DATA PROCESSING REPORT

1992 KILGOUR SEISMIC SURVEY

NORTHERN TERRITORY, EP-25

AUSTRALIA

for

M.I.M PETROLEUM EXPLORATION PTY LTD

LEVEL 2, MURUK HAUS

230 LUTWYCHE ROAD

WINDSOR QLD. 4030

by

DIGITAL EXPLORATION LIMITED

(A DIGICON COMPANY)

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DPR058A:KJF

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GENERAL INTRODUCTION

This report presents an account of the processing sequence and techniques used for processing seismic data from 1992 Kilgour seismic survey, for M.I.M Petroleum Exploration Pty Limited.

Approximately 33 kms of 24 fold digital field data was acquired by Velseis, and was processed by Digital Exploration Limited, Brisbane office,between August 1992 and March 1993.

ACQUISITION PARAMETERS

Recorded By	: Velseis
Date Recorded	: August 1992
Instruments	: Sercel SN338/Velcom
Record Length	: 2 seconds
Sample Rate	: 2 milliseconds
Recording Filter	: Out
Format/Density	: SEGY/6250 BPI
Spread Configuration	: Symmetric Split Spread
Number of Data Channels	: 48
Group Interval	: 25 metres
Geophone Array	: 12 Phones in line over 25 metres
Geophone Type	: Sensor SM7 [10 Hz]
Near Group Offset	: 37.5 metres
Far Group Offset	: 612.5 metres
Energy Source	: Minisosie
Source Interval	: 25 metres
Coverage	: 2400%

PRODUCTION PROCESSING SEQUENCE

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9. Velocity Analysis (where possible)
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PROCESSING DESCRIPTION

1. TRANSCRIPTION

The data from the field tapes were decoded and converted to Digicon's internal 9 track, trace sequential format for subsequent processing.

2. SELECTIVE TRACE EDIT

This very worst traces were edited becaue of the obvious poor contribution they would make to the stack. Generally however, the poor quality of the seismic data prevented any discrimination of what is a good or noisy trace.

3. SPECTRAL EQUALISATION

Simple deconvolution is achieved using a frequency dependent scaling routine. Between lower and upper frequency limits each data trace is partioned into a number of bands by separating data fitlers. Each band is scaled before recombining to give an output trace with a compressed pulse and flatter spectrum. Parameters used were: 250 ms AGC scaling over 11 bands between 10 Hz and 60 Hz.

4. F-K FILTER

This process applied to the shot data, a zero phase F-K filter in the F-K domain using straight forward design principles. Reflections are separated from interfering noise on the basis of differences in apparent horizontal velocity. Events which are slower than the specified velocity cut are rejected. Amplitude and phase of the signal in the accept zone are preserved according to the taper. The velocity cut used had a dip range of -12.5/+12.5 ms/trace representing an apparent velocity of 2000 m/s, with a 100% cosine taper within specified cuts.

5. INITIAL STATICS COMPUTATION AND APPLICATION

Initial static corrections were computed using a refraction static technique, to correct for near surface irregularities such as changes in elevation, weathering velocity, weathering layer thickness and sub-weathering velocity.

For this project a basic two layer refraction model was adopted, utilizing Digicon's STATICM routine. STATICM computes shot and geophone static corrections from estimates of the first arrival times stored in the seismic data base. These times are input to the data base by digitising the first breaks from the production shots. Geometry information is drawn from the data base and used with the elevation listings to fully define the profile. Details of the shot and receiver offsets, weathering velocities (Vo) and selected datum elevation (200 m) are also provided. The weathering velocity used for this project was 1000 m/s.

STATICM calculates the static corrections using a least-squares, surface consistent algorithm. The pick times were decomposed into shot and receiver delay times and travel times on the refracting horizon. A single optimal delay time is calculated for each station along with optimal refractor velocity. The delay times for a shot and receiver at the same station location is assumed to be the same.

