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304453

DATA PROCESSING REPORT

1991 MCARTHUR SEISMIC SURVEY

MAY - NOVEMBER 1991

PERMITS: EP18, EP19, EP23, EP24 AND EP33

NORTHERN TERRITORY, AUSTRALIA

for

PACIFIC OIL AND GAS PTY LTD

826 WHITEHORSE ROAD

BOX HILL VIC 3128

by

DIGITAL EXPLORATION LIMITED

(A DIGICON COMPANY)

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Descriptor: This report presents an account of the processing sequence and techniques used for processing seismic data acquired in the McArthur Basin, permits EP 18 EP 19 EP 23 EP 24 & EP 33 in the Northern Territory for Pacific Oil & Gas Pty Ltd. (31 pages, 4 appendices, 3 figures)

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FIGURE

1.0 INTRODUCTION

This report presents an account of the processing sequence and techniques used for processing seismic data acquired in the McArthur Basin, permits EP18, EP19, EP23, EP24 and EP33 in the Northern Territory for Pacific Oil and Gas Pty Ltd.

Approximately 895 kms of vibroseis data were recorded by Western Geophysical, Party 785 during the period May - August, 1991. The acquisition parameters used for the survey are described in section 2.

A list of line numbers, VP ranges and kilometre index is given in Appendix 2.

Processing of the data by Digital Exploration Limited took place between May to November, 1991 at our Brisbane processing centre. The processing parameters such as choice of optimum filters (deconvolution and bandpass), mutes and velocity analyses were established by Digital Exploration Limited in close consultation with Pacific Oil and Gas Pty Limited representatives, Bob Castleden and Koya Suto. Details of the processing sequence and parameters used are given in section 3.

2.0 ACQUISITION PARAMETERS

The data were recorded by Western Geophysical, Party 785. A brief summary of the acquisition parameters is as follows:

Recording

Date	:	May - August, 1991
Instruments	:	Sercel SN-368 & I/O Correlator
Tape Format	:	SEG D, Code 15
Tape Density	:	6250 BPI
Sample Rate	:	4 msecs.
Record Length	:	10 secs. (uncorrelated)
	:	4 secs. (correlated)
Lo-cut filter & slope	:	8 Hz @ 18 dB/octave
Hi-cut filter & slope	:	88.8 Hz @ 63 dB/octave

Source

Energy Source	:	Vibroseis X 4
Vibrator Type	:	Litton LRS-311, Buggy Mounted
Sweep/VP	:	2 (4 for line MA91-99)
Sweep Length	:	6 secs.
Sweep Taper	:	0.25 secs
Sweep Frequency	:	8-80 Hz.
Sweep Type	:	Linear upsweep
Vibrator Spacing/Moveup	:	16m/8m (12.5 m/6.25 m for line MA91-99)
Source Interval	:	25 m. centred between pegs

Spread

Number Of Groups	:	300
Geophone Type	:	GSC 20D, 10 Hz
Number of Geophone/GRP	:	12
Geophone Array	:	Linear Over 50 m
Station Interval	:	25 m centred on survey peg
Spread Pattern	:	3787.5 - 62.5 - * - 62.5 - 3787.5 m
Coverage	:	15000%

3.0 THE DATA PROCESSING SYSTEM

Digicon's installation in Brisbane is based on two Digital Equipment Corporation VAX 8650 computers, coupled with Digicon's Disco Seismic data Processing System.

The hardware configuration is flexible, with the Brisbane installation being one of many possible alternatives. Included in this establishment are twenty-five tri-density tape drives, disk storage of 6 gigabytes, five FPS array processors, two Numerix Vector processors, three Benson and one Versatec Electrostatic Plotters and twenty-six remote input/output terminals allowing multi-user, multi-functional interactive capability.

The 32-bit central processing unit and a 16 mega-byte capacity main memory enhances the scientific application of the VAX computers.

Plotting in a variety of modes is available through the on-line Benson plotters and a Geospace film plotter.

The Disco System (Digicon's Interactive Seismic Computer) is an extension of the Digicon Modular Seismic Data Processing System developed over many years. Being modular, the system is completely flexible allowing complete user control of the number and sequence of operations performed in any job. The Disco seismic monitor assembles the selected modules in the specified order and controls the processing run.

4.0 PRODUCTION PROCESSING SEQUENCE

1. Demultiplex
2. Zero To Minimum Phase Conversion
3. Trace Equalisation
4. Trace Editing
5. F-K Filter
6. Deconvolution
7. Common Mid Point Gather
8. Merge of overlapping lines
9. Datum Static Computation and Application
10. Velocity Analysis
11. Automatic Residual Static Computation and Application
12. Dip Moveout Correction
13. Velocity Analysis
14. Normal Moveout Correction
15. Pre-stack Muting
16. Time Variant Scaling
17. Non-Surface Consistent Residual Static Computation And Application
18. Common Mid Point Stack
19. Time Variant Filtering
20. Datum Correction
21. Finite Difference Wave Equation Migration
22. Tau-P Filtering
23. Time Variant Scaling
24. Display
25. Final out-out stack and final migrated data in SEGY format

PROCESSING

4.1 DEMULTIPLEX

The data from the field tapes were decoded and converted to Digicon's internal 9 track, trace sequential format for subsequent processing. The output was to 3.0 secs, 4 msecs for all the lines except lines MA91-90, MA91-103 and MA91-600 for which the output was to 4.0 secs.

4.2 ZERO TO MINIMUM PHASE CONVERSION

A minimum phase correction filter was applied to each shot record prior to deconvolution. This phase correction filter was designed to match the bandwidth of the recording instrument filter.

4.3 TRACE EQUALISATION

Correction for amplitude decay was adequately compensated for by a whole trace equalisation scaling algorithm.

4.4 TRACE EDIT

This option was used on some records to zero noisy traces which would not make a useful contribution to the stack. Information from the displayed reformatted field records and observer's logs were combined to determine the editing table.

4.5 F-K FILTER

This process applies to shot data a zero phase F-K filter in the X-T domain. Reflections are separated from interfering noise on the basis of differences in apparent horizontal velocity. Events which are slower than the specified cut velocity are rejected. Amplitude and phase of the signal in the accept zone are preserved. The cut velocity used was +/- 2976 m/sec (8.4 msec per trace). A 100% cosine taper was used.

