

Exclusive 2D Seismic Reflection Survey

N.E.B. Authorization #
9229-I9-1E

D.I.A.N.D. Land Use Permit #
N96B858

Final Report For MACKAY AREA Block EL-391 Northwest Territories

Location
Latitude: 64deg 35' to 64deg 42'
Longitude: 125deg 50' to 126deg 05'

Work Period
April 3rd to 24th, 1998

Block Operator
International Frontier Resources Ltd.

Project Operator
Northrock Resources Ltd.

Project Management
Aguila Exploration Consultants Ltd.

Acquisition Contractor
Trace Explorations Ltd.

Report Date
22nd January 1999

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ENCLOSURES

Synthetic Seismograms for wells:-

Little Bear I-070
Little Bear O-051

Normal & Reverse Polarity Seismic Sections for lines:-

G98YN121
G98YN122
G98YN123

Final Seismic Shotpoint Base Map

Interpretive Seismic Maps:-

Cretaceous Radioactive Shale Time Structure
Devonian Jungle Ridge Time Structure
Devonian Hume Time Structure
Cambrian Saline River Time Structure
Radioactive Shale to Hume Isochron
Jungle Ridge to Hume Isochron

INTRODUCTION

The MacKay project site is located in the Mackenzie River Valley of Northwest Territories near Tulita (Fort Norman). The project's natural boundaries include the East Little Bear to the north and east, the Little Bear River to the West, and Ration Creek and the East Little Bear River to the south.

The centre of the program is approximately 25 km. south east of Tulita (Fort Norman). Tulita is situated 1700 km north-northwest of Calgary, Alberta.

The MacKay program was conducted in the spring of 1998. Aguila Exploration Consultants conducted the applications and front-end operations and the geophysical acquisition was conducted by Trace Explorations, both working on behalf of Northrock Resources. Northrock Resources acted as operator. The program was conducted as an exclusive survey for Northrock Resources operating under a seismic option agreement with International Frontier Resources.

The work period was from April 3 to April 24, 1998. There were normally 50 people involved in all phases of the operation.

Mr. Randi Cofield, of Aguila Exploration Consultants, was the on site Project Manager. Mr. Warren McLeod, of Aguila Exploration Consultants directed line clearing operations and drilling operations were co-ordinated by Mr Doug Hertz, of Delta Drilling. The field recording operations were co-ordinated by Trace Party Manager Bill Busby.

Line G98YN124 was originally proposed, but not recorded. The proposed Lines G98YN123 and G98YN121 were not recorded as originally proposed: 2.32 km. were dropped from the east end of line G98YN123 and 1.18 km. was added to the south end of line G98YN121.

This project was submitted for Land Use approval to D.I.A.N.D. on March 14 and approval was received by March 27, 1998. Application to the National Energy Board was submitted on March 14 and received on March 31, 1998.