The routine is iterative, and progressively adjusted first break times are submitted for updating of sub-weathering velocities (Vr) and delay times (Td) at each group location. Both of these are constrained by suitable smoothing filters to inhibit erratic variations, 30 station smoothing for Vr, 1 station smoothing for Td . After the final iteration, usually 5, the geophone statics (Tg) are computed as an elevation correction plus a weathering layer correction.

The replacement velocity used for the elevation correction was the computed refractor velocity from the first breaks. A 90% anisotropy factor was included.

A smoothed average static is with held in the trace header for later application. This enabled processing at a floating datum close to the surface.

6. COMMON DEPTH POINT GATHER

The seismic traces along a line are gathered into common mid-point ensembles. The offsets, surface and sub-surface co-ordinates and shot sequence numbers are encoded in the trace headers for use in the subsequent processing.

7. REGIONAL VELOCITY ANALYSIS

Attempts at regularly spaced initial velocity analysis before statics yielded no reliable data on many panels. A regional velocity function was adopted for NMO going into residual statics analysis.

8. AUTOMATIC RESIDUAL STATICS CORRECTION

A two stage residual static procedure was employed .

Conventional residual statics analysis requires the generation of a pilot or model trace at every cdp along the line. The pilot is then part of the cross correlating sequence that determines the optimum shifting on the pre-stack data traces. The pilot is generated by first stacking the cdp's then doing same lateral mixing with adjacent cdp's. The worse the data quality, the more lateral mixing is required to get a reliable pilot. The Kilgour data set however has very steep dips involved. There is a need for a dip model to be given so that the lateral mixing does not eliminate dipping reflections from the pilot.

The Kilagour Survey initial stacks were structurally ambiguous. Since any dip interpretation influences the result of conventional residual statics, it was decided to use a structurally independant routine for a first stage. This first stage yielded a section from which a dip model was interpreted for input to a second conventional residual statics stage.

<u>1ST STAGE TECHNIQUE:</u> Montecarlo Method

This method estimates residual static corrections by the maximisation of stack power. For every shot and receiver station along the line the static shift that maximises stack power of the cdp's to which they contribute is chosen.

One iteration updates all shots and receivers once. Twenty iterations were used.

<u>2ND STAGE TECHNIQUE:</u> Conventional Method

The automated statics analysis routine is conducted on NMO corrected gather records by utilizing all possible cross correlations between traces within and from adjacent depth points.

A dip model, representing the observed structure on one or more events within a specified gate or gates, is input to the program to facilitate dip correction within the set of CDP gathers being operated on. The model is interpreted from the previous stacked section in the processing sequence.

The process iterates automatically and makes separate estimations of residual normal moveout and dip, then computes a set of surface consistent residual statics for all shot and receiver locations. The appropriate residuals may be output on tape for application at a later stage, or stored in the data-base.

The following correlation processing controls are generally followed while estimating residual statics and have some data dependence :

a. Static limits (+/- 10 ms. for these data).

b. Damping factor to prevent matrix instability.

c. Number of iterations (3 for these data).

d. The number of depth-points in the pilot. This was respectively 15, 9, 5 for 1st, 2nd and 3rd iterations.

Residual geophone statics are applied in accordance with receiver surface location and residual shot statics with record or shot input sequence. Both are recorded in the appropriate trace headers.

9. VELOCITY ANALYSIS

Several analysis were run on the lines after residual statics. Due to the poor data quality, the short spread and high velocities involved, these analysis showed very little resolution of the stacking velocity. There was nothing to be gained by varying from the regional function.

10. NORMAL MOVEOUT

Simple normal moveout correction based on offset, time and an RMS velocity given by the regional velocity function:

Time (ms)	Velocity (m/s)
0	3600
400	4050
700	4500
1000	4500

11. PRESTACK MUTING

The function of this process is to mute the shallow long offset traces where the signal to noise ratio is extremely poor.
In particular, the disproportionate stretching of traces with decreasing velocity and increasing offset, by NMO correction, contributes significantly to the poor S/N ratio.

