GEOLOGICAL SURVEY OF CANADA.

ATLANTIC GEOSCIENCE CENTRE

OPEN FILE REPORT

SEISMIC REPROCESSING RESULTS FROM HUSKY OIL OPERATIONS LINE HM-81-70, JEANNE D'ARC BASIN, NEWFOUNDLAND

by

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July, 1989.

INTRODUCTION.

The original field data for seismic line HM-81-70 (Fig. 1) was provided to AGC by Husky Oil Operations Limited in order that the data could be reprocessed to enhance reflector continuity and correlability. AGC engaged Western Geophysical, a Division of Western Atlas of Calgary to perform state of the art digital processing of the data. The results of this work are displayed in three 2.5"/sec seismic sections. The three versions produced include a normal polarity scaled stack, a normal polarity scaled migration and a reverse polarity scaled migration.

The line is located on the edge of the Jeanne d'Arc in the region of the Flying foam feature, however, the bulk of the line is located over the Bonavista Platform Basin. Although no dramatic data improvement was achieved, definition of events within the Bonavista platform were improved as was the definition of data near the basin margin. Included within this report is a summary of the processing undertaken by Western Geophysical.

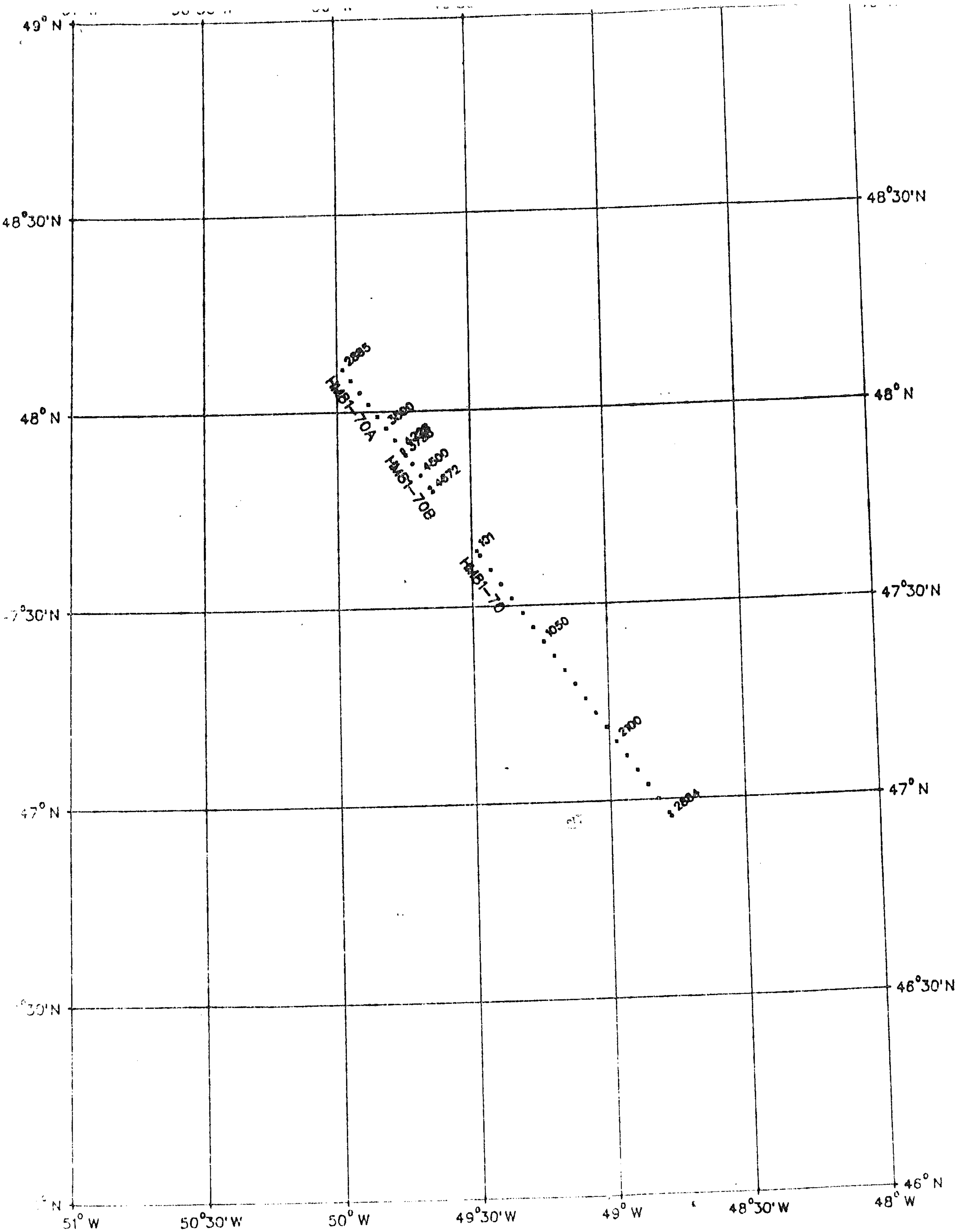
49° N
48°30'N
48°30'N
48° N
48° N
47°30'N
47°30'N
47° N
47° N
46°30'N
46° N
51° W
50°30'W
50° W
49°30'W
49° W
48°30'W
48° W
HM81-70A
HM81-70B
HM81-70
1050
2100
4500
4872

