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ATLANTIC GEOSCIENCE CENTRE

OPEN FILE REPORT

SEISMIC REPROCESSING RESULTS FOR SHELL CANADA LINE M-105 MONTAGNAIS STRUCTURE OFFSHORE NOVA SCOTIA

by

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INTRODUCTION

The Montagnais structure, located on the southwestern margin of the Lahave Bank, offshore Nova Scotia (figure 1), has become the focus of interest following the publication by Jansa and Pe-Piper(1987) of an article suggesting an extraterrestrial origin for the feature. A considerable amount of seismic data exists in the region of the Montagnais well site, much of which is of early 1970's vintage (figure 2).In order to assess the potential usefulness of these data in determining the origin of the feature, and to provide some input for planning a proposed cruise by the Atlantic Geoscience Centre in 1988 at the site, it was decided that some reprocessing of existing oil company exploration seismic data in the area may provide some answers. To this end Shell Canada was approached and they agreed to supply post-stack digital data for trial reprocessing; original field data could not be provided. Line M-105 (figure 3) was selected for reprocessing. The reasons for selecting this line are that it runs through the Montagnais well site and that its northwest to southeast orientation provides a line of section orthogonal to that displayed by Jansa and Pe-Piper(1987). This report will only describe the acquisition parameters and the testing and processing sequences as originally performed by Shell Canada in 1973, and the testing and processing sequence performed by Western Geophysical on behalf of the Atlantic Geoscience Centre. The interpretation of this line will be performed in conjunction with additional data planned to be acquired in the summer of 1988 and will be reported elsewhere.

RECORDING PARAMETERS

The data was acquired by Geophysical Services Incorporated on behalf of Shell Canada limited during August, 1973. The basic acquisition parameters are outlined below.

SOURCE

Type	Airgun array
Gun Depth	30 feet (9.14 meters)
Array Volume	1200 Cubic Inches
Antenna to Source	70 meters
Pop Interval	50 meters

VESSEL

Boat	M/V Hans Egede
Shot By	Geophysical Services Incorporated
Recording Date	August 1973