4.6 DECONVOLUTION

Deconvolution is the process of designing and applying an inverse filter to remove from the recorded data the effects of the earth's filtering of the source wavelet. The deconvolution is accomplished by the application of one or more whitening filters designed from the auto-correlation of each data trace of the input records.

The filter is designed to whiten or broaden the frequency spectrum within a band pass having an allowable signal-to-noise ratio. By whitening the pass-band, the time transient (i.e. residual shot wavelet) is collapsed into a shorter interval thus providing more precise delineation of the seismic reflection events.

On the subject data a 160 msec spiking deconvolution filter (white nosie = 1%) was designed on data within the window defined by the following offset-time pairs:

NEAR OFFSET (62.5m)	:	200 - 2000 msec
FAR OFFSET (3787.5m)	:	1400 - 2400 msec

4.7 COMMON MID POINT GATHER

The seismic traces along a line are gathered into data sets on the basis of common mid point (CMP). Information such as offsets, surface and sub-surface co-ordinates and shot sequence numbers are stored in the trace headers for use in subsequent processing. CMP's are also referred to as common depth points (CDP's).

4.8 MERGE

Lines	MA91-221,	VP 200.5 - 480.5
	MA91-221B,	VP 330.5 - 1109.5
and	MA91-223,	VP 200.5 - 480.5
	MA91-223B,	VP 330.5 - 1108.5

were merged at this juncture in the processing sequence.

4.9 DATUM STATICS COMPUTATION

Datum static corrections were applied to correct for near surface irregularities such as changes in elevation, weathering velocity, weathering layer thickness and subweathering velocity.

For this project datum statics were computed using Digicon's STATICM routine. The input is digitised first breaks from the production records. Geometry information is drawn from the database and used with the input elevation listings to fully define the profile. Details of shot and receiver offsets, weathering velocity (Vo) and selected datum elevation are also provided. Weathering velocities were obtained from the uphole survey. Velocities ranged between 1000 m/sec to 1700 m/sec.

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 variation.

After the final iteration, usually 3, the geophone statics (Tg) are computed as an elevation correction plus a weather correction as follows:-

$$Tg = -\left(\frac{E}{Vr} + K.Td\right)$$

Where $K = \sqrt{\frac{Vr - Vo}{Vr + Vo}}$

and E = elevation above datum

The shot correction (Ts) is obtained from:-

$$Ts = Tg - Tuh$$

For a surface source Tuh = 0

The weathering thickness (Wx) is computed as:-

$$Wx = \frac{Td \times Vo}{\mathrm{Cos}\left(\mathrm{arc\ Sin}\ \frac{Vo}{Vr}\right)}$$

After calculation, the shot and receiver statics are averaged to produce a mean static and a residual shot and receiver static, which is usually quite small. Subsequent processing is performed on data with only the residual components applied. Effectively the data is referenced to surface.

The mean static is applied to the data after the final filtering process to correct the data to the selected seismic datum of 200 metres above mean sea level.

4.10 VELOCITY ANALYSIS

First pass velocity analyses were performed using the constant velocity stack (CVS) technique. The analyses were located at approximately 2 km intervals. 31 alternate CMP gathers were stacked with constant velocities such as:-

2000 m/sec incrementing by 100m/sec to
2400 m/sec incrementing by 200m/sec to
5200 m/sec incrementing by 400m/sec to
5600 m/sec incrementing by 600m/sec to
6800 m/sec

4.11 RESIDUAL STATICS

The routine assumes that the static variation from trace to trace is caused by velocity and thickness variations in the low-velocity weathering layer. It further assumes that the initial datum statics applied to the data are not precise and that the refined static corrections, based on statics computed from the reflection data itself, are desirable.

The automated statics analysis routine is conducted on NMO corrected gather records by utilizing all possible cross correlations between traces within and from adjacent mid 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 CMP gathers being operated on. The model is interpreted from the previous stacked section in the processing sequence. For these data a design gate was employed which started at 200 msec and finished at 1100 msec, approximately.

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 (+/- 12 msec. 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 cross correlations. This was constant at 11, 9 and 7 through iterations 1, 2 and 3.

Residual geophone statics are applied in accordance with receiver surface location and residual shot statics with record or shot input sequence. Both are stored in the appropriate trace headers for application prior to DMO.

4.12 DIP MOVEOUT CORRECTION (DMO)

The data was processed through Digicon's Kirchhoff dip moveout routine.

The main benefits of including DMO in the processing sequence are:-

1. DIP-INDEPENDENT STACKING VELOCITIES

   Stacking velocities after DMO are dip-independent, allowing both horizontal and dipping reflectors to be stacked with the same RMS velocity, i.e. the RMS velocity associated with the horizontal event. Thus flat-dip primary reflectors and steep-dip events (such as fault plane reflectors and diffraction limbs) may be optimumly stacked at the same time.

2. REMOVAL OF REFLECTION POINT SMEAR

   Data recorded at a finite offset is transformed to zero offset thus eliminating reflection point smear. Time varying multi-channel filters applied in the common-offset domain laterally shift the reflection points to their zero-offset position.

4.13 VELOCITY ANALYSIS (VELFAN)

VELFAN Velocity Analysis is an automatic production orientated technique designed to obtain stacking velocity information from seismic data input to the programme in CMP-gather form. Stacking velocity approximates RMS velocity.

Based on pre-determined knowledge of the stacking velocities which might be expected in an area, a set of velocity ranges versus two-way reflection time is input to the program together with a number of consecutive CMP gathers, for each location at which a velocity study is required. Also input is a number, N, (usually 9 - 11, in this case 13), of velocity functions to be applied to the gathers.

The program takes the maximum and minimum functions as specified by the velocity ranges and times above, and evenly intersperses N-2 other functions between them. It applies these functions to the CMP-gathers which are subsequently stacked, filtered and displayed.

The VELFAN display consists of six parts:

a. The uncorrected central gather of the input group.
b. The central gather NMO corrected by the central velocity function.
c. The stacks formed by NMO-correcting, stacking and filtering the set of CMP gathers using the N functions.
d. A display of velocity versus reflection time showing the fan of N functions, and points of high coherence at preselected intervals, e.g. 50 milliseconds in this case.
e. A plot of relative coherence amplitude versus time.
f. A listing of velocities versus time of up to three velocities at any time level, based on coherence measurements.

For this survey the analyses were performed over 31 alternate common mid points with 13 velocity functions forming the fan. The velocities were run at 1 km. intervals with automatic residual statics applied to the input data. Velocities picked by Digital Exploration Limited were checked and approved by Pacific Oil and Gas Pty Limited.