Offset(m)	Time (ms)
0	0
37	30
137	120
287	250
613	390

12. **DIP MOVEOUT COMPENSATION**

DMO processes are designed to give dipping events on non-zero offset traces an adjustment such that these events will stack coherently at the flat-dip stacking velocity function. This is achieved by performing a partial migration before stack.

DMO processing was applied to all data using a Kirchhoff algorithm.

13. **COMMON DEPTH POINT STACK**

After the completion of prestack muting and balancing the CDP data sets, which are corrected for the final velocity and residual statics, are summed algebraically. The resultant amplitude is divided by the number of live samples contributing to the summation to produce the final unfiltered stacked sample.

14. **DATUM CORRECTION**

From Floating Datum to Seismic Datum. Seismic Datum: 100 metres.

15. **DISPLAY**

Film Plot

16. **MIGRATION**

Stacks were migrated using a high dip phase shift algorithm. The regional stacking velocity supplied the migration velocity field.

17. **DISPLAY**

Paper Plot

THE DATA PROCESSING SYSTEM

Digicon's installation in Brisbane is based on one CONVEX C3220 supercomputer, and two Digital Equipment Corporation's VAX 8650's. A brief description of the computers and peripheral devices is as follows :-

Main processing system

1) CONVEX computer system :
- 1 unit 3220 system
- 128 Mbyte memory
- 16 Gbyte disk capacity
- 200 Megaflops throughput
- 10 x Futitsu 9 track tape drives
- 4 x 3480 compatible half-inch square cartridge tapes.
- 1 x Versatec 36" electrostatic plotter

2) System 1 (VAX1) :
- 1 unit 8650 CPU
- 32 Mbyte physical memory
- 4 x 1.23 Gbyte SABRE disk drives
- 4 x FPS Array Processors
- * - 2 x Numerix Vector Processor
- 16 x Telex tri-density tape drives
- 1 x high speed line printer
- 1 x 36" Benson electrostatic plotter
- 1 x 22" Benson electrostatic plotter
- 1 x 36" thermal plotter
- 1 x 2.5/5.0 Gbyte Exabyte drive

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- 1 x 22" Benson electrostatic plotter
- 1 x 36" thermal plotter
- 1 x 2.5/5.0 Gbyte Exabyte drive

4) Additional Hardware

- 1 x GEOSPACE high resolution (508 dots/inch) film plotter
- 2 x Summagraphic digitizer tables
- 1 x Tektronix graphic terminal and hard copy unit
- 1 x Sun Sparc Station 1
- 1 x Sun Sparc Station 2

(*) The Numerix Vector Processor has 16Mbyte memory and offers computation power of 30Mflops.

LINE SUMMARY

LINE	NO. OF RECORDS	SHOT POINT RANGE	KMS
92-01	102	100 - 200	2.500
92-04	178	100 - 279	4.475
92-05	81	96 - 194	2.450
92-06	167	100 - 276	4.400
92-07	99	100 - 196	2.400
92-08	176	108 - 283	8.750
92-09	71	100 - 188	2.200
92-11	89	101 - 189	2.200
92-13	58	100 - 164	1.600
92-15	71	100 - 179	1.975
			32.950

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DISCUSSION

The data quality encountered on the Kilgour Seismic Survey was generally quite poor. The main danger when processing seismic data with a very low signal to noise ratio, is the generation of coherent events from the noise itself. Such coherent events can be mistakenly interpreted as reflections.

Testing of the processing sequence for this survey was very focused on avoiding generation of unreal data. The most critical process in this regard is the automatic residual static correction. We believe that the two stage approach we have adopted here has improved confidence in the results. However, there can be no guarantees with a limited signal data set such as this.

We would advise an interpreter, considering all the other information he has available to him, that the seismic data could occasionally be at cross purposes. The subsurface picture is more prone to distortion in the places of weakest signal.

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