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WESTERN ATLAS

Western Geophysical

FINAL REPORT
FOR DATA PROCESSING
FIVE LINES FROM
VINTAGE 1980, 1982, 1985
BASS BASIN SEISMIC SURVEYS

PERMIT AREAS T/15P & T/28P

WESTERN GEOPHYSICAL AUSTRALIA
A DIVISION OF
WESTERN ATLAS INTERNATIONAL INC
A.R.B.N. 009 474 908

MARCH 1997
WGC Project Number: J2223

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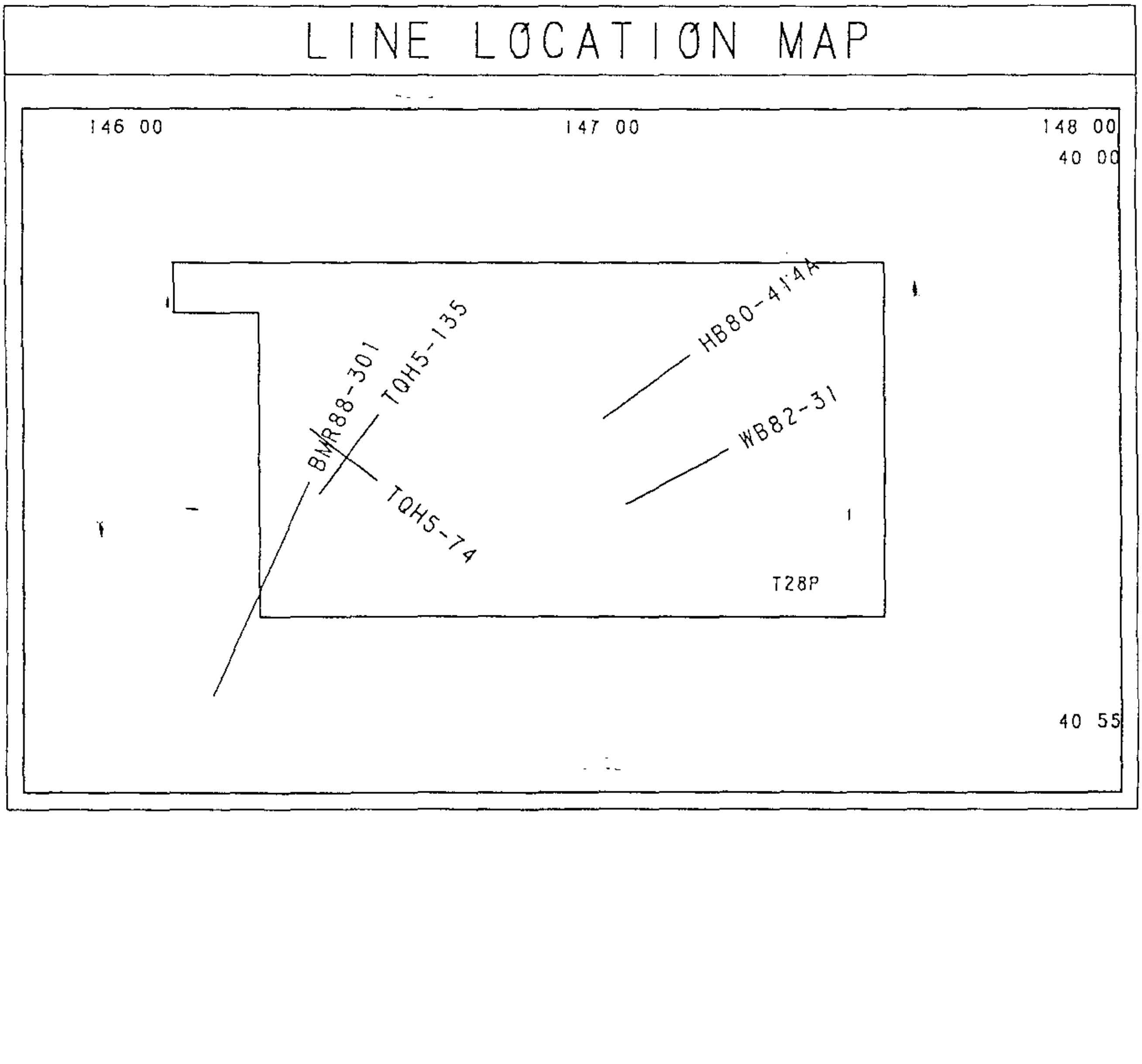
List of Enclosures

1 INTRODUCTION

This report details the processing of 5 lines taken from 4 2D seismic surveys carried out by various contractors. The project for Cue Energy Resources Ltd comprises data in permits T/15P AND T/28P in the Bass Strait, north of Tasmania. A line location map is shown in Figure 1-1.

Production data processing was conducted between November and December 1996 at the Melbourne Digital Processing Centre of Western Geophysical Australia. All of the main processing was performed on an IBM RISC. Filming was performed on Laserdot™ hardware in Adelaide via WAN.

The procedures and programs utilised in processing the data are described below in the order in which they were applied. The project was coordinated for Cue by Robert Coppin, and managed for Western by Niels Stienstra with geophysical supervision by Michelle Tham.


LINE LOCATION MAP
146 00
147 00
148 00
40 00
HB80-414A
TQH5-135
BMR88-301
WB82-31
TQH5-74
T28P
40 55
5 cm

2 ACQUISITION SUMMARY

2.1. ACQUISITION PARAMETERS.

The field data were taken from four surveys.

(1) Lines TQH5-74 and TQH5-135 were shot by GSI, using the Eugene McDermott II under Party No. 2931. The following parameters were utilised:

Streamer	240 traces 15 metre group interval (3600 metres total active length) depth - 12 metres near offset - 396 metres
Energy source	Airgun arrays, 4075 cubic inches depth - 10 metres firing interval - 30 metres
Instrumentation	Trace Sequential Recorder SEG-D 6250 BPI Low cut filter - 8 Hz (18 dB/octave slope) High cut filter - 128 Hz (72 dB/octave slope)
Data Sampling	2 ms sampling interval 6000 ms record length.
Polarity	Positive pressure at the hydrophone produces a positive number on tape (SEG Reverse).

(2) Line HB80A-414 was shot by WGC, using the Eugene McDermott II under Party No. 2931. The following parameters were utilised:

Streamer	96 traces 25 metre group interval (2424 metres total active length) depth - 7 metres near offset - 268 metres
Energy source	Airgun arrays, 23.76 litres depth - 7 metres firing interval - 25 metres
Instrumentation	DFS V SEG-B Low cut filter - 8 Hz (18 dB/octave slope) High cut filter - 128 Hz (72 dB/octave slope)
Data Sampling	2 ms sampling interval 5000 ms record length.

Polarity	Positive pressure at the hydrophone produces a negative number on tape (SEG Normal).

(3) Line WB82-31 was shot by WGC, using the Western Odyssey under Party No. 86. The following parameters were utilised:

Streamer	96 traces 25 metre group interval (2400 metres total active length) depth - 12 metres near offset - 194 metres
Energy source	Airgun arrays, 760 cubic inches depth - 6 metres firing interval - 25 metres
Instrumentation	DFS V SEG-B 1600 BPI Low cut filter - OUT High cut filter - 128 Hz (70 dB/octave slope)
Data Sampling	2 ms sampling interval 6000 ms record length.
Polarity	Positive pressure at the hydrophone produces a negative number on tape (SEG Normal).

(4) Line BMR88-301 was shot by BMR. The following parameters were utilised:

Streamer	96 traces 37.5 metre group interval (3600 metres total active length) depth - 10 metres near offset - 206 metres
Energy source	Airgun arrays, 1 x 1600 cubic inches depth - 10 metres firing interval - 37.5 metres
Instrumentation	SEG-Y 6250 BPI Low cut filter - 8 Hz High cut filter - 64 Hz
Data Sampling	4 ms sampling interval
Polarity	Positive pressure at the hydrophone produces a negative number on tape (SEG Normal).

3 PROCESSING SUMMARY

3.1. PROCESSING SEQUENCE

	Conversion of Field Tapes to WGC Code 4 Format	
	Resample to 4ms	
	51.2 ms delay compensation	G.S.I. TQH5 Lines only
	Edit bad shots and traces and attenuate spikes	
	Gain Correction	
	Spherical Divergence	
	Shot Domain FK Filter	
	(Adjacent Trace Sum)	(TQH5-74 & TQH5-135)
Brute Stack	Deconvolution Before Stack	1st Pass Velocity Analysis
	FK Multiple Attenuation	
	Radon Transform Filter	
Demultiple Stack		DMO 2nd Pass Velocity Analysis
	Instantaneous AGC gain	
	NMO	
	Inner and outer trace mutes applied	
Dmo Stack	DMO Stack	
	Zero phase bandpass filter	
	Trace Mix	
Dmo Stack Film	Gun & cable depth correction then	Bandpass Filter and Scaling
	Migration Radial Predictive Filter	
Migration Film	Gun & cable depth correction then	Bandpass Filter and Scaling

4 PERSONNEL

Name	**Title**	**Responsibilities**
Michelle Tham	Senior Geophysicist	Project Manager and technical control.
Niels Stienstra	Geophysicist	Coordination of day to day running of project and testing.

5 PROCESSING SEQUENCE

5.1. POLARITY

The data for HB80A-414, WB82-31, and BMR88-301 were recorded to conform with the SEG standard for causal seismic data (Sheriff, R.E., Encyclopaedic Dictionary of Exploration Geophysics, Third Edition) whereby 'the onset of a compression from an explosive source is represented by a negative number'. This recording polarity was maintained throughout the processing sequence.