4.14 NORMAL MOVEOUT (NMO) CORRECTION

This operation is performed assuming that the energy travels in a straight ray path and utilizes the following equation:

$$T^2 \text{ (recorded)} = T^2 \text{ (corrected to zero offset)} + \frac{X \times 1000^{2}}{VRMS}$$

Where T = time in milliseconds
X = offset in metres
VRMS = stacking velocity in metres/second

A space varying velocity function is utilized and the program computes a new space-varying function for each trace. By making floating point cubic interpolations between input control points, a high-fidelity NMO-corrected gather is output.

Velocities, referenced to surface, are annotated on the final stack sections. Datum-corrected velocities used for migration are annotated on the migrated stack sections.

4.15 PRESTACK MUTING

The function of this process is to mute the very 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, following NMO correction, contributes significantly to the poor S/N ratio.

Final mute values were:

TIME (MSEC)	OFFSET (M)
0	175
125	180
250	800
350	1175
500	1550
850	2850
1000	3800

4.16 TIME VARIANT SCALING

At this final stage of preparation of the trace it is assumed that each has been statics and NMO corrected to a simulated zero offset condition, for the particular CMP. So that each may contribute equally over its full length, to the summed trace, a short gate (500 milliseconds) Automatic Gain Control scaling function was applied before stacking, to ensure that all traces were at optimum level.

4.17 NON SURFACE CONSISTENT RESIDUAL STATIC COMPUTATION AND APPLICATION

The following correlation processing controls were used in this second pass of automatic residual statics. In this pass, the residual statics were calculated in a non-surface consistent, i.e. CMP-consistent, manner.

a) static limits ($\pm$ 8 msec)
b) number of mid-points used in the cross correlations (5 CMP's)

4.18 COMMON MID POINT STACK

After the completion of NMO-correction, prestack muting, balancing and CMP-consistent residual statics, the CMP data sets are summed algebraically. The resultant amplitude is divided by the number of normalised live samples contributing to the summation to produce the final unfiltered stacked sample. The nominal fold of the data is 150 fold.

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4.19 TIME VARIANT BANDPASS FILTERING

The stacked data were filtered using time variant digital filters with passbands of:-

TIME (MS)	BANDPASS (Hz) (6 dB down points)
0	13.5 - 65
300	10 - 60
700	10 - 55
1200	8 - 50
2000	8 - 45
3000	8 - 40
4000	8 - 40 (Lines MA91-90, -103, -600)

4.20 DATUM CORRECTION

Prior to the datum correction from the floating surface datum to the processing datum, i.e. 200m AMSL, a positive bulk shift of 200 msec was applied. Subsequently the timing lines were adjusted by -200 msec to correctly denote the event times.

4.21 MIGRATION (FINITE DIFFERENCE METHOD)

The lines were migrated using the finite difference wave equation technique with a layer thickness of 20 msec and migration velocity of 95% of the smoothed stacking velocities. Datum-corrected migration velocities are annotated on the migrated stack sections.

4.22 TAU-P FILTER

The migrated stacked data was input to the Tau-P filter program which is a 2-D time and space dip filter that has two non-linear signal estimation options available: coherence masking and dip balancing. The dip pass region given was $\pm$1.5 msec per trace. A time variant percent of the input was added to the reconstructed signal trace to form the output trace.

For this project, the addbacks were:-

TIME (msec)	%ADDBACK
0 - 700	50
700 - 1200	60
1200 - 3000	70

4.23 TIME VARIANT SCALING

A multi-gated balance was applied to the data after final filtering to bring the data to the desired amplitude level. The average absolute value (AABS) of the gate is computed and a scalar is applied to the centre point of the gate. This is repeated for each gate with the scalar interpolated between the gate centres. The following gates were used for these data:

GATE	TIME (msec)
1	0 - 500
2	500 - 1000
3	1000 - 2000
4	2000 - 3000
5	3000 - 4000 (Lines MA91-90, -103, -600)

4.24 DISPLAY

The final sections were displayed on film with the following plotting parameters:-

a) Final stacks were displayed with:

Horizontal scales of 1:12,500 (25.4 TPI or 10 TPCM) and
1:25,000 (50.8 TPI or 20 TPCM);

Vertical scale of 5 IPS or 12.7 cm per second.

b) Migrated stacks were displayed with:

Horizontal scales of 1:12,500 (25.4 TPI or 10 TPCM) and
1:25,000 (50.8 TPI or 20 TPCM);

Vertical scale of 5 IPS or 12.7 cm per second.

c) Migrated stacks after 2:1 trace sum were displayed with:

Horizontal scale of 1:50,000 (50.8 TPI or 20 TPCM);

Vertical scale of 5 IPS or 12.7 cm per second.

d) Migrated stacks after 8-30 Hz filter and 2:1 trace sum were displayed with:

Horizontal scale of 1:50,000 (50.8 TPI or 20 TPCM);

Vertical scale of 1.9685 IPS or 5 cm per second.

e) Iso-velocity plots on paper, to be used as a velocity quality control (QC) measure, were also produced at 1:50,000 horizontal scale and 5 cm/sec vertical scale.

Migration velocites were output to floppy disc to accompany the iso-velocity plots.

The films were fitted with a side panel on the left hand side with a comprehensive tabulation of line, field and processing information. Along the top of the films data relating to actual location along the line are displayed. This includes datum statics and residual statics, line intersection details, uphole and well locations, surface elevation and RMS velocity tables at their points of application. All films were in the wiggle trace-variable area mode, with timing lines every 100 milliseconds. Station annotation was at the beginning and end of each line, as well as at 500 m (20 station) intervals for the 1:12,500-scale sections, 1 km (40 station) intervals for the 1:25,000-scale sections, and 2 km (80 station) intervals for the 1:50,000-scale sections.

4.25 FINAL OUT-OUT STACK AND FINAL MIGRATED STACK TAPES

Final out-out stack and final migrated data were concatenated and output in SEGY format, 6250 bpi. A list of tape numbers and line numbers is given in Appendix 3.

Respectfully submitted,

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APPENDIX 1

PROCESSING PARAMETER TESTS

A. PRE-STACK TESTING: LINE MA91-99

Pre-stack tests were performed at VP 360.5

(1) GAIN

The shot record was measured for db level over 100 msec. time gates from 0.10 sec. to 4.00 sec. From the resultant display an exponential gain of 0 to + 10db from 0.3 sec. to 2.3 sec. was chosen and applied to the data. The db level was again measured and displayed.