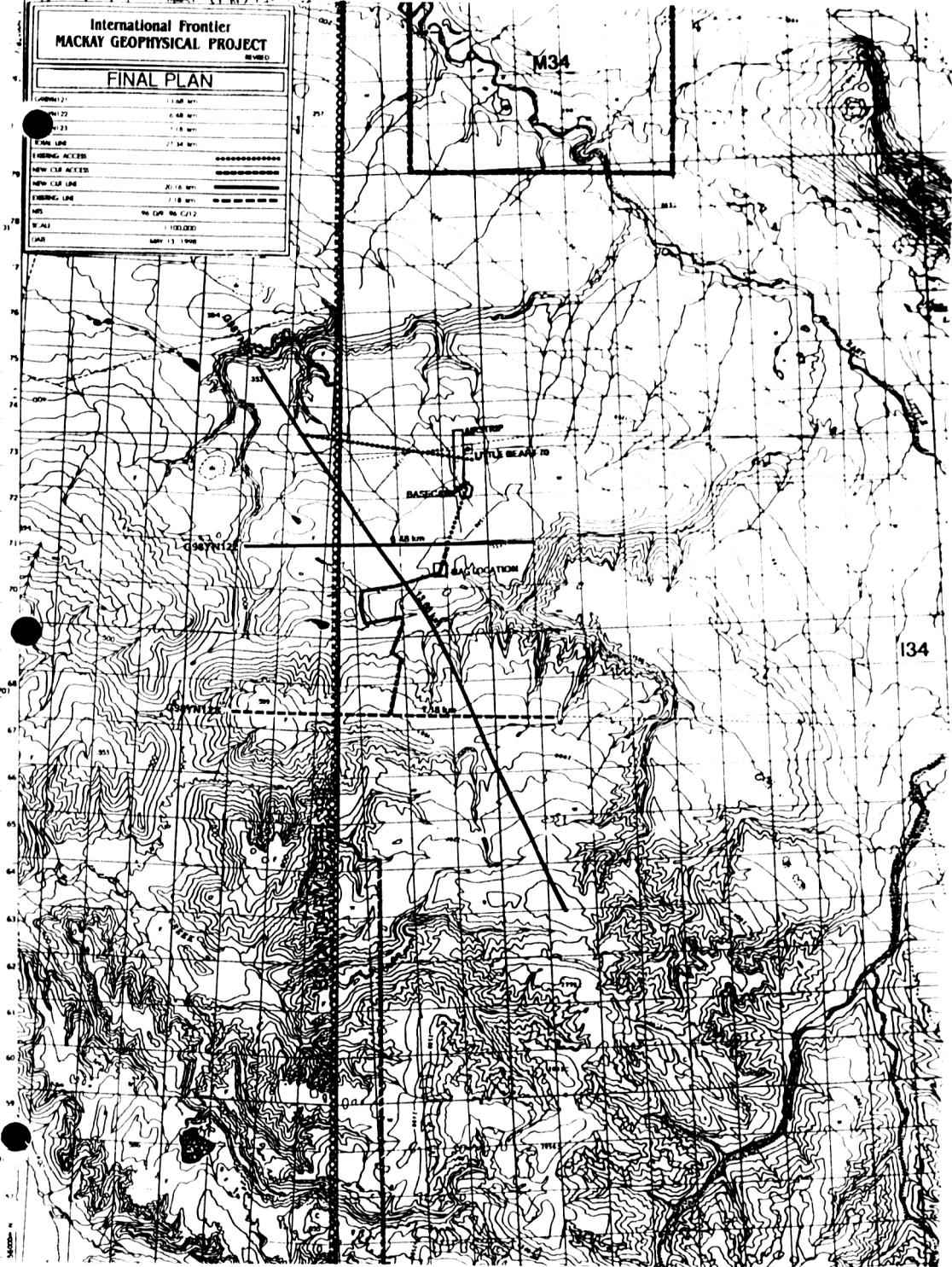
International Frontier
MACKAY GEOPHYSICAL PROJECT

REV 000

FINAL PLAN

CRATER 12	11.6 km
CRATER 22	6.48 km
CRATER 23	7.18 km
CRATER 24	27.34 km
EXIST LINE
NEW CUT ACCESS
NEW CUT LINE	20.16 km
EXIST LINE	7.18 km
MIS	96 (98 98) C12
SCAL	1:100,000
CAR	MAY 13, 1998

M34



WEATHER AND TERRAIN

Weather conditions were normal during the course of the survey, with temperatures ranging from -20 to +10 Celsius through out the course of operations. There was one spring storm during the course of the survey that resulted a weather day for the recording operations due to noise on the spread.

As the amount of sunlight increased the temperature moderated and the rate of snow melt increased noticeably. As of April 20 the I-70 airstrip degenerated to the point where fixed wing aircraft could not be utilised to support the field operations. After this point the Bell 212 was used to support field operations.

Elevations on the program varied from 336.3 m. above sea level (station 165 line G98YN121, at the bottom of the major creek draw on the program) to 768.4 m. above sea (station 757 line G98YN121, the plateau at the end of line).

The project area was in the Mackenzie River valley plain. Surface conditions consisted mainly of timbered, slightly rolling terrain. The majority of the timber encountered was spruce and willows. Erosion gullies were encountered on some creeks feeding into the East Little Bear.

In view of the drainage patterns in the area, the program was laid out to avoid any severe topography and thus minimise environmental impact.