Lines TQH5-74 and TQH5-135 were recorded as SEG reverse polarity. This recording polariy was maintained throughout the processing sequence.

5.2. FORMAT CONVERSION

The field data were converted to WGC Code 4 format. Full word, 32 bit floating point data with geophone amplitude maintained.

5.3. RESAMPLE

The data (excepting BMR88-301) were resampled from an acquisition sampling rate of 2ms to a processing sample rate of 4ms. To avoid any aliasing resulting from this resample, a minimum phase anti-alias high cut filter of 93.75 Hz with a slope of 36 dB/octave was applied.

Line BMR88-301 was recorded with a sample rate of 4 ms, and was not resampled.

5.4. STATIC CORRECTION

A -51.2 ms correction was applied to lines TQH5-74 and TQH5-135 in order to compensate for a GSI acquisition delay.

5.5. DATA INTEGRITY QC

Displays of near trace sections and shot records of each line were produced to identify bad channels and shots.

5.6. FIELD DATA EDITS

Records flagged as bad in the Observer's logs or as displayed in the near trace gather and QC attribute plots were edited from the processing sequence.

5.7. GAIN CORRECTION

A gain correction of 3 dB/sec was applied from 0 to 3 seconds.

5.8. SPHERICAL DIVERGENCE

To correct for spherical spreading, the inverse of the amplitude decay factor (A) was applied to the data using the following regional velocity function :-

Time (ms)	Velocity (m/s)
0	1480
101	1480
641	2050
1222	2220
1484	2303
2019	2611
2914	3190
4227	4014
5335	4474

5.9. DIP FILTERING (FK) - SHOT DOMAIN

The following NMO FK filter designs were used to attenuate linear noise present on shot records:-

Line	Trace Spacing	Pass zone
TQH5-135&74	15 m	-/+ 3.6 ms/trace
HB80A-414	25 m	-/+ 6.0 ms/trace
WB82-31	25 m	-/+ 6.0 ms/trace
BMR88-301	37.5 m	-/+ 9.0 ms/trace

NMO was applied prior to FK filtering with the velocity function used for spherical divergence. A removable AGC of 300ms was also applied prior to FK filtering.

5.10. ADJACENT TRACE SUM

A 2:1 adjacent trace sum was carried out on both TQH5 lines only.

Input	**Ouput**
240 channels	120 channels

5.11. DECONVOLUTION BEFORE STACK

Predictive deconvolution was applied on a trace by trace basis to compress the time duration of seismic wavelet and restore frequency components weakened and dispersed while propagating in an inhomogeneous and attenuating medium - the earth.

Deconvolution was applied using the following parameters over one window for all vintages:

Gap:	25 ms
Operator:	1024 ms
Window:	200-2200 ms (near offset)

5.12. FIRST PASS VELOCITY ANALYSIS

Velocity analyses were carried out at 2km intervals along each line using IVP software package.

5.13. F-K MULTIPLE ATTENUATION FILTER (MAFK)

MAFK was applied using the following reduced percentage of the velocity trend.

Time (ms)	**% of first pass trend**
0	92
2000	92
3000	90
4000	88
6000	85

5.14. RADON TRANSFORM FILTER

Radon transform filter was applied using the following reduced percentage of the velocity trend.

Time (ms)	**% of first pass trend**
0	96
2000	94
4000	92
6000	90

5.15. SECOND PASS VELOCITY ANALYSIS

DMO velocity analyses were produced at 1 km intervals along each survey line. The first pass velocity trend was used as the central function.

5.16. INSTANTANEOUS AGC GAIN

Automatic gain compensation was applied sample by sample with a 5000 or 6000 ms gate depending upon the processing data length of the line..

5.17. DIP MOVEOUT (DMO)

Reflections which emanate from a horizon with zero dip are all zero offset, and true stacking velocities can be calculated. However, if the horizon is dipping, reflection point dispersal occurs up dip of the true zero offset location. True stacking velocities cannot be calculated and the horizon will be inaccurately imaged using traditional processing methods.
To move finite offset data down dip to true zero offset, Dip Moveout (DMO) is used.

DMO is carried out on NMO corrected data sorted to common offset. It is a wave theoretical process that converts the NMO corrected data to zero offset independent of dip. After DMO has been applied, all dipping events will be correctly imaged by post stack migration. A useful by-product of DMO is the dispersive effect it has on coherent noise.

For second pass velocity analysis, the data were sorted to common offset. NMO correction was then applied using first pass velocities. DMO was then carried out (with the high-fidelity option turned on) using a maximum dip limit of 60 degrees for all vintages.

5.18. NORMAL MOVEOUT APPLICATION, MUTING AND DMO STACK

The normal moveout corrections for the second pass stacks were computed from the picked second pass velocities. The calculations were performed independently for each line using a straight ray computation method. DMO was applied to the data, and a stacked output produced.

Prior to DMO the following outer and inner trace mutes were applied:-

(1) Lines TQH5-74, 135

Outer	Time (ms)	4	500	700	1000	3000
	Offset (m)	553	614	974	1694	3974

Inner	Time (ms)	1500	2500	6000		
	Offset (m)	400	1297	1317		

(2) Lines WB82-31 and HB80A-414A

Outer	Time (ms)	4	200	700	1250	2500
	Offset (m)	368	418	1010	1832	2643

(3) Line BMR88-301

Outer	Time (ms)	4	900	2400	3500
	Offset (m)	553	585	2570	3770
Inner	Time (ms)	1400	2400	6000	
	Offset (m)	0	943	943	

5.19. ZERO BANDPASS FILTER

A zero bandpass filter was constructed from an analysis of 500 CDP locations from each line. Its application improved seismic resolution in the zone of interest.

5.20. TRACE MIX

A three-trace running mix with a weighting of (1, 1, 0.1) was applied inorder to enhance continuity in the shallow data.

5.21. MODIFIED RESIDUAL MIGRATION

Modified Residual Migration consists of migrating the data twice. An Extended Stolt (FK) Migration is applied to the data first. This is accurate to 90 degrees, even with velocity variations with depth. As this method uses a time migration algorithm, and hence applies a pseudo depth conversion before migration, it is extremely sensitive to lateral velocity variation. For this reason a minimum velocity function, extracted from the original velocity field, is used to migrate the data. A second "residual" migration is therefore required using a residual velocity field derived from the difference between the original velocity field and minimum velocity function. The finite difference algorithm is used for this residual phase. The advantage of this method is accurate imaging of steep dips.

The data was migrated using the time variant percentages of the final pass velocity trend smoothed over 300 CDPs :

Time (ms)	%
0	100
6000	100

5.22. RADIAL PREDICTIVE FILTER

A multichannel random noise filter with a +/- 7ms/trace acceptance fan was chosen over two other kinds of noise filters, and applied trace-by-trace with a 65% feedback of each unfiltered trace.

5.23. GUN AND CABLE STATICS CORRECTION

To compensate for the depth of the gun and cable below sea level, the following combined correction was applied :

Line:	TQH5-74,135	BMR88-301	WB82-31	HB80A-414
Correction:	15 ms	13.3 ms	12 ms	11.7 ms

5.24. TIME VARIANT FILTER

The following zero phase time variant filter was applied to all vintages:-

Time (ms)	**Low cut (Hz)**	**Slope (dB/octave)**	**High Cut (Hz)**	**Slope (dB/octave)**
0	15	18	80	72
700	15	18	80	72
1200	10	18	70	72
1600	8	18	60	72
4000	8	18	50	72

5.25. SCALING

An instantaneous AGC gain was applied using a 500 ms gate.

6 APPENDICES

6.1. DELIVERABLE ITEMS

6.1.1. Archive Tapes

One copy each of raw and filtered migrated data were produced on exabyte (2.5g):-

CLIENT:	**Cue Energy**
LINES:	ALL 5 LINES
AREA:	BASS BASIN T/25A & T/18P
FORMAT:	SEGY exabyte 2.5g @ 4ms
DATE:	**March 1997**

One copy each of raw and filtered stack data were produced on exabyte (2.5g):-

CLIENT:	**Cue Energy**
LINES:	ALL 5 LINES
AREA:	BASS BASIN T/25A & T/18P
FORMAT:	SEGY exabyte 2.5g @ 4ms
DATE:	**March 1997**

6.1.2. Velocity Data

A diskette comprising 2nd pass DMO velocities for all lines in ascii format was supplied.

6.1.3. Films

The final filtered stack and migration outputs were displayed as follows :-

Filtered and Scaled Stack - on film with five accompanying prints

Horizontal Scale	To match previous sections
Vertical Scale	As above.
Display Polarity	Negative numbers displayed as trough excepting BMR88-301 (SEG Reverse)
Display Gain :	11 dB

Filtered and Scaled Migration - on film with five accompanying paper prints

Horizontal Scale	To match previous sections
Vertical Scale	As above.
Display Polarity	Negative numbers displayed as trough excepting BMR88-301 (SEG Reverse)
Display Gain :	11 dB

6.2. LINE SUMMARY

No.	LINE	FSP	LSP	DIR	KM
1	TQH5-74	1	450	309	13.5
2	TQH5-135	250	802	37.9	16.59
3	HB80A-414A	1	746	54.0	19.78
4	WB82-31	1	846	242	21.15
5	BMR88-301	3050	4128	22.5	40.46

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ENCLOSURE 1.