(2) F-K

The shot record was tested using velocity cuts of ± 595 m/s, 694 m/s, 833 m/s, 1562.5 m/s, 2976 m/s and 6410 m/s after the application of the trace equalisation. The 2976 m/s velocity cut was chosen as this effectively removed the majority of the coherent noise without interfering with the reflection signal.

(3) DECONVOLUTION BEFORE STACK

The following combination of parameters were tested.

(a) wavelet deconvolution using Digicon's "DEFLAT" program, with an output wavelet of 8-60 Hz, 1 operator per shot.
(b) Wavelet deconvolution using Digicon's "DEFLAT" program, with an output wavelet of 8-60 Hz, using 3 offset-dependant operators per shot.
(c) Spike; 0.5 white noise, single gate:
    near trace: 200 msec - 2000 msec
    far trace: 1400 msec - 2400 msec
    operator length: 160 msec
(d) Gap; 0.5% white noise, single gate, operator length 160 msec, gap 12 msec.

(e) Gap; 0.5% white noise, single gate, operator length 160 msec, gap 24 msec.
(f) Gap; 0.5% white noise, single gate, operator length 160 msec, gap 48 msec.

Filtered displays, with autocorrelations appended, were produced.

B. STACK PANEL TESTS

Stack panel test were performed on line MA91-99, VP280.5-360.5 using parameters chosen from the shot record tests.

Each test panel had a whole trace equalisation applied before FK filtering, refraction statics and a single velocity function applied before stack. A pre-stack 500 msec AGC was followed by a 1000 msec AGC post stack.

1) FK filter tests in shot domain, using 160 ms spiking deconvolution, 1% white noise and refraction static application.

   a) velocity cut of ±6410 m/s (±3.9 ms/trace)
   b) velocity cut of ±2976 m/s (±8.4 ms/trace)
   c) velocity cut of ±1563 m/s (±16.0 ms/trace)
   d) velocity cut of ± 833 m/s (±30.0 ms/trace)

2) FK filter tests in shot and receiver domains using 160 ms spiking deconvolution, 1% white noise and refraction static application

   a) velocity cut of ±6410 m/s (±3.9 ms/trace)
   b) velocity cut of ±2976 m/s (±8.4 ms/trace)
   c) velocity cut of ±1563 m/s (±16.0 ms/trace)
   d) velocity cut of ± 833 m/s (±30.0 ms/trace)

3) Elevation static comparison (with 1d) using FK velocity cut of ±833 m/s.

4) Deconvolution before stack tests using gathers with FK velocity cuts of ±2976 m/s in both shot and receiver domains.

   a) (12 ms gap + 160 ms) operator, 1% white noise
   b) (24 ms gap + 160 ms) operator, 1% white noise
   c) (48 ms gap + 160 ms) operator, 1% white noise
   d) wavelet deconvolution, 1 operator/shot
   e) wavelet deconvolution, 5 operators/shot
   f) surface consistent 12 ms gap deconvolution performed after shot FK and before receiver FK application
   g) surface consistent spiking deconvolution performed after shot FK and before receiver FK application
   h) surface consistent spiking deconvolution performed after shot and receiver FK application

5) DMO stack on shot FK (±2976 m/sec), 160 ms spiking deconvolution

6) Outer trace mute test on VP 300 - 340 only

FOLD	OFFSET (M)
5	0 - 175
10	0 - 300
15	0 - 425
20	0 - 550
30	0 - 800
45	0 - 1175
60	0 - 1550
75	0 - 1925
90	0 - 2300
105	0 - 2675
120	0 - 3050
135	0 - 3425
150	0 - 3800

7) Inner trace mute test on VP 300 - 340 only

FOLD	OFFSET (M)
100	1300 - 3800
110	1050 - 3800
120	800 - 3800
130	550 - 3800
135	425 - 3800
138	350 - 3800
141	275 - 3800
144	200 - 3800
147	125 - 3800
150	0 - 3800

8) This suite of outer trace mute tests was performed based on results from tests (6) and (7)

a)

TIME (MSEC)	OFFSET (M)
0	175
125	180
250	800
350	1175
500	1750
850	2850
1000	3800

b)

TIME (MSEC)	OFFSET (M)
0	175
125	180
250	800
350	1175
500	1750
650	1925
850	2850
1000	3800

The final mute chosen from these tests was:

TIME (MSEC)	OFFSET (M)
0	175
125	180
250	800
350	1175
500	1550
850	2850
1000	3800

C) POST-STACK TESTING

Post-stack tests were performed on Line MA91-99, VP280.5 - 360.5

1) Deconvolution after stack test

The following deconvolutions were tested:

a) no DAS
b) (16 ms gap + 160 ms) operator
c) (24 ms gap + 160 ms) operator
d) (32 ms gap + 160 ms) operator
e) Spectral Whitening, o/p 8-80 Hz

2) TAU-P Filter Test

This suite of tests consisted of using a dip scan of ±1.5 ms/trace and varying percent addback of the unfiltered input to the reconstructed signal trace.

Addbacks were:- a) 90%
b) 80%
c) 70%
d) 60%
e) 50%

3) F-X Deconvolution

F-X deconvolution test was performed using 31 traces with 11 trace overlap to estimate the noise.

4) <u>KLS Filter Test</u>

This technique utilizes the K-L transformation to accentuate flat energy at the expense of dipping data. Covariance matrices are computed within a series of overlapping time windows down a group of traces within user defined panels of traces. Each panel is then constructed using a user specified number of prinicipal components. In this way the flat energy is enhanced. The algorithm then advances half a panel and performs the same operation once again.

The reconstructed traces which overlap within adjacent panels are tapered together using smooth tapers. In these tests, panels of 51 traces were used to compute the covariance matrix and then reconstructed using several different principal components. These were 20, 15, 10 and 5.

5) <u>FK Filter Test</u>

F-K filter tests rejecting dips of 0.5 ms/trace, 1.0 ms/trace and 1.5 ms/trace were tried.