LOGISTICS AND SUMMARY

This project came up late in the Territories working season. The winter road was closed and access to the project was hampered by the possible break up of the Mackenzie River. Spring break up conditions impact on the risk and economic aspects of late season operations.

In view of the spring break up timing and risk considerations on this project Aguila Exploration proposed a low impact seismic operation to accomplish this project on time and in an environmentally sensitive manner. This methodology may allow future seismic operations in the Northwest Territories to be extended outside of the traditional winter season.

The support and front-end field personnel were based out of Norman Wells and Tulita. Line clearing personnel chose to set up tents and they lived on the land. A medical/survival tent was set up on site at the airstrip (64° 39' 45" latitude and 125° 56' 48" longitude) near the Little Bear I-70 well site. This location served as the field base of operations. Both fixed and rotary wing aircraft supported the line clearing operations.

Speciality drilling equipment was trucked from Calgary to Yellowknife, flown to Norman Wells via charter aircraft, then flown to the project site via helicopter. Drilling operations were supported by fixed and rotary wing air support. Upon completion of drilling operations the drills were flown back to Norman Wells, then flown to Hay River via charter aircraft, and trucked to Calgary.

Trace Explorations had been working for another client in the area prior to commencing operations on the MacKay program and the recording equipment was in Norman Wells. However the heli-portable doghouse had to be shipped from Calgary. The survey instruments were flown up from Calgary to Norman Wells. As Trace exploration maintains a shop facility and base in Norman Wells, all equipment was mobilised out of Norman Wells. Expediting for the recording field operations was based in Trace's yard in Norman Wells. Recording operations were supported by fixed and rotary wing air support.

Direct Land Use supervision was handled by the Renewable Resources Officer in Norman Wells. Land Use Permit (number N96B858) was issued by the Inuvik Office of Indian and Northern Affairs. Meetings were held in Tulita (Fort Norman) and Norman Wells with Aguila and Trace representatives and local interest groups.

Two expeditors were used to support the field operations. One was based out of Norman Wells and a local expeditor worked out of Tulita. The expediting service consisted of two expeditors and two trucks.

The expeditors arranged personnel movements, purchased fuels, foods, and other essential supplies for the field operation. Crew members in transit through Norman Wells stayed in the Trace facilities or in hotels in Norman Wells.

Canadian Airlines was used to transport personnel and equipment from the south. An L100-30 Hercules aircraft from NWT Air was chartered to mobilise the drills and heli-portable doghouse from Yellowknife and demobilise the drills to Hay River. A Bell 212, a Bell 206B Jet Ranger, and an Eurocopter AS 350 A-Star helicopter from Great Slave and a Bell 206B Jet Ranger from Canadian Helicopters were used for rotary wing support. Fixed wing aircraft from North Wright (Twin Otter) was used to transport supplies and personnel as operationally necessary.

These aircraft transported the drills, explosives, personnel, snowmachines, fuels and lubricants, and supplies to the field.

Some personnel were obtained from Calgary and Edmonton. However, native residents of the Northwest Territories made up over 65% of the crew compliment. Time-off periods were on a self-determined basis, subject to availability of replacement personnel.

Daily fuel consumption averaged 800 litres of diesel and 100 litres of gasoline. Fuel and lubricants were purchased in bulk from a supplier in Norman Wells. Aviation fuel was both purchased from the bulk dealer and supplied by the chartered companies.

Upon completion of operations all equipment was flown back to Tulita or Norman Wells. Crew members were transported to their homes via commercial and chartered aircraft. The recording and survey equipment was flown to Calgary.

SAFETY, HEALTH, ENVIRONMENT

Environmental concerns were addressed at the pre-commencement meetings. While no specific concerns were brought up, the issue of trapper's compensation was raised. In view of the presence of the operator in the area, this issue was referred to International Frontier Resources.

All lines were hand cut to a 2.5 metre width and the operations were helicopter supported. The only mechanical equipment on the ground was snow machines and the two low impact seismic drills. All these units had all rubber tracks.