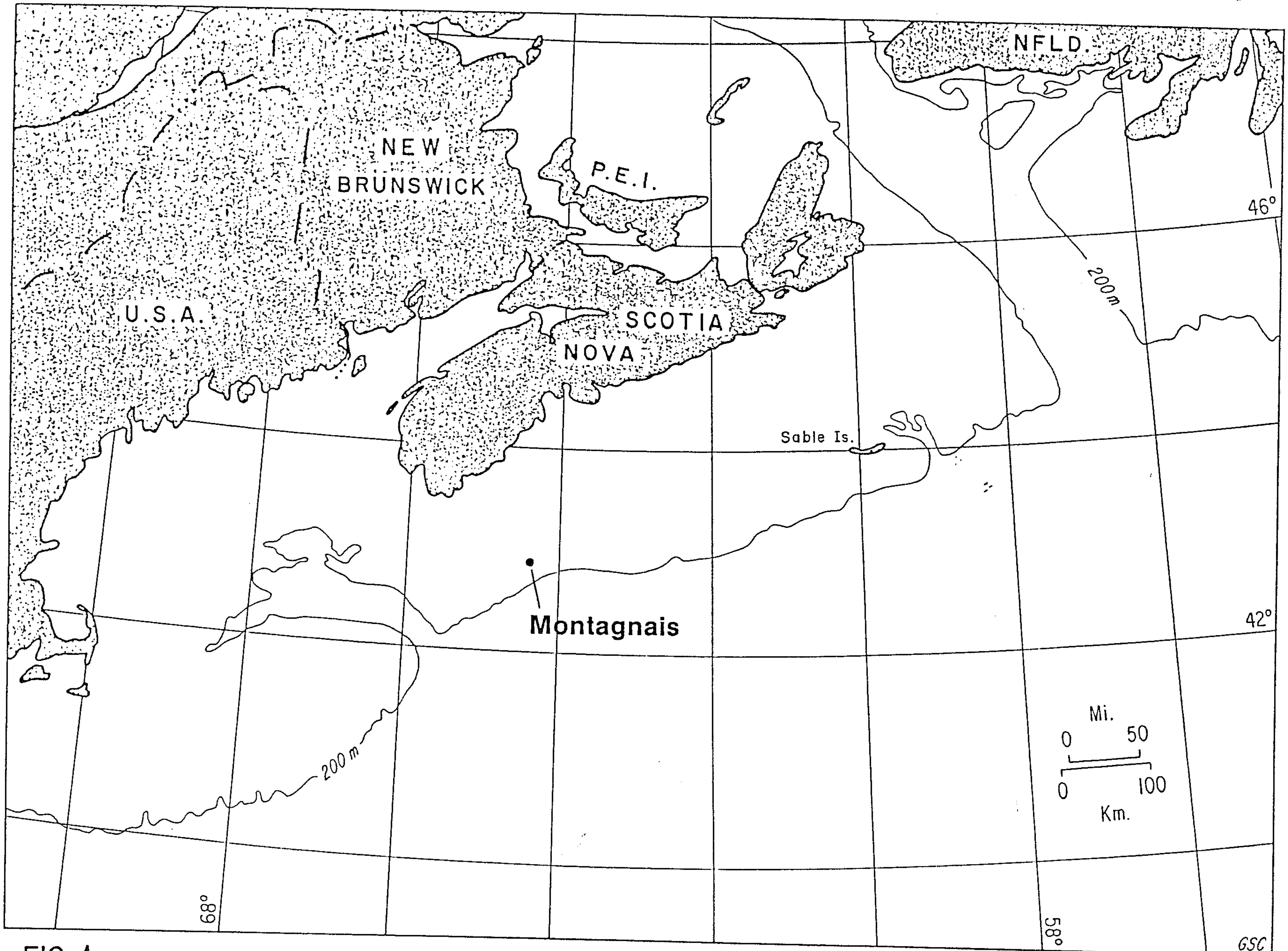

NFLD.
NEW
BRUNSWICK
P.E.I.
U.S.A.
SCOTIA
NOVA
Sable Is.
200m
200m
46°
42°
Montagnais
Mi.
0
50
0
100
Km.
68°
58°
GSC