6) <u>Filter Test</u>

The following bandpass filters were tried:-

8 - 70 Hz
12 - 70 Hz
16 - 70 Hz
8 - 80 Hz
8 - 70 Hz
8 - 60 Hz
8 - 50 Hz
8 - 40 Hz
5 - 10 Hz
10 - 15 Hz
15 - 20 Hz
20 - 30 Hz
30 - 40 Hz
40 - 50 Hz
50 - 60 Hz
60 - 70 Hz
70 - 80 Hz

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7) <u>Scaling Test</u>

Post stack scaling tests consisted of the following:

a) AGC 500 ms
b) AGC 1000 ms
c) Balance gates: 0 - 500
500 - 1000
1000 - 2000
2000 - 3000
d) AUTOBAL 300 ms with 15 traces spatial smoothing
e) AUTOBAL 300 ms with no spatial smoothing

8) <u>Migration</u>

Migration tests were run on line MA91-99, VP 600 - 1200 and comprised the following:

a) 100% smoothed stacking velocities, finite difference with 20 ms layer
b) 100% smoothed stacking velocities, finite difference with 40 ms layer
c) 90% smoothed stacking velocities, finite difference with 20 ms layer
d) 100% smoothed stacking velocities using FK algorithm

APPENDIX 2

LIST OF LINES

LINE NO.	V.P RANGE	TOTAL SHOTS PROCESSED	STATION	KM	F. TAPES
MA91 - 90	200.5 - 3456.5	3258	200 - 3456	81.400	W3226 - W3249
MA91 - 93	200.5 - 2816.5	2609	200 - 2817	65.425	W3121 - W3141
MA91 - 98	181.5 - 2700.5	2509	181 - 2700	62.975	W3142 - W3160
MA91 - 99	200.5 - 1403.5	1204	200 - 1403	30.075	W3113 - W3120
MA91 - 103	5057.5 - 200.5	4770	5057 - 200	121.425	W3169 - W3178
MA91 - 109	200.5 - 1399.5	1200	200 - 1399	29.975	W3190 - W3225
MA91 - 200	1080.5 - 200.5	881	1080 - 200	22.000	W3162 - W3168
MA91 - 210	1999.5 - 200.5	1800	2000 - 200	45.000	W3370 - W3383
MA91 - 211	200.5 - 599.5	400	200 - 600	10.000	W3340 - W3342
MA91 - 213	200.5 - 881.5	682	200 - 881	17.025	W3184 - W3189
MA91 - 215	600.5 - 200.5	401	600 - 200	10.000	W3289 - W3292
MA91 - 217	840.5 - 200.5	637	840 - 200	16.000	W3179 - W3183
MA91 - 220	1139.5 - 200.5	940	1140 - 200	23.500	W3395 - W3401
MA91 - 221	200.5 - 480.5	281	200 - 480	7.000	W3293 - W3295
MA91 - 221B	330.5 - 1109.5	776	330 - 1110	19.500	W3364 - W3369
MA91 - 223	480.5 - 200.5	281	480 - 200	7.000	W3296 - W3298
MA91 - 223B	1108.5 - 330.5	779	1110 - 330	19.500	W3358 - W3363
MA91 - 225	200.5 - 809.5	610	200 - 810	15.250	W3299 - W3303
MA91 - 227	200.5 - 1109.5	910	200 - 1110	22.750	W3343, W3351-W3357
MA91 - 230	540.5 - 1905.5	1337	540 - 1906	34.150	W3384 - W3394
MA91 - 241	200.5 - 999.5	800	200 - 1000	20.000	W3310 - W3316
MA91 - 250	200.5 - 2000.5	1801	200 - 2000	45.000	W3275 - W3288
MA91 - 251	999.5 - 204.5	795	1000 - 204	19.900	W3317 - W3323
MA91 - 261	200.5 - 872.5	671	200 - 874	16.850	W3324 - W3328
MA91 - 271	779.5 - 200.5	579	780 - 200	14.500	W3329 - W3333
MA91 - 294	1000.5 - 200.5	801	1000 - 200	20.000	W3304 - W3309
MA91 - 296	200.5 - 919.5	720	200 - 920	18.000	W3334 - W3339
MA91 - 600	3437.5 - 200.5	3215	3437 - 200	80.925	W3250 - W3274
		35,647		895.125	

APPENDIX 3

LINE INTERSECTION LIST

LINE MA91-90	VP 1024	LINE MA91 - 103	VP 2627 + 9	
LINE MA91-93	VP 485	LINE MA91 - 98	VP 2908 + 23	
	756 + 19	MA91 - 210	1908 + 23	
	857 + 2	MA91 - 220	1070 + 21	
	961	MA91 - 230	1807 + 12	
	1163 + 7	SH90 - 100	1693 + 12	
	2410 + 6	SH90 - 102	1835 + 4	(CARPENTARIA HWY)
LINE MA91-98	VP 590 + 4	LINE MA91 - 271	VP 480	
	730	MA91 - 261	478 + 8	
	870 + 1	MA91 - 251	480	
	1010	MA91 - 241	480	
	1279 + 14	MA91 - 109	468	
	1370 + 3	MA91 - 227	340	
	1429 + 22	MA91 - 225	340	
	1495 + 4	MA91 - 223	340	
	1549 + 21	MA91 - 221	340	
	1615 + 10	SH90 - 103	430 + 9	(JAMISON 1)
	1615 + 18	MA91 - 103	4817	(JAMISON 1)
	1678 + 4	MA91 - 217	600	
	1700 + 4	MA91 - 215	460	
	1741 + 3	MA91 - 213	640 + 3	
	1803 + 15	MA91 - 99	472	
	1880 + 3	MA91 - 211	458 + 8	
	2098 + 23	MA91 - 93	485	
LINE MA91-99	VP 472	LINE MA91 - 98	VP 1803 + 15	
	1152 + 19	SH90 - 100	1193 + 3	
	374 + 5	MA91 - 296	783 + 24	
	551 + 20	MA91 - 200	879 + 6	
	746 + 4	MA91 - 210	1612 + 20	
	845 + 8	MA91 - 220	773 + 10	
	948	MA91 - 230	1509 + 15	
LINE MA91-103	VP 4897	LINE MA91 - 200	VP 694 + 12	
	4817	MA91 - 98	1615 + 18	(JAMISON 1)
	4721 + 3	MA91 - 296	591 + 21	
	2627 + 9	MA91 - 90	1024	
	4619 + 2	SH90 - 103	100	
	4858 + 9	SH90 - 103	499	
	2728 + 22	BEETALOO STATION ROAD		

