



BRANCH

**9229 - N9 - 3E**  
REPORT ON THE  
REFLECTION SEISMOGRAPH SURVEY  
LITTLE BEAR AREA  
OF THE  
NORTHWEST TERRITORIES

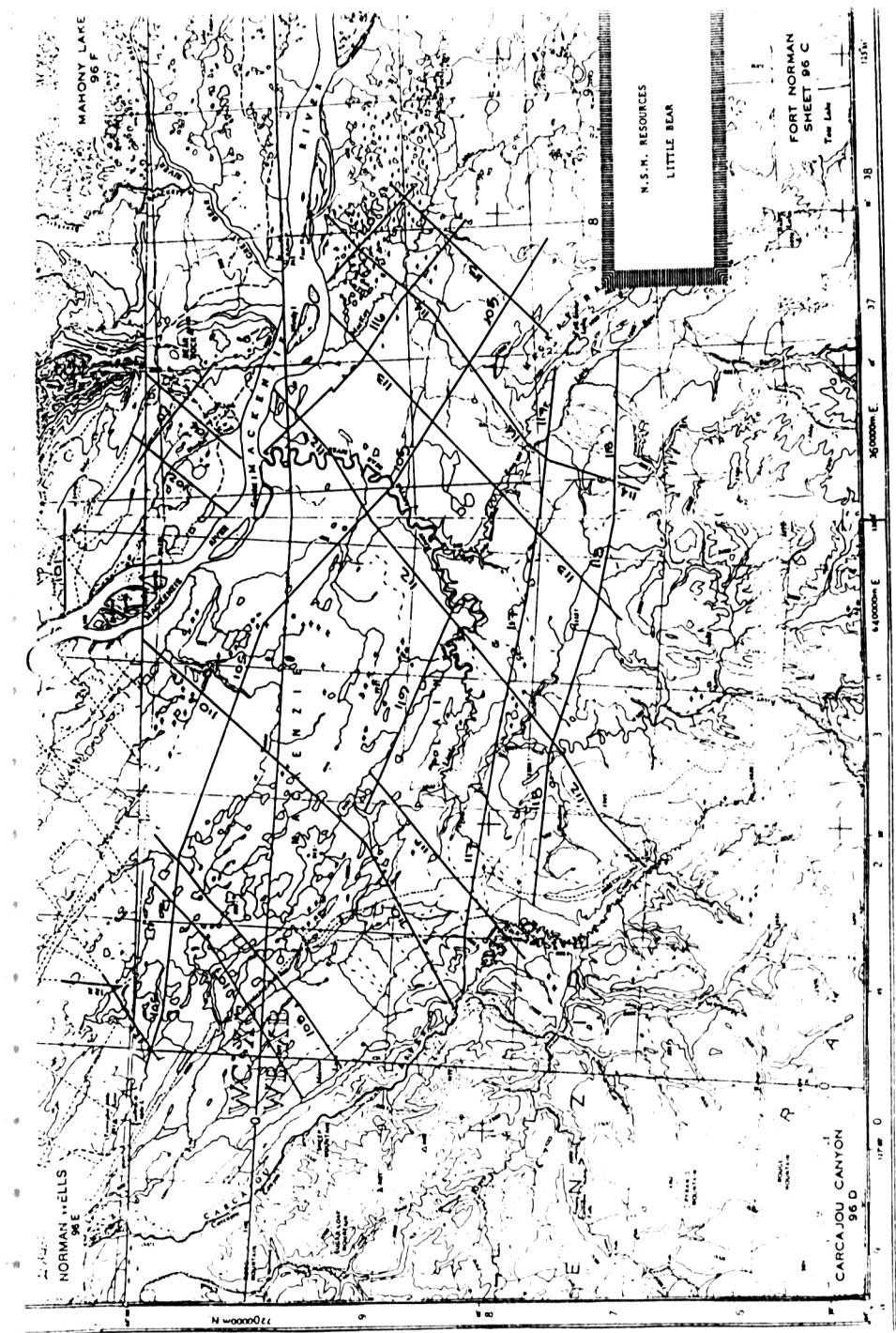
64°40' N to 65°05' N, 125°30' to 127°W

For  
NSM Resources Ltd.  
By  
Petrel Consultants Ltd.

**9229 - N9 - 3E**

Land Use Permit N83B862  
Cogla Project Number 9229-N9-3E  
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Scale 1:63,000 Environs



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## INTRODUCTION

The Little Bear Area lies on either side of the MacKenzie River near Fort Norman, N.W.T. It consists of 9.5 grid areas between 64°40' and 65°05' north latitudes and 125°30' and 127° west longitudes.

NSM Resources Ltd. negotiated a farmout from Amerada Minerals Corp. of Canada Ltd. with a commitment to conduct a 300 mile (482 km) seismic survey and option drilling program. The seismic data previously acquired by Amerada consisting of 478 km of 400% and 600% shooting was reviewed and studied by Petrel Consultants prior to the outlining and shooting of a 1200%, 497 km seismic program. This was shot by Western Geophysical Ltd. between March 4th and April 14th, 1983 and processed by Petrel immediately following. All seismic data was interpreted and mapped by Petrel and is the basis for this report.