FIG. 1

2D MARINE SEISMIC

PROCESSING REPORT

OF

GRAND BANKS LINE HM-81-70

FOR

ATLANTIC GEOSCIENCE CENTRE

BY

WESTERN GEOPHYSICAL, A DIVISION
OF WESTERN ATLAS CANADA LTD.

CALGARY DIGITAL CENTRE - SEPTEMBER 1988

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TABLE OF CONTENTS

INTRODUCTION

The reprocessing of Grand Banks line HM-81-70, shotpoints 101-2884 (93.264 km), was performed by Western Geophysical, A Division of Western Atlas Canada Ltd. for the Atlantic Geoscience Centre. The data was collected and and originally processed in 1981 by G.S.I. for Husky Oil Operations Limited. Data enhancement was the objective of the reprocessing.

This report details the reprocessing methods and parameters used in this processing sequence. Also provided is a statement of the products generated and their final disposition, along with a list of the personnel involved in this project.

ACQUISITION PARAMETERS

ACQUISITION DATES: October 1981

VESSEL: M/V JAVA SEAL - Party 2434
Shot by G.S.I.

SOURCE:

Energy Source	AIR GUN
Gun Array Volume	4000 CU. IN.
Gun Depth	7 M
Shotpoint Interval	33.5 M
Source-Antenna Distance	67.3 M

CABLE:

Centre Near Group to Centre Far Group	3182.5 M
Cable Depth	AVG. 14 M
Offset Centre Guns to Centre Near Group	248 M
Group Interval	33.5 M
Number of Groups Recorded	96

INSTRUMENTS:

Recording System	DFS V
Filter	LOW CUT 8 HZ, 18 db/oct HIGH CUT 90 HZ, 72 db/oct
Sampling Interval	4 MS
Record Length	7 SECONDS
Format	MULTIPLEXED SEG-B
Primary Nav. System	ARGO

PROCESSING FLOWCHARTS

I PRE STACK PROCESSING

FIELD TAPE

1. DEMULTIPLEX/FORMAT CONVERSION
2. INSTRUMENT PHASE COMPENSATION
3. GEOMETRIC SPREADING GAIN
4. PRESTACK DECONVOLUTION
5. TRACE BALANCE
6. CDP SORT
7. PRELIMINARY VELOCITY ANALYSIS
8. F-K DOMAIN MULTIPLE ATTEN.
9. FINAL VELOCITY ANALYSES
10. DMO STACK

II POST STACK PROCESSING

11. RMS GAIN
12. POST STACK DECONVOLUTION
13. TIME-VARYING FILTER
14. MIGRATION
15. LOW-CUT FILTER
16. REFLECTION STRENGTH GAIN

FILM/PRINT

SEISMIC DATA PROCESSING

1. FORMAT CONVERSION/EDIT

The field tapes received in SEG-B format were converted to Western's internal Code-4 format. The near trace of each shot record and every 60th shot record were displayed for quality control and subsequent parameter selection. Data was processed to a record length of 7 seconds. The tiger firing delay of 51.2 milliseconds was also compensated in this processing step.

2. INSTRUMENT PHASE COMPENSATION

The phase response of the recording system (as obtained from Texas Instruments DFS-V specifications) was used to design an inverse operator, which when convolved with the data, transferred the system's response to a zero-phase bandpass filter.

3. GAIN COMPENSATION FOR SPHERICAL SPREADING

This time and offset variant, non data amplitude dependent trace scaling compensated for amplitude loss resulting from the increasing area of the propagating wavefront. The gain correction based on the radius of the expanding wavefront, was calculated as a function of offset and time dependent velocities. These were obtained from the print of the line supplied to Western Geophysical by Atlantic Geoscience Centre.

4. PRESTACK DECONVOLUTION

Minimum phase predictive deconvolution was applied in the time domain using the Wiener-Levinson algorithm. The design parameters and windowing for autocorrelation determination were as follows:

Minimum Prediction Distance	12 ms
Maximum Prediction Distance	300 ms
Percent White Noise	0.1%
Autocorrelation Averaging	1 Trace
Autocorrelation Windowing	Two windows overlapped from 500 ms to 7000 ms.

5. TRACE BALANCE

Each trace was scaled to a fixed root mean square value (2000) to remove source and receiver induced amplitude differences between traces. Minimizing large amplitude differences between traces in this manner was essential for optimizing the autocorrelation averaging performed in the following step.