LINE : TQH5-74
SP : 1 - 450
FILTERED MIGRATION

SP 402.0	CDP 922	
TIME(S)	RMS VEL	DIX INT
.013	1502	1502
.104	1502	1502
.267	1812	1985
.458	1966	2163
.608	2136	2587
.844	2249	2517
1.008	2275	2404
1.149	2262	2167
1.308	2322	2716
1.589	2415	2808
2.159	2802	3671
2.409	3049	4667
2.869	3359	4657
4.069	4040	5326
4.910	4334	5540
5.995	4708	6121

SP 369.0	CDP 856	
TIME(S)	RMS VEL	DIX INT
.013	1502	1502
.114	1495	1494
.298	1826	2004
.418	2043	2502
.578	2167	2462
.748	2198	2300
.888	2229	2388
1.098	2260	2387
1.328	2291	2434
1.559	2399	2944
1.989	2662	3451
2.189	2848	4278
2.381	3029	4615
2.918	3390	4665
4.099	4043	5323
4.859	4309	5527
5.995	4714	6152

SP 336.0	CDP 790	
TIME(S)	RMS VEL	DIX INT
.013	1495	1495
.114	1502	1503
.278	1780	1950
.408	2009	2427
.657	2142	2344
.818	2213	2482
1.068	2260	2407
1.308	2306	2500
1.539	2399	2869
1.939	2647	3438
2.389	3065	4436
3.199	3545	4682
4.180	4068	5434
5.995	4714	5940

SP 303.0	CDP 724	
TIME(S)	RMS VEL	DIX INT
.013	1502	1502
.114	1508	1509
.288	1842	2031
.418	2043	2430
.728	2198	2391
.966	2230	2325
1.168	2275	2479
1.378	2322	2568
1.529	2399	3012
1.939	2662	3471
2.509	3034	4051
3.149	3498	4911
4.408	4169	5500
5.995	4702	5936

SP 270.0	CDP 658	
TIME(S)	RMS VEL	DIX INT
.013	1508	1508
.120	1508	1508
.298	1857	2059
.438	1981	2222
.718	2167	2430
.978	2213	2335
1.178	2260	2477
1.358	2337	2789
1.609	2461	3046
1.909	2647	3479
2.549	3080	4109
3.189	3498	4815
4.353	4157	5577
5.995	4714	5943

SP 237.0	CDP 592	
TIME(S)	RMS VEL	DIX INT
.013	1514	1514
.125	1508	1507
.298	1888	2121
.444	2015	2252
.728	2198	2457
1.007	2249	2377
1.178	2275	2422
1.378	2322	2582
1.739	2523	3175
2.000	2712	3735
2.462	3035	4153
3.425	3643	4863
4.302	4144	5693
5.995	4708	5904

SP 204.0	CDP 526	
TIME(S)	RMS VEL	DIX INT
.013	1502	1502
.130	1502	1502
.288	1826	2055
.418	1966	2245
.698	2167	2436
.920	2249	2489
1.258	2291	2402
1.458	2368	2804
1.859	2569	3195
2.099	2817	4276
2.619	3142	4206
3.209	3514	4831
4.349	4164	5602
5.990	4689	5857

SP 171.0	CDP 460	
TIME(S)	RMS VEL	DIX INT
.013	1502	1502
.125	1502	1502
.288	1873	2114
.408	1997	2267
.515	2097	2441
.718	2182	2384
.918	2213	2321
1.138	2260	2446
1.358	2322	2619
1.549	2446	3192
1.889	2647	3416
2.139	2771	3571
2.629	3189	4587
3.249	3545	4768
4.317	4157	5623
5.995	4708	5893

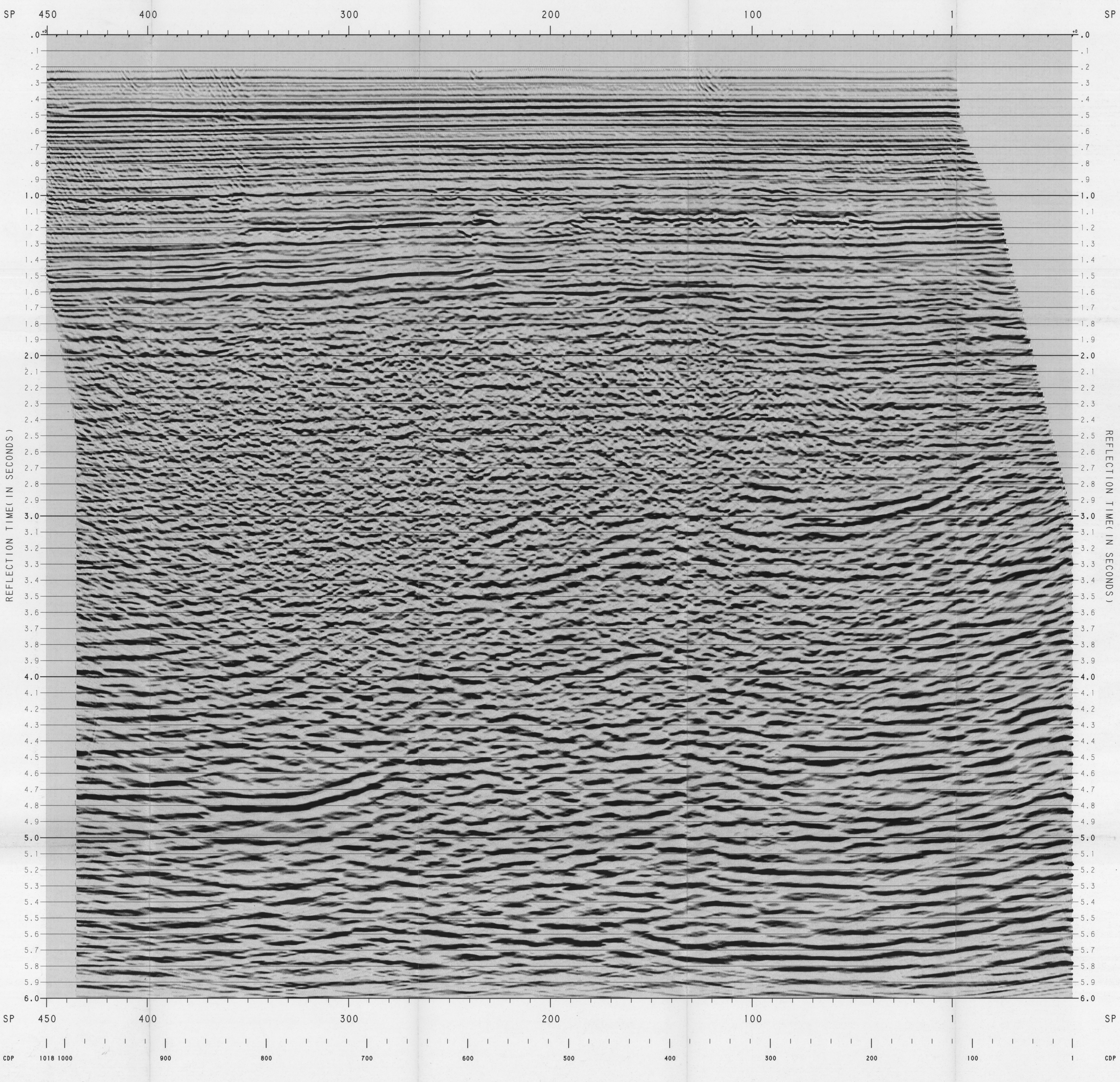
SP 138.0	CDP 394	
TIME(S)	RMS VEL	DIX INT
.013	1502	1502
.130	1502	1502
.348	1950	2174
.588	2105	2311
.818	2151	2264
1.148	2275	2557
1.368	2337	2637
1.589	2461	3121
1.899	2662	3516
2.449	3049	4114
3.149	3452	4592
4.189	4087	5586
5.990	4714	5921

SP 105.0	CDP 328	
TIME(S)	RMS VEL	DIX INT
.013	1508	1508
.130	1502	1501
.328	1935	2173
.419	2009	2256
.568	2151	2508
.838	2167	2200
1.118	2260	2518
1.378	2322	2572
1.669	2523	3313
1.899	2662	3509
2.497	3073	4114
2.867	3308	4589
3.876	3941	5345
5.995	4689	5813

SP 72.0	CDP 262	
TIME(S)	RMS VEL	DIX INT
.013	1502	1502
.138	1501	1501
.328	1935	2197
.578	2105	2309
.818	2182	2357
1.138	2275	2497
1.378	2399	2916
1.669	2508	2970
1.939	2585	3018
2.449	3080	4489
3.069	3452	4638
3.719	3839	5297
5.995	4689	5816

SP 39.0	CDP 196	
TIME(S)	RMS VEL	DIX INT
.013	1502	1502
.104	1508	1509
.328	1950	2124
.578	2105	2293
.758	2198	2473
.951	2218	2295
1.208	2275	2475
1.382	2395	3103
1.609	2461	2830
1.789	2523	3021
1.999	2647	3531
2.756	3251	4469
3.927	3897	5104
5.995	4689	5908

SP 6.0	CDP 130	
TIME(S)	RMS VEL	DIX INT
.013	1502	1502
.120	1495	1494
.308	1904	2124
.448	1966	2096
.598	2105	2474
.848	2136	2208
1.028	2244	2695
1.278	2291	2475
1.549	2523	3411
1.769	2538	2641
2.029	2662	3387
2.509	3049	4317
2.989	3390	4793
3.810	3853	5201
5.995	4689	5868



LINE : TQH5-74
SHOTPOINTS 1 - 450

NORTHWEST
DIRECTION SHOT - 309

5 cm

FINAL MIGRATION

Cue Energy Resources N.L.