## Surface Conditions and Field Operations

The area surveyed is gently rolling, lightly timbered terrain cut by several deeply incised rivers running into the MacKenzie River.

Field parameters are outlined in Appendix A but basically consisted of 1200% dynamite shooting using a 1608 meter split spread. Record quality was generally good except in an elongated area extending southwestward from Windy Island to a point west of the Little Bear I-70 well.



## Data Base

The data shot by Amerada and Mobil in the early 1970's formed a grid of coverage over the north-central and western portions of the prospect area and were of generally good quality having been shot by dynamite in 400% and 600% mode. The new, 1983, data recorded in 1200% mode was of better quality and was positioned to tie the wells in the area; to fill-in as a regional grid over all the option acreage and provide detailed coverage over the Mirror Lake structure and Jungle Ridge reef prospects. Six wells had been previously drilled and the logs from these were used to illustrate geological concepts and to identify the geophysical data.

## Regional Geology

The Little Bear Area lies on the MacKenzie Plain between the Franklin Mountains to the east and the MacKenzie Mountains and Redstone Arch to the west. Overlying the thick Proterozoic sediments is a sequence of Middle to Lower Cambrian marine shales and sandstones followed by the Upper Cambrian and Siluro-Ordovician evaporites, shales and carbonates. Above this is a Lower to Upper Devonian sequence of marine carbonates and shales again overlain by Cretaceous clastics. A thin veneer of Eocene is present in some parts of the area. Approximately 4000 to 9000 feet of Phanerozoic sediments are present in the survey area.

During the Middle Devonian, reef growths (Kee Scarp) occurred in a wide band extending north and south from Norman Wells.



An active tectonic history is present with seven major unconformities being identified between the Proterozoic and late Cretaceous. A full sequence of the above formations is present in most areas but as shown in the East MacKay B-45 well south of Fort Norman, the Cretaceous overlies directly the Middle Cambrian. Reference is made to the enclosed well log cross section which illustrates the stratigraphy and unconformities present.

Economic hydrocarbon prospects are believed present in any Kee Scarp reef developments; in the porous Hume and Bear Rock carbonates and in the Ronning group. Some potential for basal Cambrian sands is present although no successful testing has been done to date in this formation. The Bluefish A-37 well reported a Kee Scarp platform development which is encouraging for possible nearby reef production. Also in the East MacKay B-45 well an 1830 foot column of oil was tested from the Ronning indicating potential from this zone.

#### Interpretation

Identification of seismic reflectors was made using sonic logs and synthetic seismograms prepared from the Dodo, Slater, Bluefish, Little Bear and MacKay wells. Many reflectors are present and the ones correlated include:



- Cretaceous Sand - Yellow
- Canol - Red
- Hume - Green
- Bear Rock - Dark Blue
- Saline River - Yellow
- Mt. Cap - Brown
- Proterozoic - Red
- Within Proterozoic - Light Blue

Seismic maps were prepared using the above correlations on the following:

Cretaceous Sand Structure in Time

Hume Structure in Time

Proterozoic Structure in Time

Cretaceous Sand to Hume Isochron

Hume to Proterozoic

Canol to Hume Isochron (North of MacKenzie River only)

Composite map showing anomalies

The Hume (Mid-Devonian) is the best reflector in the section and the time map illustrates the structural form. This, in conjunction to illustrative lines (105 and 108) show two general structural settings exist. A northwest-southeast trending syncline is present across the western part of the area with associated highs, one culminating in the



Mirror Lake Structure and the other in the Norman Range where outcrops are observed. To the east, across the Norman - MacKay thrust, a pronounced north - south high is mapped. This was tested in the south, by the Mackay B-45 well which found the Hume absent due to erosion on the old uplift.

Between these two major features a northeast - southwest recurrent fault zone is present which was believed to be active at Proterozoic and Cretaceous times. This is in the area of poor data quality and further seismic coverage is needed to fully understand the sequence of events in this area. The correlation on seismic between the Bluefish K-71 and Little Bear I-70 on lines 112 and 118 shows the effect of the erosion and the reduction in the geologic section in the Upper Devonian.

The major uplift in the west at Mirror Lake is the result of a Laramide fault system which acted as a sole fault in the Saline River evaporitic section. The Ranning to recent sediments are largely un-interpreted. The Lower Cambrian is severely broken in what appears as step thrusts which caused a large increase in isopach between the Saline River and Proterozoic. The movement along the sole fault extends to the northeast where the fault surfaces as a thrust east of the Norman and MacKay Ranges. It is postulated that an ancient high existed near the MacKay B-45 well trending north - south. Subsequent Laramide thrusting resulted in the MacKay Range being forced up against the ancient high. Eastward movement was greater north of the ancient high resulting in the Norman Range being east of the MacKay Range with a break in movement along the northeast - southwest recurrent weakness zone now acting as a tear fault.