7. VELOCITY ANALYSIS

Velocity analyses were performed at an interval of 4 km. Five adjacent common midpoint gathers with common offset traces summed together provided the input. A cross correlation based technique was used to determine stacking velocities by searching for coherence (semblance) along hyperbolic trajectories.

8. FK DOMAIN MULTIPLE ATTENUATION

The preliminary velocity analysis (step 7) provided the multiple velocities with sufficient accuracy to determine intermediate velocity functions with which to temporarily NMO correct the data. These gathers with over-corrected primary (negative dip) and under-corrected multiple (positive dip) were then transformed into the FK domain where all positive dips were removed. An inverse FK transform was then applied and the temporary velocity correction removed.

9. FINAL VELOCITY ANALYSIS

When FK demultiple was performed, a second set of velocity analyses was done, providing a better estimate of primary velocities as the multiple interference had been removed.

A DMO velocity analysis over selected areas of the line was also performed, whereby the cdf gathers were corrected for DMO prior to velocity analysis.

10. DMO STACK (4800%)

All of the following operations were performed in this processing step:

i) Normal Moveout Correction
ii) Trace Muting
iii) Dip Moveout Correction and Common Reflection Point Stack

i) Normal Moveout Correction

Based on the final interpolated velocities, the component of arrival time associated with shot to receiver offset for each trace sample was removed (NMO).

ii) Trace Muting

After NMO correction, but before the application of the dip moveout correction, the data was muted to remove stretching effects and unwanted refractions.

iii) Dip Moveout (DMO)

This conditioning of the data specifically addresses several problems with conventional stacking and migrating such as:

a) DMO followed by conventional post stack migration is equivalent to full prestack migration.

b) Dip and azimuth dependency of the stacking velocity - all zero-offset time concurrent events stack-in with the same velocity (i.e. the RMS velocity of the medium at that time). Therefore, no dips are discriminated against by the stack and the 'dip bandwidth' is increased.

c) Linear diagonal noise on the stack - this effect produced by near surface diffractions now has moveout characteristic of the lower medium in which it propagates. This results in it being stacked out at later times in much the same way that slower velocity multiples are attenuated by stacking.

d) Midpoint smear - moveout curves from dipping events represent reflections from a single point rather than from a region on the dipping interface as is the case without DMO correction.

11. RMS GAIN

Each trace was divided into non-overlapping zones beginning with a length of 128 ms and doubling to a maximum of 512 ms. A multiplier was calculated for each zone to adjust the root-mean square to a value of 2000. This multiplier was applied at the centre of each zone. The multipliers at all other times were determined by linear interpolation between zone centres.

12. MULTI-CHANNEL FREQUENCY DOMAIN DECONVOLUTION

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

The design parameters were as follows:

Number of Windows 2

Window	Start Time (ms)	Stop Time (ms)
1	50	4683
2	2367	7000

Minimum Prediction Distance .... 60 ms
Maximum Prediction Distance .... 300 ms
Percent White Noise 0.1%
Autocorrelation Averaging .... 101 Trace Running Average

13. TIME VARIANT FILTER

The data was filtered with zero-phase bandpass filters having time dependent passbands. The filters used are listed below. 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.

Time	Low Cut	High Cut
50 ms	8 hz, 18 db/oct	60 hz, 48 db/oct
2500 ms	6 hz, 18 db/oct	50 hz, 42 db/oct
5000 ms	4 hz, 18 db/oct	40 hz, 36 db/oct
7200 ms	4 hz, 18 db/oct	30 hz, 24 db/oct

14. MIGRATION

Testing of both the Finite Difference and F-K migration methods resulted in the selection of the Stolt F-K migration algorithm for migration of the data. Smoothed stacking velocities were used for the migration velocity field.

15. LOW CUT FILTER

The data was filtered with a zero-phase bandpass filter of 4 Hz, slope of 18. The cutoff frequency is specified at -3 db.

16. GAIN
REFLECTION STRENGTH GAIN

RMS Amplitude - 2000
Maximum standout after Gain - 6

FINAL PRESENTATIONS

Displays

1. Gained migration at 34.9 tr/in and 2.5 in/sec, normal and reverse polarity.
   Total: 2 Films, 2 Prints.

2. Gained stack at 34.9 tr/in and 2.5 in/sec, normal polarity.
   Total: 1 Film, 1 Print.

STAFFING OF PROJECT

All of the seismic processing was performed in Western Geophysical's Calgary Processing Centre.

Personnel:

Atlantic Geoscience Centre

Client Representative: Mr. A. Edwards

Western Geophysical, A Division of Western Atlas Canada Ltd.

Seismic Processing Q.C. Supervisor - Mr. Ron Weedmark
Seismic Processing - Ms. Brendalee Bowman

This report prepared by B. Bowman, September 1987.