BASS BASIN SURVEY
AREA : T-22-P

WESTERN ATLAS
Western Geophysical

RECORDED BY GSI, OCT 1985
PROCESSED BY WGC, MELBOURNE
PROCESSING DATE : DEC 1996

RECORDING DATA

BOAT
M/V EUGENE MCDERMOTT II
MAP LOCATIONS — SOURCE POSITION

SOURCE
AIRGUN VOLUME — 4075 CU IN
GUN DEPTH — 10 METRES
S.P. INTERVAL — 30 METRES

INSTRUMENTS
RECORDING SYSTEM: TRACE SEQUENTIAL RECORDER
FORMAT — 6250 BPI PHASE ENCODED SEG D
FILTERS — LOW CUT 8 HZ / 18 DB/OCT; HIGH CUT 128 HZ / 72 DB/OCT
RECORD LENGTH — 6000 MS
SAMPLE RATE — 2 MS
POLARITY — COMPRESSION POSITIVE

CABLE
STREAMER TYPE — GSI MULTIPLEXOR STREAMER
STREAMER LENGTH — 3600 METRES
NUMBER OF GROUPS — 240
GROUP INTERVAL — 15 METRES
CABLE DEPTH — 12 METRES

62 M
396 M
3585 M
240 1
ENERGY SOURCE: AIRGUN

SCALES
HORIZONTAL 42.65 TRACES/IN
VERTICAL 3.75 IN/SEC
0 1 KILOMETER

LEGEND
↓ VELOCITY FUNCTION
▼ INTERSECTIONS
○ WELL LOCATION

DATUM PLANE : SEA LEVEL

SP ANNOTATED AT SOURCE LOCATION

PLAYBACK
SCALE — 1 : 25187
HORIZONTAL — 42.65 TR/IN
VERTICAL — 3.75 IN/SEC
SAMPLE RATE — 4 MS

POLARITY
FIELD : COMPRESSION RECORDED AS A POSITIVE NUMBER (SEG REVERSE)

PROCESSING:
FIELD POLARITY MAINTAINED

DISPLAY : SEG NORMAL

DISPLAY GAIN - 11 DB

PROCESSING SEQUENCE

PROCESSING SAMPLE RATE 4 MS

PROCESSING DATA LENGTH 6000 MS

FORMAT CONVERSION
INPUT SEGD FORMAT, 2 MS SAMPLE RATE, OUTPUT 240 CHANNELS, OMEGA INTERNAL FORMAT

RESAMPLE
INPUT SAMPLE RATE : 2 MS
OUTPUT SAMPLE RATE : 4 MS
MINIMUM PHASE ANTI-ALIAS FILTER

STATIC CORRECTION
AIRGUN DELAY : -51.2 MS

AMPLITUDE RECOVERY
EXPONENTIAL GAIN 3DB/SEC FROM 0 TO 3 SEC

SPHERICAL DIVERGENCE CORRECTION
A = T*(V**2)
WHERE T = TWO WAY TIME,
V = REGIONAL VELOCITY FUNCTION

SHOT DOMAIN FK FILTER
PASS ZONE : +/- 3.6MS/TRC (50% AMPLITUDE)

ADJACENT TRACE SUM
ADJACENT FIELD TRACES SUMMED 2 ON 1

DECONVOLUTION BEFORE STACK
LEAST SQUARES MINIMUM PHASE INVERSE FILTER
MINIMUM PREDICTION LAG : 25 MS
OPERATOR LENGTH : 1024 MS
WHITE NOISE : 0.1%

FIRST PASS VELOCITY ANALYSIS
FIRST PASS VELOCITY EVERY 2 KM
PICKED AND QC VIA IVP

MULTIPLE ATTENUATOR FILTER
MULTIPLES REJECTED IN THE FK DOMAIN
PASSING ZERO AND POSITIVE WAVENUMBERS

TIME (MS)	VELOCITY USED: % STACKING VELOCITY
0	92
2000	92
3000	90
4000	88
6000	85

RADON TRANSFORM FILTER
96 % PRIMARY VELOCITY USED
DELTA X = -48 MS, DELTA Y = 349 MS
REJECT IN TAU-P DOMAIN

DIP MOVEOUT CORRECTION (DMO)
HIFI OPTION USED

SECOND PASS VELOCITY ANALYSIS
SECOND PASS VELOCITY EVERY 1 KM
PICKED AND QC VIA IVP

TRACE EQUALIZATION
TRACE AMPLITUDE EQUALIZED TO 6000 RMS

NMO / MUTE / STACK

OFFSET (M)	OUTER TRACE MUTE: STOP TIME (MS)
553	4
614	500
974	700
1694	1000
3974	3000

OFFSET (M)	INNER TRACE MUTE: STOP TIME (MS)
400	1500
1297	2500
1317	6000

ZERO PHASE BANDPASS FILTER

TRACE MIX
3 TRACE RUNNING MIX,
TRACE WEIGHTING (1,1,0.1)

MODIFIED RESIDUAL MIGRATION
1ST PASS : CASCADED STOLT MIGRATION
VELOCITY : MINIMUM VELOCITY FUNCTION
2ND PASS : FINITE DIFFERENCE MIGRATION
VELOCITY : RESIDUAL VELOCITY FINCTION

RADIAL PREDICTIVE FILTER
MULTICHANNEL RANDOM NOISE FILTER
+/- 7MSEC/TRACE ACCEPTANCE FAN
65% FEEDBACK OF UNFILTERED TRACE

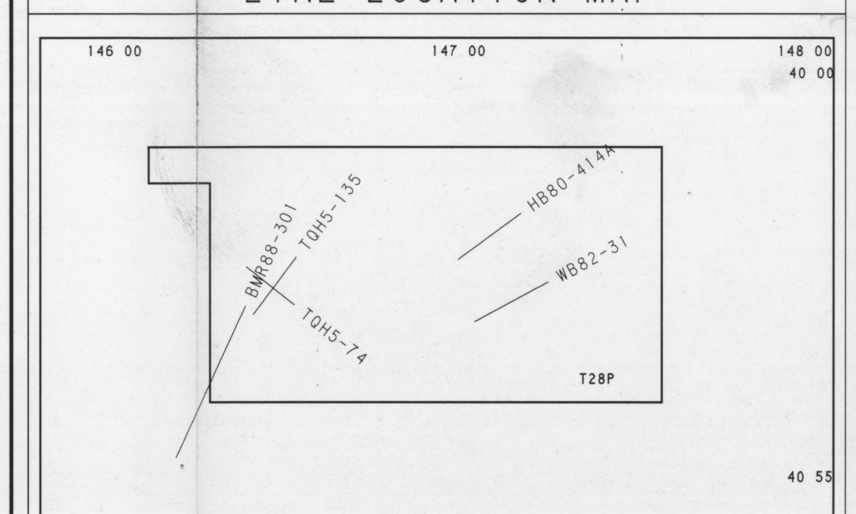
STATICS CORRECTION
+15 MS GUN AND CABLE DEPTH CORRECTION

TIME VARIANT FILTER

TIME (MS)	LOW CUT (HZ/SLOPE)	HIGH CUT
2	15 / 18	80 / 72
700	15 / 18	80 / 72
1200	10 / 18	70 / 72
1600	8 / 18	60 / 72
4000	8 / 18	50 / 72