Medic North, based out of Yellowknife supplied First Aid attendant for the entire duration of the project. A tent was provided by a local contractor and was set up at the I-70 well site location that served as a First Aid location. As well as all necessary First Aid supplies, other equipment included a satellite telephone, and XJ radio telephone (to monitor field operations and act as back up communication), a snow machine and body sled, and survival gear.

Field operations were inspected once by Mr. Ed Reyven of the National Energy Board and twice by Mr. Steve Deschene (D.I.A.N.D., Norman Wells Renewable Resource Officer). All inspections expressed no concerns regarding the safety and environmental aspects of the operations.

Copies of all safety meetings, audits, etc. were forwarded to the National Energy Board and to Northrock Resources.

LINE CLEARING OPERATIONS

All line clearing was done by hand. No mechanical line clearing equipment was utilised on this project. This procedure left all the snow cover on the tundra and resulted in minimal environmental impact.

Local contractors, from Tulita, cleared the lines. In addition, two hand cutting foremen were mobilised from Calgary and Edmonton to train and advise on hand cutting operations. Mr. Warren McLeod, with Aguila Exploration Consultants, co-ordinated the line clearing operations.

The line clearing performance expectations were not met on this project and affected the economics of the program.

The program consisted of both existing and new cut lines. The new cut lines were cut to a 2.5 m. width. The debris was bucked and slashed and windrowed to either side of the line.

In view of the melting conditions, a crew of hand cutters remained on the program working ahead of the drills, cutting down the stumps left by the snow melt.

Line G98YN123 was an existing line, however it was a very old hand cut (with axe) heli-portable line and was over grown. Lines G98YN121 and G98YN122 were new cut lines.

Over 19 hand cutting personnel were involved in line clearing. Access to the project was via snow machine and supported by helicopter. Line clearing personnel from Tulita chose to live on the project site and set up a tent camp near the I-70 well site.

Minimal small creek crossings were constructed of man-made snow fills. These were removed after completion of operations in the area.

SURVEYING OPERATIONS

Mr. Lorne Kelley, with Mercedes Surveys on contract to Aguilis, was the chief surveyor on the program.

Shotpoint and geophone group locations were derived using a surveyor's steel chain. Shipping tags were used to mark the geophone and shotpoint locations.

Chaining notes were kept for each line and were forwarded to the client with the data shipments.

A Novatel GPS system was used to establish control and survey the lines. New cut lines were derived from topographic features and sun shots utilising a Wild TC1010 and a hand held GPS unit. Control used included two Geodetic Survey of Canada benchmarks (one on the MacKay Range and one located to the south of the program).

The use of real time GPS was very cost effective on this project. The traditional control problems of operations in the NWT have been eliminated. Two benchmarks were established in the project area (one located at the Little Bear I-70 well site and another just to the south of line G98YN121).

All survey work was performed in the metric system.

DRILLING OPERATIONS

As the lines were cleared by hand cutting, low impact seismic drills were used on this program. The 2.5 metre width minimised the amount of hand cutting required to support the operation. There were two (2) Comtrak 100 drills positioned on the crew. These were air/ water/ hammer combination type drills mounted on rubber tracks.

Drilling production was hampered by the move up time. Initially the snow depth, especially on some of the detours though the drainage areas, slowed the drills down. Once the snow melted the stumps of cleared trees were re-cut to ease moving on the line.

Initially the shot holes were drilled to a 15 m. depth. Once it was determined that the formations were remaining consistent the depth was decreased to 12 m. All production holes were loaded with 2 kilograms of Geogel dynamite, double capped and tamped with the drill cuttings.

No holes were drilled on lakes or near watercourses. When applicable the shot point was skidded to maintain continuity.

Drilling formations consisted primarily of clay and surface rocks, permafrost, and shale.