LINE MA91-109	VP 259 + 22	LINE MA91 - 294	VP 940
	378 + 3	MA91 - 296	258 + 23
	468	MA91 - 98	1279 + 14
	546 + 23	MA91 - 200	355
	748	MA91 - 210	1090
	845 + 2	MA91 - 220	250 + 19
	936 + 1	MA91 - 230	987 + 10
	1154 + 19	SH90 - 100	326 + 3
LINE MA91-200	VP 355	LINE MA91 - 109	VP 546 + 23
	445 + 15	MA91 - 227	419 + 8
	505 + 10	MA91 - 225	419 + 15
	570 + 15	MA91 - 223	420
	625 + 7	MA91 - 221	420 + 1
	694 + 12	SH90 - 103	564
	694 + 12	MA91 - 103	4897
	753 + 21	MA91 - 217	679 + 19
	775 + 23	MA91 - 215	539 + 24
	816 + 23	MA91 - 213	720
	879 + 6	MA91 - 99	551 + 20
	956 + 3	MA91 - 211	537 + 23
LINE MA91-210	VP 398 + 12	LINE MA91 - 271	VP 753 + 2
	540 + 3	MA91 - 261	755 + 8
	680 + 13	MA91 - 251	760 + 4
	819 + 11	MA91 - 241	762 + 18
	1090	MA91 - 109	748
	1177 + 22	MA91 - 227	618 + 18
	1240 + 7	MA91 - 225	617 + 18
	1304 + 13	MA91 - 223B	617 + 4
	1359 + 3	MA91 - 221B	616 + 20
	1435 + 22	SH90 - 103	890 + 10
	1612 + 20	MA91 - 99	746 + 4
	1908 + 23	MA91 - 93	756 + 19
LINE MA91-211	VP 360	LINE MA91 - 296	VP 860
	458 + 8	MA91 - 98	1880 + 3
	537 + 23	MA91 - 200	956 + 3
LINE MA91-213	VP 542 + 23	LINE MA91 - 296	VP 720 + 22
	640 + 3	MA91 - 98	1741 + 3
	720	MA91 - 200	816 + 23
LINE MA91-215	VP 363 + 12	LINE MA91 - 296	VP 680
	460	MA91 - 98	1700 + 4
	539 + 24	MA91 - 200	775 + 23
LINE MA91-217	VP 503 + 7	LINE MA91 - 296	VP 657 + 18
	600	MA91 - 98	1678 + 4
	679 + 19	MA91 - 200	753 + 21

LINE MA91-220	VP 250 + 19	LINE MA91 - 109	VP 845 + 2
	336 + 21	MA91 - 227	716 + 11
	401 + 2	MA91 - 225	715 + 18
	464 + 19	MA91 - 223B	715 + 12
	519 + 20	MA91 - 221B	715 + 10
	600	SH90 - 103	1058 (approx.)
	773 + 10	MA91 - 99	845 + 8
	1070 + 21	MA91 - 93	857 + 2
LINE MA91-221	VP 245 + 15	LINE MA91 - 296	VP 529 + 20
-221	340	MA91 - 98	1549 + 21
-221	420 + 1	MA91 - 200	625 + 7
-221B	616 + 20	MA91 - 210	1359 + 3
-221B	715 + 10	MA91 - 220	519 + 20
-221B	810 + 12	MA91 - 230	1256 + 4
-221B	1223 + 15	SH90 - 100	781 + 3
LINE MA91-223	VP 246 + 11	LINE MA91 - 296	VP 474 + 19
-223	340	MA91 - 98	1495 + 4
-223	420	MA91 - 200	570 + 15
-223B	617 + 4	MA91 - 210	1304 + 13
-223B	715 + 12	MA91 - 220	464 + 19
-223B	805 + 17	MA91 - 230	1201
-223B	1023 + 10	SH90 - 100	680
LINE MA91-225	VP 247 + 16	LINE MA91 - 296	VP 409 + 11
	340	MA91 - 98	1429 + 22
	419 + 15	MA91 - 200	505 + 10
	617 + 18	MA91 - 210	1240 + 7
	715 + 18	MA91 - 220	401 + 2
	800 + 18	MA91 - 230	1137 + 18
LINE MA91-227	VP 248 + 18	LINE MA91 - 296	VP 349 + 21
	340	MA91 - 98	1370 + 3
	419 + 8	MA91 - 200	445 + 15
	618 + 18	MA91 - 210	1177 + 22
	716 + 11	MA91 - 220	336 + 21
	804 + 2	MA91 - 230	1071 + 22
	1025 + 18	SH90 - 100	460 + 3
LINE MA91-230	VP 578 + 6	LINE MA91 - 251	VP 957 + 22
	716 + 14	MA91 - 241	960 + 1
	987 + 10	MA91 - 109	936 + 1
	1071 + 22	MA91 - 227	804 + 2
	1137 + 18	MA91 - 225	800 + 18
	1201	MA91 - 223B	805 + 17
	1256 + 4	MA91 - 221B	810 + 12
	1340	SH90 - 109	1225 + 6
	1509 + 15	MA91 - 99	948
	1807 + 12	MA91 - 93	961

LINE MA91-241	VP 276	LINE MA91 - 294	VP 670 + 11
	480	MA91 - 98	1010
	762 + 18	MA91 - 210	819 + 11
	960 + 1	MA91 - 230	716 + 14
LINE MA91-250	VP 360	LINE SH90 - 100	VP 2767
	1932 + 22	89 - 203	2027
LINE MA91-251	VP 276 + 8	LINE MA91 - 294	VP 530 + 6
	480	MA91 - 98	870 + 1
	760 + 4	MA91 - 210	680 + 13
	957 + 22	MA91 - 230	578 + 6
LINE MA91-261	VP 274	LINE MA91 - 294	VP 390
	478 + 8	MA91 - 98	730
	755 + 8	MA91 - 210	540 + 3
LINE MA91-271	VP 274 + 13	LINE MA91 - 294	VP 250 + 6
	480	MA91 - 98	590 + 4
	753 + 2	MA91 - 210	398 + 12
LINE MA91-294	VP 250 + 6	LINE MA91 - 271	VP 274 + 13
	390	MA91 - 261	274
	530 + 6	MA91 - 251	276 + 8
	670 + 11	MA91 - 241	276
	940	MA91 - 109	259 + 22
LINE MA91-296	VP 258 + 23	LINE MA91 - 109	VP 378 + 3
	349 + 21	MA91 - 227	248 + 18
	409 + 11	MA91 - 225	247 + 16
	474 + 19	MA91 - 223	246 + 11
	529 + 20	MA91 - 221	245 + 15
	591 + 21	SH90 - 103	270 + 12
	591 + 21	MA91 - 103	4721 + 3
	657 + 18	MA91 - 217	503 + 7
	680	MA91 - 215	363 + 12
	720 + 22	MA91 - 213	542 + 23
	783 + 24	MA91 - 99	374 + 5
	860	MA91 - 211	360
LINE MA91-600	VP 2690 + 11	Stuart Highway	
	3332	89 - 100	VP 270 + 2
	3437	89 - 113	724 + 6
JAMISON 1		LINE SH90 - 103	VP 430 + 9
		MA91 - 103	4817
		MA91 - 98	1615 + 18
STUART HIGHWAY		LINE MA91 - 600	VP 2690 + 11
CARPENTARIA HIGHWAY		LINE MA91 - 93	VP 2410 + 6

