	100	161
1984	CR-9-84	60	105	252
1984	CR-10-84	60	100	196

Number of Shots	Group Interval	Kms
36	30	5,01
26	30	4,5
10	30	2,6
23	30	4,95
28	30	5,16
16	30	3,18
34	30	5,55
21	30	3,81