RECORDING OPERATIONS

Instruments	I/O System II
Number of Traces	240
Geophone Type	Mark L 210
Geophone Frequency	10 Hz.
Geophone Array	6 geophones over 20 m. (2.86 m. spacing)
Sample Rate	2 milliseconds
Record Length	3 seconds
Anti-Alias Filter	207 Hz.
Low Cut Filter	Out
Receiver Interval	20 m.
Source Interval	160 m.
Extra Source points	4 extra at B.O.L. and E.O.L. of each line
Fold	1500%
Spread	2400 - 20 - 0 - 20 - 2400
Roll in	180 traces live
Source	shot hole dynamite
Source Array	single hole
Hole Depth	15 m.
Charge Size	2 kg. and double capped

The cable lay out was a 2400 - 20 - X - 20 - 2400 balanced spread, with source points located on the group flags. Group 1 was always to the north or east.

Record quality was good through out the survey, with the exception of the south end of line G98YN121.

The recording crew removed all flagging, lath, and survey markers upon completion of operations in an area.

Recording personnel were based out of Norman Wells and Tulita and flown to the project site via fixed and rotary wing aircraft. Once the airstrip at I-70 became too wet, due to spring melting conditions, all support was by helicopter.

DATES OF OPERATIONS

Line Clearing mobilised :	April 3, 1998
Line Clearing commenced :	April 4, 1998
Drills mobilised :	April 7, 1998
Surveying commenced :	April 8, 1998
Drilling commenced :	April 11, 1998
Line Clearing ceased :	April 15, 1998
Recording crew mobilised :	April 15, 1998
Surveying completed :	April 16, 1998
Recording commenced :	April 16, 1998
Drilling operations ceased :	April 21, 1998
Line Clearing demobilised :	April 21, 1998
Drills demobilised :	April 23, 1998
Recording ceased :	April 23, 1998
Recording demobilised :	April 24, 1998

RECORDING PRODUCTION SUMMARY

Total Kilometres Surveyed :	27.34
Number of Shots :	199
Number of Stations :	1370
Number of Recording Days :	7
Kilometres Recorded per day :	3.42 km/day
Days Mobilised / Demobilised :	2
Days lost due to weather :	1
Days Lost Due to Equipment Failure	0
Down Time per day :	no instrument/equipment down time noted

DRILLING PRODUCTION SUMMARY

Total moving days	3 days
Total testing days	0
Total weather days	0
Total drilling days	11 days
Number of locations drilled	199 holes
Average hole depth	12.49 metres
Average holes per day	18.1 holes
Total metres drilled	2486 metres
Total days mob/demob	9 days

The 3 moving days are stand by waiting for Hercules aircraft to demob.

The 9 days noted as mob/demob represent the time spent disassembling and assembling drills in Norman Wells and in the field.

RECORDING PRODUCTION

	Date	Line Number	Locations	Kilometers	Hours	Comments
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14					12*	Norman Wells
15					12*	mobilise
16	G98YN122	3		0.08	12	lay-out
17	G98YN122	45		6.4	12	
18	G98YN121	12		1.12	12	
19	G98YN121	32		4.96	12	
20	G98YN121	3		0.48	8	weather day
21	G98YN121	50		7.12	12	
22	G98YN123	23		3.04	12	
23	G98YN123	29		4.14	12	
24					12	demobilise
25					10*	Norman Wells
26					5*	Norman Wells
27						
28						
29						
30						

* partial crew packing and unpacking equipment in Norman Wells

PERSONNEL

Recording

- 1 – Party Manager
- 1 – Field Clerk
- 1 – Base Mechanic
- 1 - Observer
- 1 – Jr. Observer
- 1 – Staging/Battery Manager
- 3 – Trouble Shooters
- 12 - Line Crew Helpers

Surveying

- 1 - Cat Push
- 2 - Chainers
- 1 - Surveyor

Source

- 1 – Drill Push
- 2 - Drillers
- 2 – Drill Helpers

Support

- 1 - Medic
- 1 - Project Manager
- 1 – Expediter / Technical Support

Line Clearing

- 17 – Hand Cutters
- 1 - Expediter
- 1 - Monitor

Total of 52 personnel

EQUIPMENT

Camp :

1 - Medic	Tent
3 - Line Clearing	Tents

Drilling :

2 - Low Impact Seismic Drills	Track mounted
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Recording & Survey :

1 - Recorder	Heli-portable doghouse
1 - Shooter	Snow Machine
3 - Trouble Shooter	Snow Machines
4 - Line Crew	Snow Machines
2 - Survey	Snow Machines
1 - Monitor	Snow Machine