APPENDIX 4

SEG Y TAPE INVENTORY

OUT -OUT STACK (4.0 SEC)

CPT - 2672

LINE NO	CDP RANGE	SEQUENTIAL TRACE NO
MA91 - 90	402 - 6912	1 - 6511
MA91 - 103	402 - 10112	6512 - 16222
MA91 - 600	403 - 6872	16223 - 22692

OUT - OUT STACK (3.0 SEC)

CPT - 2694

LINE NO	CDP RANGE	SEQUENTIAL TRACE NO
MA91 - 93	402 - 5631	1 - 5230
MA91 - 98	364 - 5398	5231 - 10265
MA91 - 99	402 - 2804	10266 - 12668
MA91 - 109	402 - 2796	12669 - 15062
MA91 - 200	402 - 2158	15063 - 16819
MA91 - 210	402 - 3997	16820 - 20415
MA91 - 211	402 - 1196	20416 - 21210
MA91 - 213	402 - 1760	21211 - 22569
MA91 - 215	402 - 1198	22570 - 23366

OUT - OUT STACK (3.0 SEC)

CPT - 2722

LINE NO	CDP RANGE	SEQUENTIAL TRACE NO
MA91 - 217	402 - 1678	1 - 1277
MA91 - 220	402 - 2277	1278 - 3153
MA91 - 221	403 - 2217	3154 - 4968
MA91 - 223	402 - 2215	4969 - 6782
MA91 - 225	402 - 1616	6783 - 7997
MA91 - 227	402 - 2216	7998 - 9812
MA91 - 230	1082 - 3809	9813 - 12540
MA91 - 241	402 - 1996	12541 - 14135
MA91 - 250	402 - 3998	14136 - 17732
MA91 - 251	410 - 1996	17733 - 19319
MA91 - 261	402 - 1742	19320 - 20660
MA91 - 271	402 - 1556	20661 - 21815
MA91 - 294	402 - 1998	21816 - 23411
MA91 - 296	402 - 1837	23412 - 24847

APPENDIX 4 (Cont.)

SEG Y TAPE INVENTORY

FINAL MIGRATED STACK (4.0 SECS)

CPT - 2723

LINE NO	CDP RANGE	SEQUENTIAL TRACE NO
MA91 - 90	402 - 6912	1 - 6511
MA91 - 103	402 - 10112	6512 - 16222
MA91 - 600	403 - 6872	16223 - 22692

FINAL MIGRATED STACK (3.0 SEC)

CPT - 2309

LINE NO	CDP RANGE	SEQUENTIAL TRACE NO
MA91 - 93	402 - 5631	1 - 5230
MA91 - 98	364 - 5398	5231 - 10265
MA91 - 99	402 - 2804	10266 - 12668
MA91 - 109	402 - 2796	12669 - 15063
MA91 - 200	402 - 2158	15064 - 16820
MA91 - 210	402 - 3996	16821 - 20415
MA91 - 211	402 - 1196	20416 - 21210
MA91 - 213	402 - 1760	21211 - 22569
MA91 - 215	402 - 1198	22570 - 23366

FINAL MIGRATED STACK (3.0 SEC)

CPT - 2675

LINE NO	CDP RANGE	SEQUENTIAL TRACE NO
MA91 - 217	402 - 1678	1 - 1277
MA91 - 220	402 - 2277	1278 - 3153
MA91 - 221	403 - 2217	3154 - 4968
MA91 - 223	402 - 2215	4969 - 6782
MA91 - 225	402 - 1616	6783 - 7997
MA91 - 227	402 - 2216	7998 - 9812
MA91 - 230	1082 - 3809	9813 - 12540
MA91 - 241	402 - 1996	12541 - 14135
MA91 - 250	402 - 3998	14136 - 17732
MA91 - 251	410 - 1996	17733 - 19319
MA91 - 261	402 - 1742	19320 - 20660
MA91 - 271	402 - 1556	20661 - 21815
MA91 - 294	402 - 1998	21816 - 23411
MA91 - 296	402 - 1837	23412 - 24847