SCALING
INSTANTANEOUS AGC GAIN USING A 500 MS GATE

LINE LOCATION MAP



LINE : TQH5-135
SP. : 250 - 802
FILTERED MIGRATION

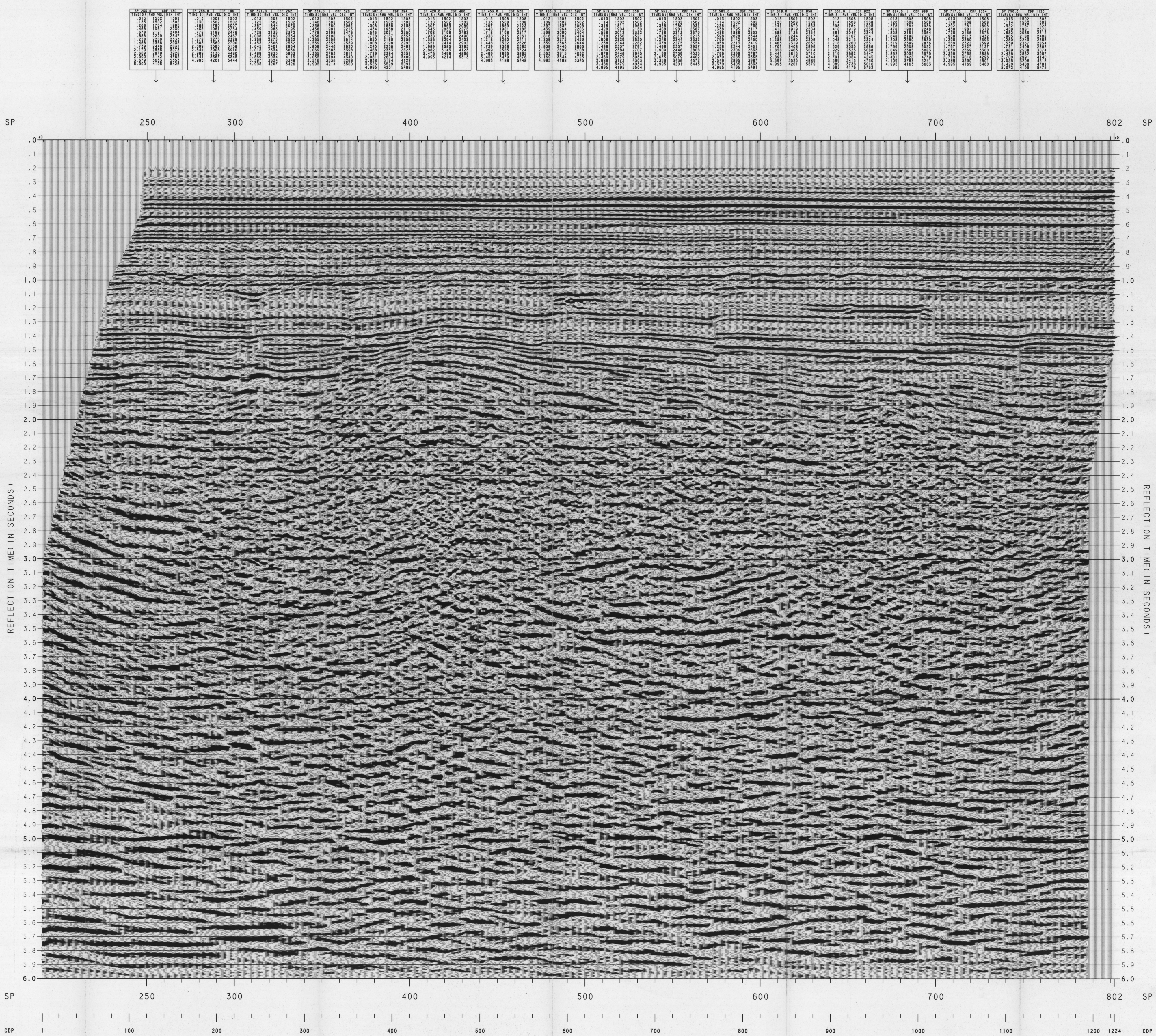
520019 OR-0421
ENCLOSURE 2

LINE : TQH5-135

SHOTPOINTS 250 - 802

EAST
DIRECTION SHOT - 038

5 cm



FINAL MIGRATION

Cue Energy Resources N.L.

BASS BASIN SURVEY

AREA : T-22-P

Western Atlas
Western Geophysical

RECORDED BY GSI, OCT 1985
PROCESSED BY WGC, MELBOURNE
PROCESSING DATE : DEC 1996

RECORDING DATA

BOAT

M/V EUGENE MCDERMOTT II
MAP LOCATIONS SOURCE POSITION

SOURCE

AIRGUN VOLUME	4075 CU IN
GUN DEPTH	10 METRES
S.P. INTERVAL	30 METRES

INSTRUMENTS

RECORDING SYSTEM:	TRACE SEQUENTIAL RECORDER
FORMAT	6250 BPI PHASE ENCODED SEG D
FILTERS	LOW CUT 8 HZ / 18 DB/OCT
	HIGH CUT 128 HZ / 72 DB/OCT
RECORD LENGTH	6000 MS
SAMPLE RATE	2 MS
POLARITY	COMPRESSION POSITIVE

CABLE

STREAMER TYPE	GSI MULTIPLEXOR STREAMER
STREAMER LENGTH	3600 METRES
NUMBER OF GROUPS	240
GROUP INTERVAL	15 METRES
CABLE DEPTH	12 METRES

62 M
396 M
3585 M
240
1
ENERGY SOURCE:
AIRGUN

SCALES

HORIZONTAL 42.65 TRACES/IN
VERTICAL 3.75 IN/SEC
0 1
KILOMETER

LEGEND

↓ VELOCITY FUNCTION
▼ INTERSECTIONS
○ WELL LOCATION

DATUM PLANE : SEA LEVEL

SP ANNOTATED AT SOURCE LOCATION

PLAYBACK

SCALE	1 : 25187
HORIZONTAL	42.65 TR/IN
VERTICAL	3.75 IN/SEC
SAMPLE RATE	4 MS

POLARITY

FIELD : COMPRESSION RECORDED AS A POSITIVE NUMBER (SEG REVERSE)

PROCESSING:
FIELD POLARITY MAINTAINED

DISPLAY : SEG NORMAL

DISPLAY GAIN = 11 DB

PROCESSING SEQUENCE

PROCESSING SAMPLE RATE 4 MS

PROCESSING DATA LENGTH 6000 MS

FORMAT CONVERSION

INPUT SEGD FORMAT, 2 MS SAMPLE RATE,
OUTPUT 240 CHANNELS,
OMEGA INTERNAL FORMAT

RESAMPLE

INPUT SAMPLE RATE : 2 MS
OUTPUT SAMPLE RATE : 4 MS
MINIMUM PHASE ANTI-ALIAS FILTER

STATIC CORRECTION

AIRGUN DELAY : -51.2 MS

AMPLITUDE RECOVERY

EXPONENTIAL GAIN 3DB/SEC FROM 0 TO 3 SEC

SPHERICAL DIVERGENCE CORRECTION
A = T*(V**2)
WHERE T = TWO WAY TIME,
V = REGIONAL VELOCITY FUNCTION

SHOT DOMAIN FK FILTER

PASS ZONE : +/- 3.6MS/TRC (50% AMPLITUDE)

ADJACENT TRACE SUM

ADJACENT FIELD TRACES SUMMED 2 ON 1

DECONVOLUTION BEFORE STACK

LEAST SQUARES MINIMUM PHASE INVERSE FILTER

MINIMUM PREDICTION LAG	:	25 MS
OPERATOR LENGTH	:	1024 MS
WHITE NOISE	:	0.1%

FIRST PASS VELOCITY ANALYSIS

FIRST PASS VELOCITY EVERY 2 KM
PICKED AND QC VIA IVP

MULTIPLE ATTENUATOR FILTER

MULTIPLES REJECTED IN THE FK DOMAIN
PASSING ZERO AND POSITIVE WAVENUMBERS

TIME (MS)	VELOCITY USED: % STACKING VELOCITY
0	92
2000	92
3000	90
4000	88
6000	85

RADON TRANSFORM FILTER

96 % PRIMARY VELOCITY USED
DELTA X = -48 MS, DELTA Y = 349 MS
REJECT IN TAU-P DOMAIN

DIP MOVEOUT CORRECTION (DMO)

HIFI OPTION USED

SECOND PASS VELOCITY ANALYSIS

SECOND PASS VELOCITY EVERY 1 KM
PICKED AND QC VIA IVP

TRACE EQUALIZATION

TRACE AMPLITUDE EQUALIZED TO 6000 RMS

NMO / MUTE / STACK

OFFSET (M)	OUTER TRACE MUTE: STOP TIME (MS)
553	4
614	500
974	700
1694	1000
3974	3000

OFFSET (M)	INNER TRACE MUTE: STOP TIME (MS)
400	1500
1297	2500
1317	6000

ZERO PHASE BANDPASS FILTER

TRACE MIX

3 TRACE RUNNING MIX,
TRACE WEIGHTING (1,1,0.1)

MODIFIED RESIDUAL MIGRATION

1ST PASS	:	CASCADED STOLT MIGRATION
VELOCITY	:	MINIMUM VELOCITY FUNCTION
2ND PASS	:	FINITE DIFFERENCE MIGRATION
VELOCITY	:	RESIDUAL VELOCITY FUNCTION

RADIAL PREDICTIVE FILTER

MULTICHANNEL RANDOM NOISE FILTER
+/- 7MSEC/TRACE ACCEPTANCE FAN
65% FEEDBACK OF UNFILTERED TRACE

STATICS CORRECTION

+15 MS GUN AND CABLE DEPTH CORRECTION

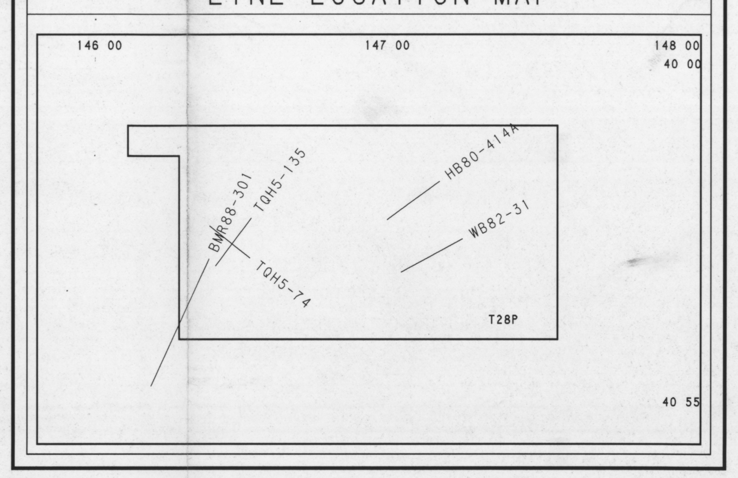
TIME VARIANT FILTER

TIME (MS)	LOW CUT (HZ/SLOPE)	HIGH CUT
2	15 / 18	80 / 72
700	15 / 18	80 / 72
1200	10 / 18	70 / 72
1600	8 / 18	60 / 72
4000	8 / 18	50 / 72