FIG. 1

PRE 1982 DATA

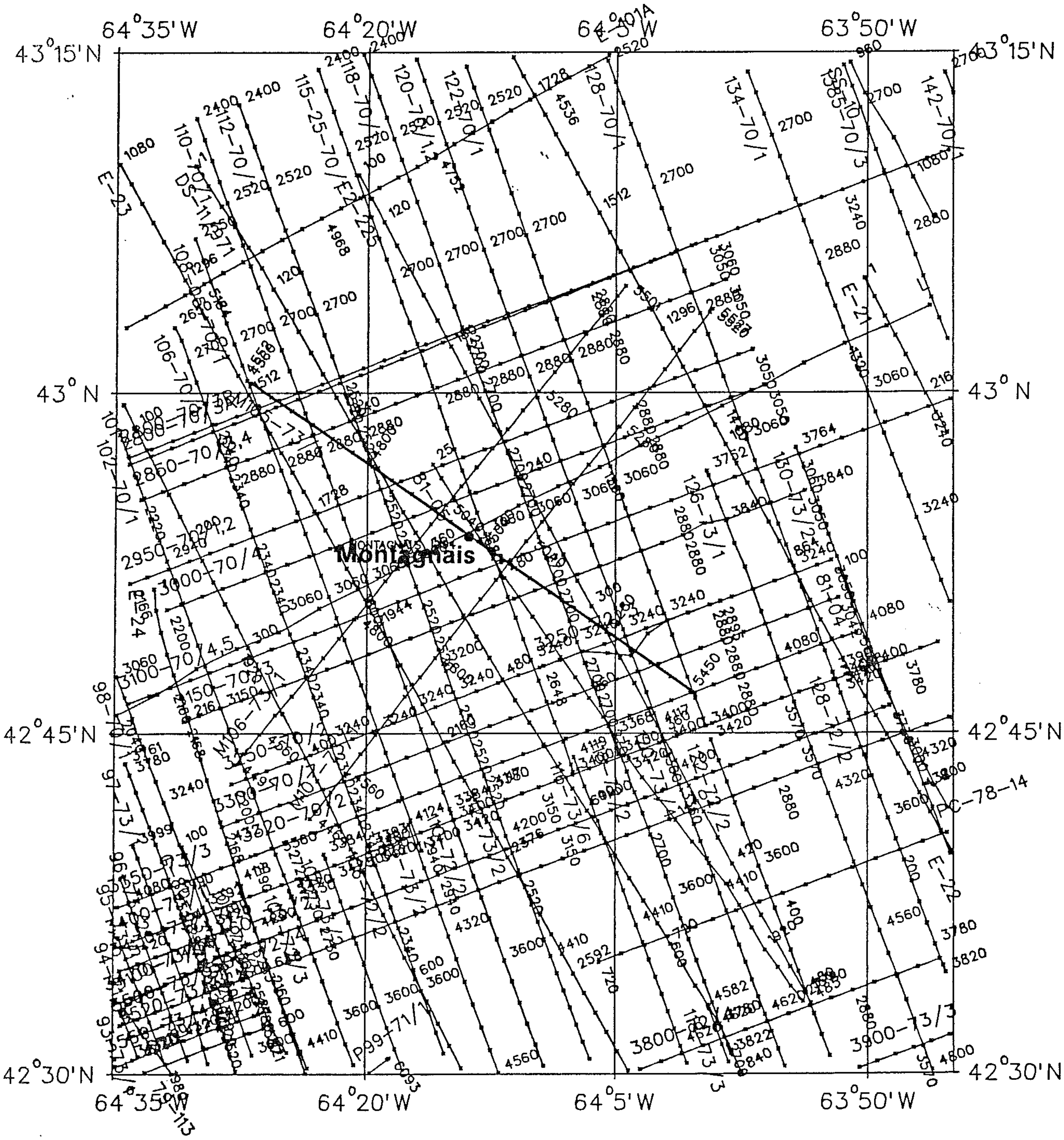
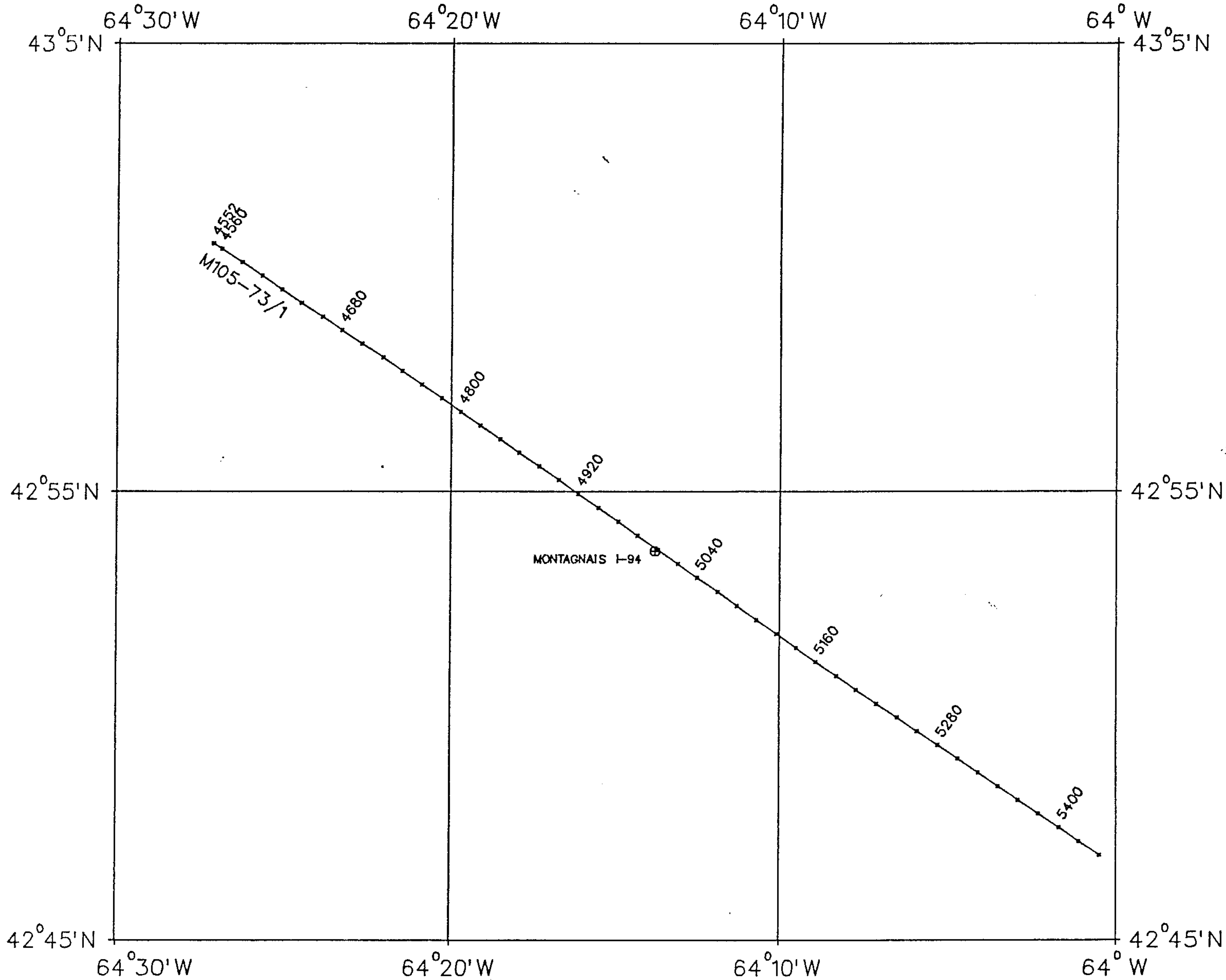