304453

FIGURE 1
LOCATION MAP OF LINES
MA91-90 AND MA91-103

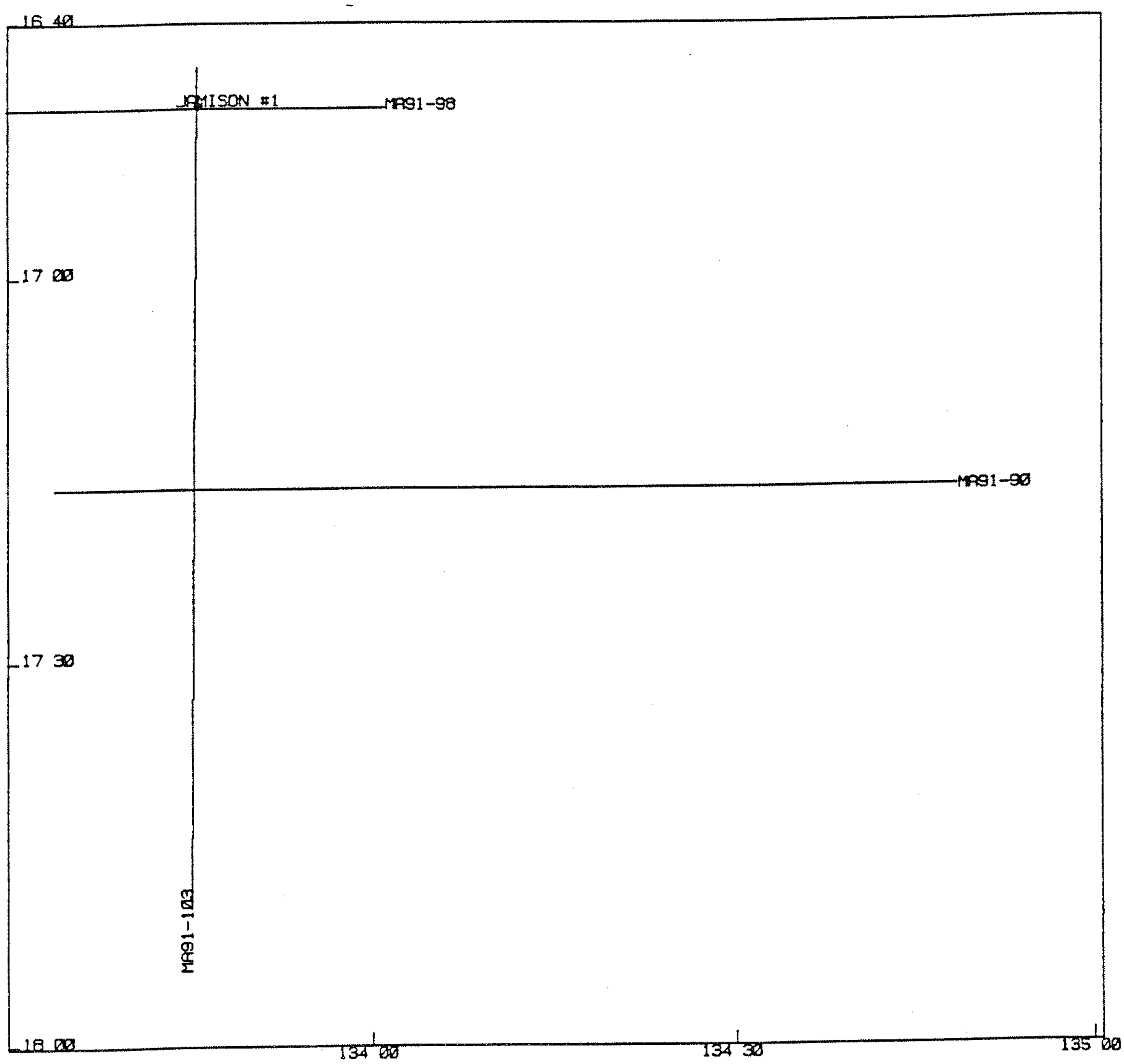

FIGURE 2
LOCATION MAP OF LINE MA91-600

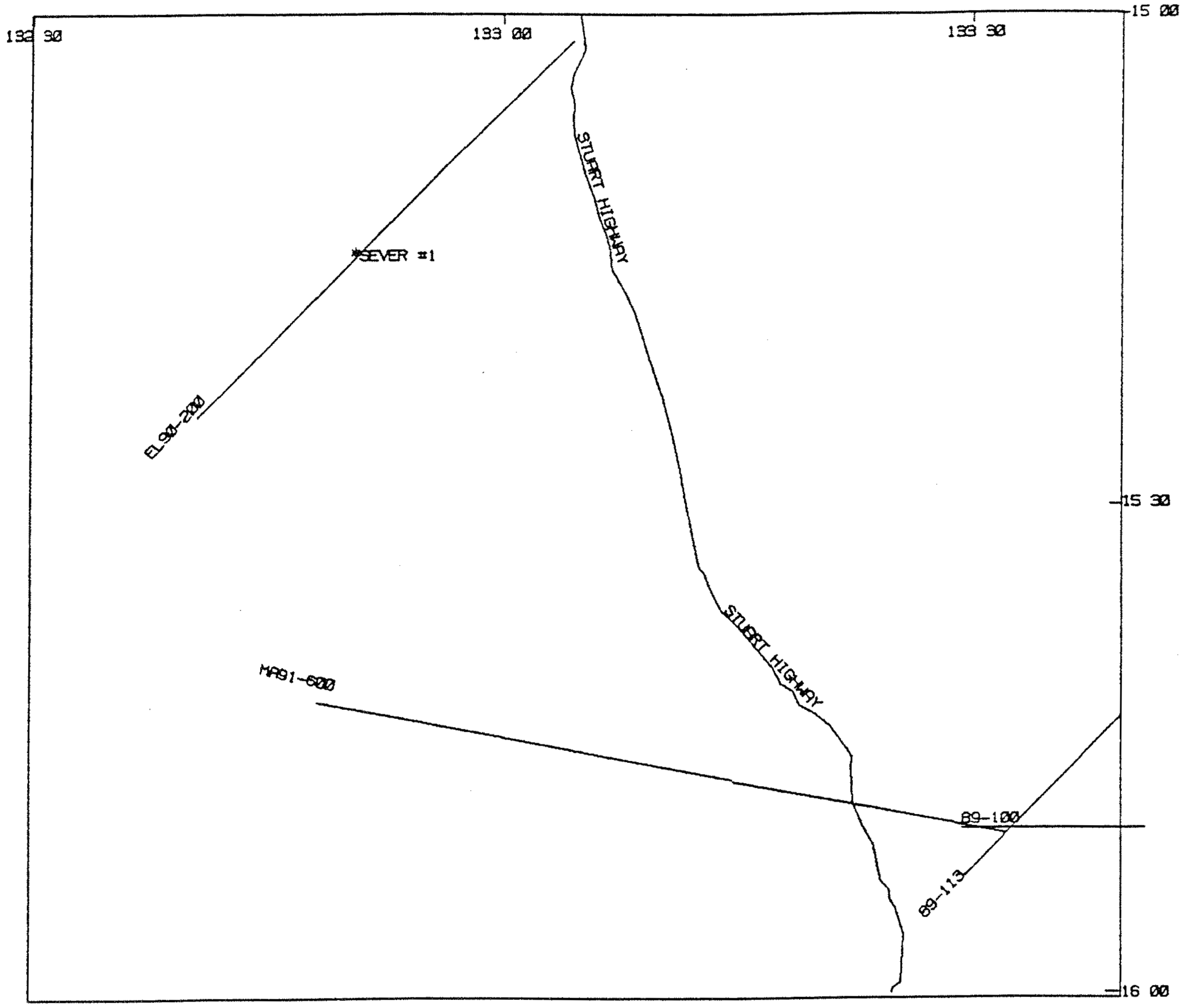

FIGURE 3
LOCATION MAP