SCALING

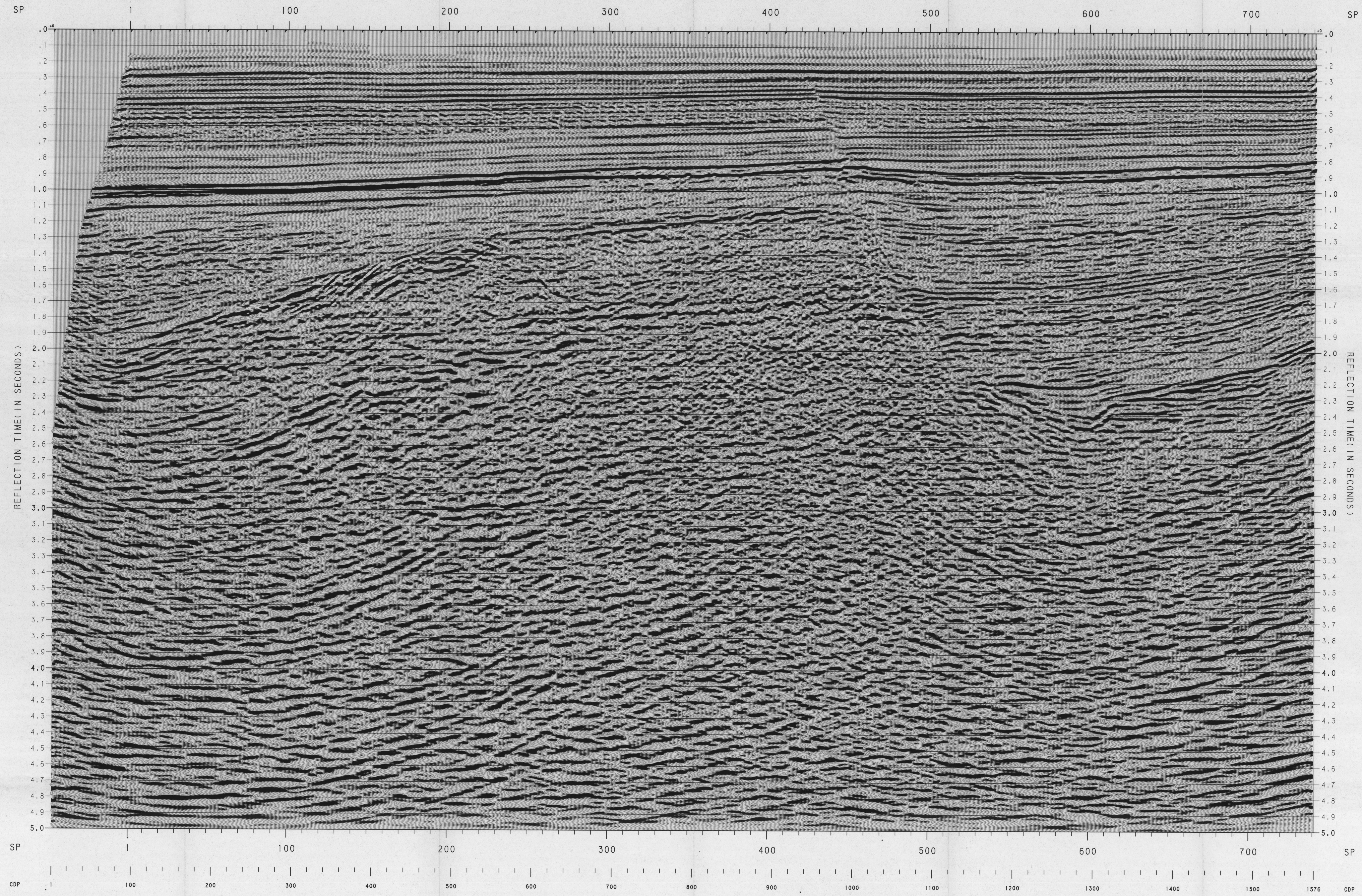
INSTANTANEOUS AGC GAIN USING A 500 MS GATE

LINE LOCATION MAP



LINE : HB80A-414
SP : 1 - 746
FILTERED MIGRATION

520020 OR-0421
ENCLOSURE 3.



LINE : HB80A-414

SHOTPOINTS 1 - 746

NORTHEAST
DIRECTION SHOT - 54

5 cm

FINAL MIGRATION

Cue Energy Resources N.L.

BASS BASIN SURVEY

AREA : T-15-P

Western Geophysical

WESTERN ATLAS

RECORDED BY WGC. MAY 1980
PROCESSED BY WGC. MELBOURNE
PROCESSING DATE : DEC 1996

RECORDING DATA

BOAT

M/V EUGENE MCDERMOTT II	PARTY 2931
NAVIGATION	MAXIRAN

SOURCE

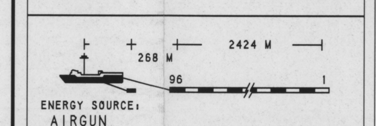
AIRGUN VOLUME	23.76 LITRES
PRESSURE	13800 KPASCAL
GUN DEPTH	7 METRES
POP INTERVAL	25 METRES
S.P. INTERVAL	25 METRES

INSTRUMENTS

RECORDING SYSTEM:	DFS V
FORMAT	SEG B
FILTERS	LOW CUT 8 HZ / 18 DB/OCT HIGH CUT 128 HZ / 72 DB/OCT
RECORD LENGTH	5000 MS
SAMPLE RATE	2 MS
POLARITY	COMPRESSION NEGATIVE

CABLE

STREAMER TYPE	STREAMER
STREAMER LENGTH	2424 METRES
NUMBER OF GROUPS	96
GROUP INTERVAL	25 METRES
LEAD IN	268 METRES
CABLE DEPTH	7 METRES



SCALES

HORIZONTAL 20 TRACES/CM
VERTICAL 10.0 CM/SEC

0 1
KILOMETER

LEGEND

VELOCITY FUNCTION
INTERSECTIONS
WELL LOCATION

DATUM PLANE : SEA LEVEL

SP ANNOTATED AT SOURCE LOCATION

PLAYBACK

SCALE :	1 : 25000
HORIZONTAL	20 TR/CM
VERTICAL	10 CM/SEC
SAMPLE RATE	2 MS

POLARITY

FIELD : COMPRESSION RECORDED AS A NEGATIVE NUMBER (SEG NORMAL)

PROCESSING:
FIELD POLARITY MAINTAINED

DISPLAY : SEG NORMAL

DISPLAY GAIN = 11 DB

PROCESSING SEQUENCE

PROCESSING SAMPLE RATE 4 MS

PROCESSING DATA LENGTH 5000 MS

FORMAT CONVERSION
INPUT SEGD FORMAT, 4 MS SAMPLE RATE, OUTPUT 96 CHANNELS, OMEGA INTERNAL FORMAT

RESAMPLE
INPUT SAMPLE RATE : 2 MS
OUTPUT SAMPLE RATE : 4 MS
MINIMUM PHASE ANTI-ALIAS FILTER

AMPLITUDE RECOVERY
EXPONENTIAL GAIN 3DB/SEC FROM 0 TO 3 SEC

SPHERICAL DIVERGENCE CORRECTION
A = T*(V**2)
WHERE T = TWO WAY TIME,
V = REGIONAL VELOCITY FUNCTION

SHOT DOMAIN FK FILTER
PASS ZONE : +/- 6.0MS/TRC (50% AMPLITUDE)

DECONVOLUTION BEFORE STACK
LEAST SQUARES MINIMUM PHASE INVERSE FILTER

MINIMUM PREDICTION LAG :	25 MS
OPERATOR LENGTH :	1024 MS
WHITE NOISE :	0.1%

FIRST PASS VELOCITY ANALYSIS
FIRST PASS VELOCITY EVERY 2 KM
PICKED AND QC VIA IVP

MULTIPLE ATTENUATOR FILTER
MULTIPLES REJECTED IN THE FK DOMAIN
PASSING ZERO AND POSITIVE WAVENUMBERS

TIME (MS)	VELOCITY USED: % STACKING VELOCITY
0	92
2000	92
3000	90
4000	88
6000	85

RADON TRANSFORM FILTER
96 % PRIMARY VELOCITY USED
DELTA X = -21 MS, DELTA Y = 154 MS
REJECT IN TAU-P DOMAIN

DIP MOVEOUT CORRECTION (DMO)
HIFI OPTION USED

SECOND PASS VELOCITY ANALYSIS
SECOND PASS VELOCITY EVERY 1 KM
PICKED AND QC VIA IVP

TRACE EQUALIZATION
TRACE AMPLITUDE EQUALIZED TO 5 SEC

NMO / MUTE / STACK

OFFSET (M)	OUTER TRACE MUTE: STOP TIME (MS)
368	4
418	200
1010	700
1832	1250
2643	2500

ZERO PHASE BANDPASS FILTER

TRACE MIX
3 TRACE RUNNING MIX,
TRACE WEIGHTING (1,1,0.1)

MODIFIED RESIDUAL MIGRATION

1ST PASS	: CASCADED STOLT MIGRATION
VELOCITY	: MINIMUM VELOCITY FUNCTION
2ND PASS	: FINITE DIFFERENCE MIGRATION
VELOCITY	: RESIDUAL VELOCITY FONCTION

RADIAL PREDICTIVE FILTER
MULTICHANNEL RANDOM NOISE FILTER
+/- 7MSEC/TRACE ACCEPTANCE FAN
65% FEEDBACK OF UNFILTERED TRACE

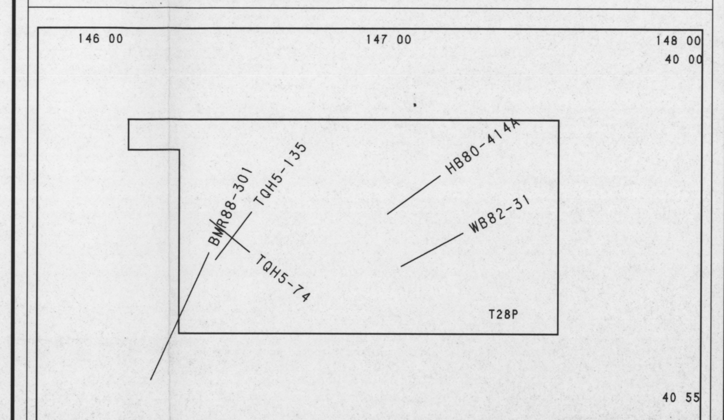
STATICS CORRECTION
+11.7 MS GUN AND CABLE DEPTH CORRECTION