FIG. 2

SCALE 1 : 500000.
PROJECTION UTM
PLOT DATE 88/02/23.

LINE M105-73/1



SCALE 1 : 250000.
PROJECTION UTM
PLOT DATE 88/02/23.

FIG. 3

CABLE

Type	G.S.I.
Number of Groups	48
Spread	275-2625 meters
Group Interval	50 meters
Hydrophones per Group	47
Hydrophone Spacing	1 meter
Cable Depth	50 feet (15.24 meters)

INSTRUMENTS

Field Recorder	DFS-4
Filter	6DB at 8HZ and 18DB/OCT 6DB at 62HZ and 18DB/OCT with 2 MSEC ALIAS
Sample Interval	4 MSEC
Record Length	6 seconds

ORIGINAL PROCESSING
PERFORMED BY SHELL CANADA LIMITED

The original processing sequence performed by Shell Canada is listed below. After demultiplex, sort, edit, gain recovery and stack the data were deconvolved and filtered using the following parameters:

Deconvolution

Operator Length	200 msec
Number of Gates	3
Lag	24 msec
Derivation Window	500-5000
Application	204-end

Bandpass Filtering

Type Time variant

Gate 1	Gate 2	Gate 3	Gate 4
10/61-45/41	08/61-40/41	08/61-35/41	08/61-30/41
0-800	800-2000	2000-3000	3000-end

Two final stack versions were produced by Shell Canada; one with full trace display and a second trace summed version. Copies of the original lines can be acquired through the Canada Oil and Gas Lands Administration, Ottawa, from project number 8624-S6-12E.

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POST-STACK REPROCESSING TESTS

The test procedure concentrated on post-stack deconvolution trials, coherency filtering, migration algorithms and migration velocities. The following abbreviations are used:

TVF=Time variant filter
RSGN=Reflection strength gain
RAC=Residual amplitude compensation
F-K=Frequency-wavenumber
COH FILT=Coherency filter
RPF=Radial predictive filter
DAS=Deconvolution After Stack

1. Post-stack deconvolution.
   The deconvolution trials concentrated on 12 msec gapped data versus 60 msec gapped and one window deconvolution versus two. The data also were displayed with and without coherency filtering.