Line Clearing :

12 - Line Clearing	Snow Machines
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NORTHERN ECONOMIC CONTENT

Air & Ground Support	\$290,558	62%
Canadian Helicopters	helicopter support	86083
Great Slave Helicopters	helicopter support	136414
North Wright Air	aircraft support	12405
Flint Construction Northern	crane	690
Matco Services	ground handling	925
NWT Air	aircraft support	51841
RTL Transport	truckling	2200
Board & Room	\$28,191	6%
Rayuka Developments	meals/accommodation	28191
Safety	\$13,020	3%
Medic North	medical/safety	13020
Tulita Area	\$135,806	29%
Albert Bernarde	rentals	750
Arsene Menacho	expediting	5500
Lawrence Pelleisy	rentals	750
Robert Horassi	monitor	6300
Victor Menacho	rentals	750
Tulita Development	administration	616
L&F Services	line clearing	22175
Sammy's Confectionery	line clearing	24201
Tulita District Land Corp	liaison officer	1749
Willow Lake Slashing	line clearing	73015
Total	\$467,575	

Northern contractors accounted for 55% of the total program acquisition costs.

SEISMIC PROCESSING

The seismic was processed by Mr. David Curry, of Dynamic Geophysical Inc., Calgary, Alberta, using ProMax software.

Extensive trace editing was required on certain portions of the data due to near surface conditions. The worst data problems were caused by the thick surface gravels at the south end of line G98YN121.

Deconvolution of the data was carried out by using a four component surface consistent minimum phase operator.

Due to the varying surface conditions caused by the gravels and permafrost, a satisfactory weathering correction could not be obtained. The data is therefore only corrected with elevation statics, to a seismic datum of 500m asl, using a replacement velocity of 2850 m/sec.

The data is stacked to 1500%. The most satisfactory migration was obtained with a post stack finite difference algorithm, utilizing 90% of the smoothed stacking velocities. Experiments with pre-stack migrations were unsatisfactory.

No post stack noise attenuation was applied to the data.

Processing sequence:

SEG-Y Input	
Amplitude Recovery	
Trace Editing	
Deconvolution	1/Type: 4-Component Surface Consistent Minimum Phase Spiking Gate: 20.0 m 800 - 2100 ms 2400.0 m 1200 - 2200 ms Operator: 100 ms, 0.1% pw
	2/Type: Trace by Trace Gate: Same as above Operator: 100 ms, 0.1% pw
Compute and Apply Refraction Statics	Datum Elevation: 500 m Replacement Velocity: 2850 m/sec
Velocity Analysis	
Compute and Apply Residual Statics	Type: Maximum Power Autostatics
Velocity Analysis 2	
Recompute and Apply Residual Statics	Type: Maximum Power Autostatics
Normal Moveout Correction	
Trace Muting	
Compute and Apply Trim Statics	
CDP/Ensemble Stack	
Shift to Final Datum	
Finite Difference Migration - 90% Smoothed Stacking Velocities	
Time Variant Bandpass Filter	0 - 1100 ms : 12/18 - 60/70 Hz 1300 - 3000 ms : 10/15 - 50/60 Hz
Automatic Gain Control 300 ms	

SEISMIC INTERPRETATION

The program was designed to explore for potential Devonian reef complexes, using leads interpreted from publicly available seismic sections, obtained from microfiche images stored at the N.E.B.

The data was interpreted using synthetic seismograms created from the nearby Little Bear wells. The key seismic reflectors of the Cretaceous Radioactive shale marker, the Devonian Jungle Ridge clinoform, and the Devonian Hume platform were interpreted from this method. The Cambrian Saline River reflector was interpreted from thickness calculations from a selection of wells throughout the MacKenzie Basin.

Four time structure maps were produced from these key seismic reflectors. These are included with the report.

In addition isochron maps of the Radioactive shale to the Hume, and the Jungle Ridge to the Hume were created to study thickening in regional isopachs. These are also enclosed.

Unfortunately the data did not indicate any obvious reefing, although it highlighted a structural platform at the northern end of the program, that will require further evaluation.