TIME VARIANT FILTER

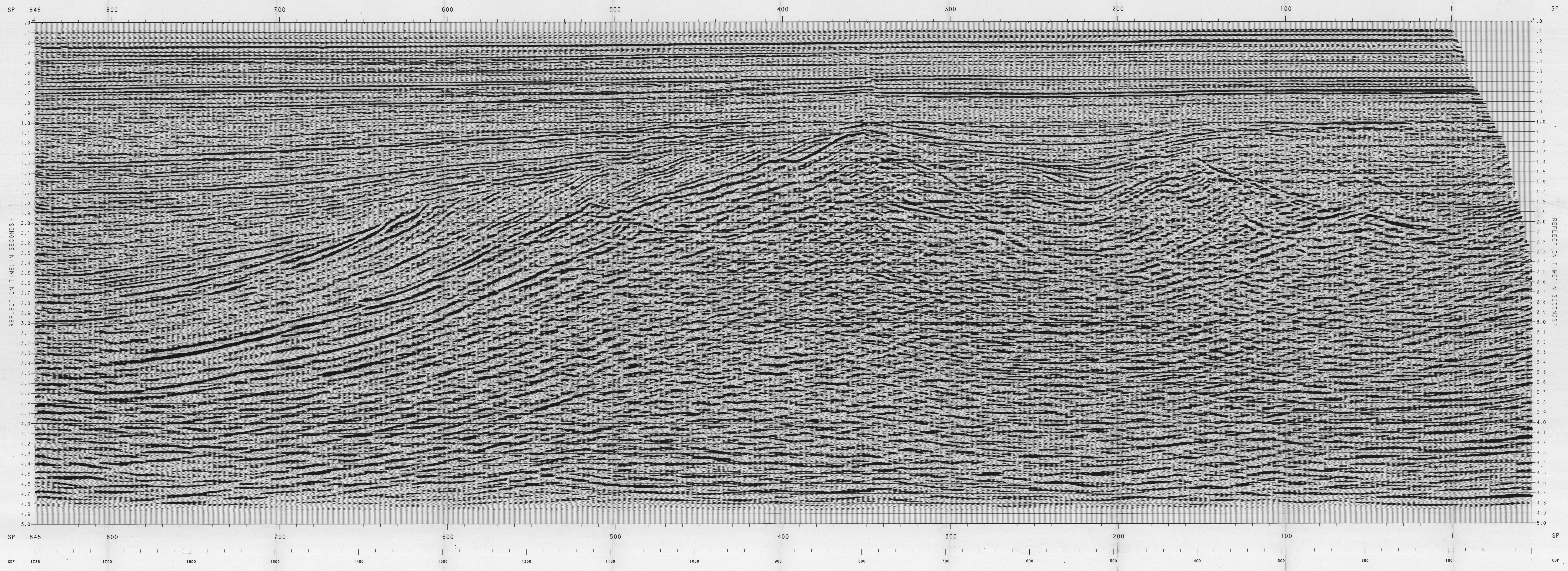
TIME (MS)	LOW CUT (HZ/SLOPE)	HIGH CUT
2	15 / 18	80 / 72
700	15 / 18	80 / 72
1200	10 / 18	70 / 72
1600	8 / 18	60 / 72
4000	8 / 18	50 / 72

SCALING
INSTANTANEOUS AGC GAIN USING A 500 MS GATE

LINE LOCATION MAP



LINE : WB82-31
SP 1 - 846
FILTERED MIGRATION



520021 OR-0421
ENCLOSURE 4.

LINE : WB82-31
SHOTPOINTS 1 - 846

SOUTHWEST
DIRECTION SHOT - 242

FINAL MIGRATION

Cue Energy Resources N.L.

BASS BASIN SURVEY
AREA : T-15-P

Western Atlas
Western Geophysical

RECORDED BY WGC, FEB 1982
PROCESSED BY WGC, MELBOURNE
PROCESSING DATE : DEC 1996

RECORDING DATA

BOAT

M/V WESTERN ODYSSEY — PARTY 86
NAVIGATION — WINS

SOURCE

AIRGUN VOLUME	760 CU IN
NUMBER OF GUNS	10
PRESSURE	4500 PSI
GUN DEPTH	6 METRES
POP INTERVAL	25 METRES
S.P. INTERVAL	25 METRES

INSTRUMENTS

RECORDING SYSTEM:	DFS V
FORMAT	1600 BPI; SEG B
FILTERS	LOW CUT OUT / 18 DB/OCT HIGH CUT 128 HZ / 70 DB/OCT
RECORD LENGTH	5000 MS
SAMPLE RATE	2 MS
POLARITY	COMPRESSION NEGATIVE

CABLE

STREAMER TYPE	STREAMER
STREAMER LENGTH	2400 METRES
NUMBER OF GROUPS	96
GROUP INTERVAL	25 METRES
LEAD IN	194 METRES
CABLE DEPTH	12 METRES

77 M 194 M 2400 M 96 1
ENERGY SOURCE: AIRGUN

SCALES
HORIZONTAL 32 TRACES/IN
VERTICAL 3.75 IN/SEC
0 1 KILOMETER

LEGEND
VELOCITY FUNCTION
INTERSECTIONS
WELL LOCATION

DATUM PLANE : SEA LEVEL

SP ANNOTATED AT SOURCE LOCATION

PLAYBACK

SCALE	1 : 15748
HORIZONTAL	32 TR/IN
VERTICAL	3.75 IN/SEC
SAMPLE RATE	4 MS

POLARITY

FIELD : COMPRESSION RECORDED AS A NEGATIVE NUMBER (SEG NORMAL)

PROCESSING: FIELD POLARITY MAINTAINED

DISPLAY : SEG NORMAL

DISPLAY GAIN - 11 DB

PROCESSING SEQUENCE

PROCESSING SAMPLE RATE 4 MS

PROCESSING DATA LENGTH 5000 MS

FORMAT CONVERSION
INPUT SEGD FORMAT, 2 MS SAMPLE RATE, OUTPUT 96 CHANNELS, OMEGA INTERNAL FORMAT

RESAMPLE
INPUT SAMPLE RATE : 2 MS
OUTPUT SAMPLE RATE : 4 MS
MINIMUM PHASE ANTI-ALIAS FILTER

AMPLITUDE RECOVERY
EXPONENTIAL GAIN 3DB/SEC FROM 0 TO 3 SEC
SPHERICAL DIVERGENCE CORRECTION
A = T*(V**2)
WHERE T = TWO WAY TIME,
V = REGIONAL VELOCITY FUNCTION

SHOT DOMAIN FK FILTER
PASS ZONE : +/- 6.0MS/TRC (50% AMPLITUDE)

DECONVOLUTION BEFORE STACK
LEAST SQUARES MINIMUM PHASE INVERSE FILTER
MINIMUM PREDICTION LAG : 25 MS
OPERATOR LENGTH : 1024 MS
WHITE NOISE : 0.1%

FIRST PASS VELOCITY ANALYSIS
FIRST PASS VELOCITY EVERY 2 KM
PICKED AND QC VIA IVP

MULTIPLE ATTENUATOR FILTER
MULTIPLES REJECTED IN THE FK DOMAIN PASSING ZERO AND POSITIVE WAVENUMBERS
VELOCITY USED:

TIME (MS)	% STACKING VELOCITY
0	92
2000	92
3000	90
4000	88
6000	85

RADON TRANSFORM FILTER
96 % PRIMARY VELOCITY USED
DELTA X = -20 MS, DELTA Y = 146 MS
REJECT IN TAU-P DOMAIN

DIP MOVEOUT CORRECTION (DMO)
HIFI OPTION USED

SECOND PASS VELOCITY ANALYSIS
SECOND PASS VELOCITY EVERY 1 KM
PICKED AND QC VIA IVP

TRACE EQUALIZATION
TRACE AMPLITUDE EQUALIZED TO 5 SEC

NMO / MUTE / STACK

OFFSET (M)	OUTER TRACE MUTE: STOP TIME (MS)
368	4
418	200
1010	700
1832	1250
2643	2500

ZERO PHASE BANDPASS FILTER

TRACE MIX
3 TRACE RUNNING MIX,
TRACE WEIGHTING (1,1,0.1)

MODIFIED RESIDUAL MIGRATION
1ST PASS : CASCADED STOLT MIGRATION
VELOCITY : MINIMUM VELOCITY FUNCTION
2ND PASS : FINITE DIFFERENCE MIGRATION
VELOCITY : RESIDUAL VELOCITY FUNCTION

RADIAL PREDICTIVE FILTER
MULTICHANNEL RANDOM NOISE FILTER
+/- 7MSEC/TRACE ACCEPTANCE FAN
65% FEEDBACK OF UNFILTERED TRACE

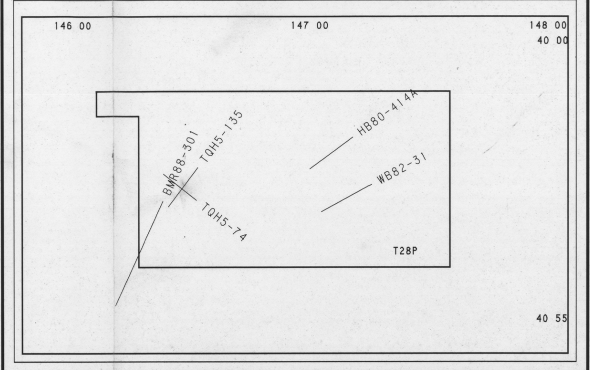
STATICS CORRECTION
+12 MS GUN AND CABLE DEPTH CORRECTION