TESTS:
12-600 2 window TVF RSGN
12-600 1 window TVF RSGN
No DAS TVF RSGN
No DAS TVF RAC (COH FILT)
60-600 1 window TVF RSGN
60-600 2 window TVF RSGN
60-600 1 window TVF RAC (COH FILT)
12-600 2 window TVF RAC (COH FILT)

2. Coherency Filter Tests

TESTS:
1:1 Array Form
1:2:1 Array Form
1:4:6:4:1 Array Form
RPF 70% add back
RPF 80% add back
RPF 90% add back
RPF 0% add back
Post stack F-K filter

3. Migration Tests

TESTS:
F-K Stolt Migration
Cascaded Finite Difference

4. Migration Velocity Tests

TESTS: Finite difference
90% of Stacking Velocity
100% of Stacking Velocity

110% of Stacking Velocity
Cascaded Finite Difference
90% of Stacking Velocity
100% of Stacking Velocity
110% of Stacking Velocity

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POST-STACK REPROCESSING SEQUENCE

Following extensive trials on the complete section the following processing sequence was picked as the optimum to improve the data.

1. Water Bottom Mute

2. Residual Amplitude Compensation(RAC)

Time(seconds)	Scaler
0.250	2.5
1.000	3.5
6.000	2.5

Time variant scalers derived from amplitude decay analysis of the data were applied. In addition, the scalers were modified to provide a 3DB drop in amplitude at 6.0 seconds.

3. Deconvolution After Stack

Type	Minimum Phase Inverse Filter
Number of Windows	1
Operator Length	600 msec
Prediction Distance	12 msec
Number of Channels	51
White Noise	0.1%

Minimum phase predictive deconvolution was applied in the frequency domain, using the Wiener-Levinson algorithm.

4. Time Variant Filter

Time	Lo-Cut(HZ)	Hi-Cut(HZ)
0	8	55
1000	6	45
3000	4	30
4000	4	25

The data were filtered with zero-phase bandpass filters having time and space dependant passbands. For intermediate times, a weighted average was taken of the trace filtered with the earlier and later filter separately. The cutoff frequency is specified at -3 DB (times vary relative to water bottom).

5. Cascaded Finite Difference Migration

Number of Cascades	10

All the data were migrated using the finite difference solution to the scalar wave equation. Full migration was performed using ten iterations of partial migrations, each using artificially slow velocities. The cascaded approach allows for the imaging of steeply dipping events which are outside the limits of a conventional finite difference migration. The velocities used for migration were those originally picked and applied by Shell Canada Limited, based on processing trials 100% of stacking velocities provided the best migration of the data.

6. Bandpass Filter

Lo-Cut	6HZ
Hi-Cut	60HZ

A low cut filter was applied to the data to remove noise induced by the migration process.

7. 1:2:1 Array Form

Output every trace with no decimation.

8. Residual Amplitude Compensation(RAC)

Time	Scaler
0.250	1.9
3.000	4.0
6.000	4.0

Time variant scalers derived from amplitude analysis of the data were applied.

9. Film Display

Final Filterd Stack 12 msec gap(Enclosure 1)

Final Migration(Enclosure 2)

Display of both films is at 38.4 tr/inch and 2.5 inches/ second.

The final film versions are held in storage by the Eastern Petroleum Geology Subdivision of the Atlantic Geoscience Centre.

10. Data Retained on Tape

Final Stack 12 msec gap

Final Stack 60 msec gap

Final Migration

The concatenated tape is held in storage at the Public Archives of Canada in Edmonton, Alberta.

CONCLUSIONS

The final processed versions show some improvement in the continuity of events, the most dramatic improvements resulting from the application of migration and better display techniques. The post stack deconvolution had some effect on water bottom multiple suppression but would probably have been more effective if deconvolution could have been performed as a pre-stack processing sequence. The application of post-stack processing to old data is a valid exercise in this area, however, the improvements in data quality observed are not as much as may be expected if full modern processing could have been applied.

REFERENCE

Jansa L.F. and G.Pe-Piper, 1987, Identification of an underwater extraterrestrial impact crater: Nature Vol. 327, No. 6123, pp. 612-614.