TIME VARIANT FILTER

TIME (MS)	LOW CUT (HZ/SLOPE)	HIGH CUT
2	15 / 18	80 / 72
700	15 / 18	80 / 72
1200	10 / 18	70 / 72
1600	8 / 18	60 / 72
4000	8 / 18	50 / 72

SCALING
INSTANTANEOUS AGC GAIN USING A 500 MS GATE

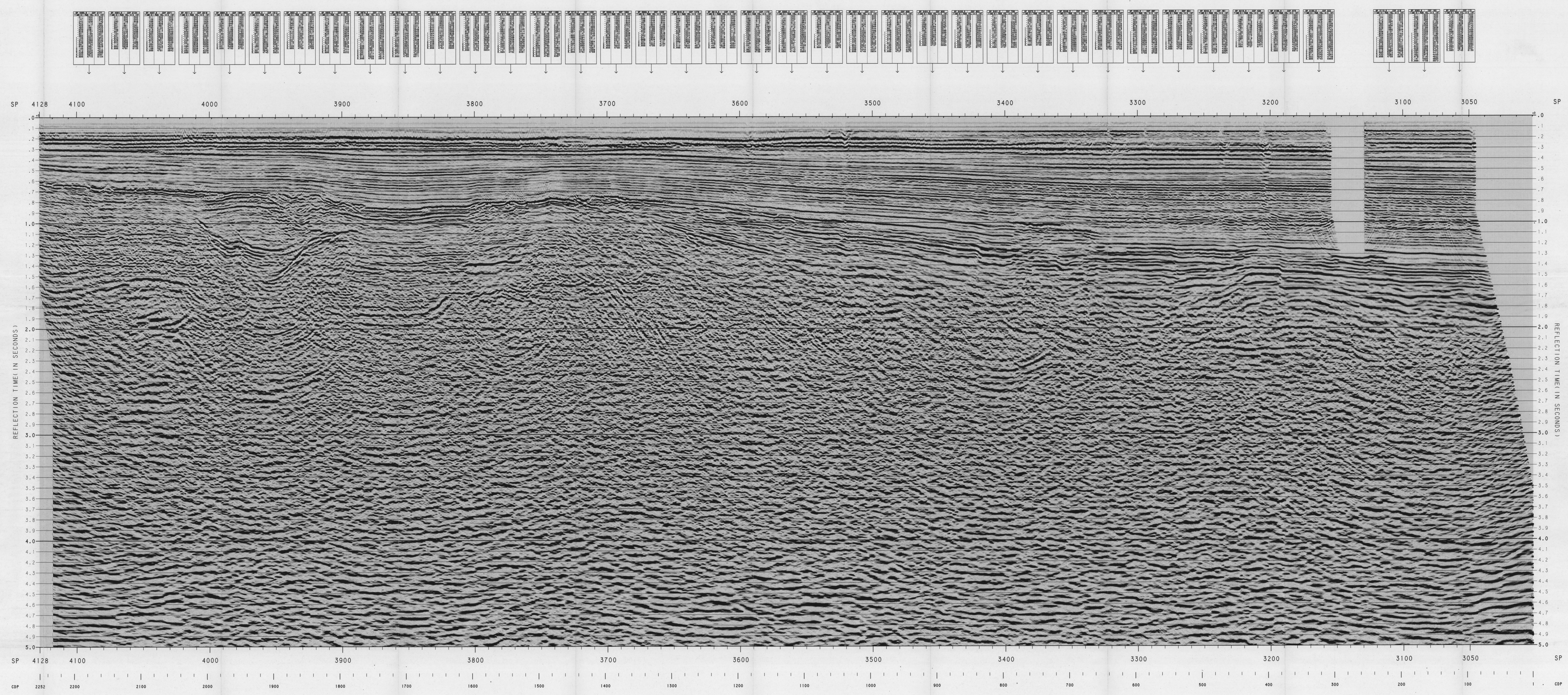
LINE LOCATION MAP



LINE : BMR88-301
SP : 3050 - 4128
FILTERED MIGRATION

520022

OR-0421.
ENCLOSURE 5.



LINE : BMR88-301
SHOTPOINTS 3050 - 4128

NORTH NORTHEAST
DIRECTION SHOT = 22.5

5 cm

FINAL MIGRATION

Cue Energy Resources N.L.

BASS BASIN SURVEY
AREA : T-15-P

WESTERN ATLAS
Western Geophysical

RECORDED BY BMR, DEC 1982
PROCESSED BY WGC, MELBOURNE
PROCESSING DATE : DEC 1996

RECORDING DATA

BOAT
RECORDED BY: BMR

SOURCE
AIRGUN VOLUME 1 × 1600 CU IN
GUN DEPTH 10 METRES
S.P. INTERVAL 37.5 METRES

INSTRUMENTS
FORMAT 6250 BPI; SEG Y
FILTERS LOW CUT 8 HZ, HIGH CUT 64 HZ
RECORD LENGTH 5000 MS
SAMPLE RATE 2 MS
POLARITY SEG NORMAL

CABLE
STREAMER LENGTH 3600 METRES
NUMBER OF GROUPS 96
GROUP INTERVAL 37.5 METRES
LEAD IN 206 METRES
CABLE DEPTH 10 METRES

206 M 3600 M 96 1
ENERGY SOURCE: AIRGUN

SCALES
HORIZONTAL 42.67 TRACES/IN
VERTICAL 3.75 IN/SEC
0 KILOMETER 1

LEGEND
VELOCITY FUNCTION
INTERSECTIONS
WELL LOCATION

DATUM PLANE : SEA LEVEL

SP ANNOTATED AT SOURCE LOCATION

PLAYBACK
SCALE 1 : 31496
HORIZONTAL 42.67 TR/IN
VERTICAL 3.75 IN/SEC
SAMPLE RATE 2 MS

POLARITY
FIELD : COMPRESSION RECORDED AS A NEGATIVE NUMBER (SEG NORMAL)
PROCESSING: FIELD POLARITY MAINTAINED
DISPLAY : SEG REVERSE

DISPLAY GAIN = 11 DB

PROCESSING SEQUENCE

PROCESSING SAMPLE RATE 4 MS

PROCESSING DATA LENGTH 5000 MS

FORMAT CONVERSION
INPUT SEGD FORMAT, 2 MS SAMPLE RATE, OUTPUT 96 CHANNELS, OMEGA INTERNAL FORMAT

RESAMPLE
INPUT SAMPLE RATE : 2 MS
OUTPUT SAMPLE RATE : 4 MS
MINIMUM PHASE ANTI-ALIAS FILTER

AMPLITUDE RECOVERY
EXPONENTIAL GAIN 3DB/SEC FROM 0 TO 3 SEC
SPHERICAL DIVERGENCE CORRECTION
A = T*(V**2)
WHERE T = TWO WAY TIME,
V = REGIONAL VELOCITY FUNCTION

SHOT DOMAIN FK FILTER
PASS ZONE : +/- 9.0MS/TRC (50% AMPLITUDE)

DECONVOLUTION BEFORE STACK
LEAST SQUARES MINIMUM PHASE INVERSE FILTER
MINIMUM PREDICTION LAG : 25 MS
OPERATOR LENGTH : 1024 MS
WHITE NOISE : 0.1%

FIRST PASS VELOCITY ANALYSIS
FIRST PASS VELOCITY EVERY 2 KM
PICKED AND QC VIA IVP

MULTIPLE ATTENUATOR FILTER
MULTIPLES REJECTED IN THE FK DOMAIN
PASSING ZERO AND POSITIVE WAVENUMBERS
VELOCITY USED:

TIME (MS)	% STACKING VELOCITY
0	92
2000	92
3000	90
4000	88
6000	85

RADON TRANSFORM FILTER
96 % PRIMARY VELOCITY USED
DELTA X = -43 MS, DELTA Y = 313 MS
REJECT IN TAU-P DOMAIN

DIP MOVEOUT CORRECTION (DMO)
HIFI OPTION USED

SECOND PASS VELOCITY ANALYSIS
SECOND PASS VELOCITY EVERY 1 KM
PICKED AND QC VIA IVP

TRACE EQUALIZATION
TRACE AMPLITUDE EQUALIZED TO 5 SEC

NMO / MUTE / STACK

OFFSET (M)	OUTER TRACE MUTE: STOP TIME (MS)
553	4
585	900
2570	2400
3770	3500

OFFSET (M)	INNER TRACE MUTE: STOP TIME (MS)
0	1400
943	2400
943	6000

ZERO PHASE BANDPASS FILTER

TRACE MIX
3 TRACE RUNNING MIX,
TRACE WEIGHTING (1,1,0.1)

MODIFIED RESIDUAL MIGRATION
1ST PASS : CASCADED STOLT MIGRATION
VELOCITY : MINIMUM VELOCITY FUNCTION
2ND PASS : FINITE DIFFERENCE MIGRATION
VELOCITY : RESIDUAL VELOCITY FUNCTION

RADIAL PREDICTIVE FILTER
MULTICHANNEL RANDOM NOISE FILTER
+/- 7MSEC/TRACE ACCEPTANCE FAN
65% FEEDBACK OF UNFILTERED TRACE

STATICS CORRECTION
+13.3 MS GUN AND CABLE DEPTH CORRECTION

TIME VARIANT FILTER

TIME (MS)	LOW CUT (HZ/SLOPE)	HIGH CUT
2	15 / 18	80 / 72
700	15 / 18	80 / 72
1200	10 / 18	70 / 72
1600	8 / 18	60 / 72
4000	8 / 18	50 / 72

SCALING
INSTANTANEOUS AGC GAIN USING A 500 MS GATE

LINE LOCATION MAP