### Features of Interest

The Mirror Lake feature is an elongated structural high caused by the Laramide step-thrust. Its culmination is illustrated on Lines 108 and 3M-1 where critical southwest dip is shown. West of this a major thrust outcrops along the Carcajou River. Closure is present at the Hume level in all directions and a test at SP 14 on Line 3M-1 is warranted. Hume, Bear Rock and Ronning carbonates provide the target for hydrocarbon accumulations.

The Windy Island high is considered prospective for Hume, Bear Rock and Ronning porosity. This is the ancient high tested at the MacKay B-45 well which encountered 1830 feet of oil from the eroded Ronning. Seismic data, although poor in parts of this area suggests that the Hume subcrop exists north of the MacKay B-45 well and would be present in a location on Line 113 at SP 105. This high has been in existence since mid Devonian time and has been subjected to PreCretaceous erosion which stripped the Hume, Bear Rock and part of the Ronning from its crest. This feature is considered as the abutment which deflected Laramide thrusting.

The Kee Scarp prospect recommended is that feature northwest of the Bluefish A-37 well north of the MacKenzie River. This well encountered a Kee Scarp platform and it is postulated a reef may be present, cresting at SP 2074 on Line 63-20. The Canol to Hume isochron map outlines the prospect and it is to be noted that only on one Line (63-20) is the feature



described and on this there are doubts as to the reliability of dips. The criteria is for the Hare Indian reflector to change polarity as a reef is approached; the Canol to Hume interval should thicken due to drape and a slight velocity pullup effect should be anticipated. The first two are believed present but other extraneous dips on the section above the Canol suggest the reef feature may be in question. Nevertheless, a test is recommended to the Hare Indian. In scanning the data for additional Kee Scarp prospects, seismic character on Line 118, SP 280-370 and Line 114, SP 917 indicates the possibility for reef development. This is south of any known Kee Scarp and is of interest and warrants additional investigation and seismic work.

Other features of geologic interest include the Saline River salt basin edge, illustrated on the Hume to Proterozoic isochron map as a thick. In the Vermillion Ridge well (8 km north of Line 101) a 2215 foot section of salt interspersed with anhydrite is present. This section is thinning to the southwest and is believed terminated as shown on the above map. The salt served as a zone for the sole thrust movement described above.

The reflections below the Proterozoic unconformity are particularly good and indications are that an old high was present in a north-south direction west of the line (126°20'W) shown on the enclosed feature map. Although some effect is still noted on the Proterozoic surface the high was generally peneplaned by later erosion and has no economic interest at this time.



A striking series of reversals and dips, have been correlated on the migrated sections at the top of Mt. Cap (brown), particularly on Lines 110 and 112. These are believed spurious and have been investigated by processing the data in unmigrated form as well as over and under migration. These latter displays show a great series of diffractions originating in the salt section where the sole fault has spawned relief faults which have cut the high velocity anhydrite members. Most are believed out-of-the-plane of section and consequently the migration was ineffective and erroneous and of no economic significance.

The three major unconformities, at the base of Cretaceous, Upper Devonian and Devonian occur as opaque areas on the seismic. In some areas these are shown on the sections but cannot be followed extensively. The PreCretaceous unconformity on the eastern side of the area shows the best ~~on seismic and differences in the Hume to Ronning reflectors were noted.~~ On Line 105 the Hume (green) reflector is eroded and the Ronning (purple) replaces it as the major carbonate reflector.

Efforts were made to ascertain areas of porous Bear Rock. On the basis of synthetic seismograms the Bear Rock (blue) reflector should show a reduced amplitude where porosity is present. A scattered series of such anomalies are shown on the Hume structure map but these are not considered worthy of testing unless associated with a structural high. No cases of this co-incidence are noted.



The Cretaceous Sand marker (yellow event) is shown to be an unconformity in many areas as seen on the sections. The overlying clastics thicken to the west and southwest and appear to be sourced in that direction. Porosity in these sands is noted in the wells but no encouragement or hydrocarbon shows are recorded. This part of the section outcrops along the west flank of the Norman and MacKay ranges and no other structural closures apart from the barren MacKay B-45 structure were mapped.

#### Conclusions and Recommendations

Three areas of interest were considered worthy of follow-up action.

**1. Mirror Lake - SP 14, Line 3M-1, 65°N, 126°45'W**

No further seismic is suggested and a test well is recommended.

**2. Jungle Ridge - SP 2074, Line 63-20, 65°N, 125°45'W**

This Kee Scarp prospect should have two seismic lines as additional control over the possible reef. Failing this, a recommendation to drill is submitted.

**3. Windy Island - SP 105, Line 113, 65°N, 125°30'W**

Seismic control to the north, east and west is recommended before testing this feature. Since topographic restraints exist here a program to fit within these is recommended.



Seismic program over the following areas of interest is recommended:

1. **Windy Island (above)**

35 km on 5 lines is recommended as shown on the composite map. These should provide dip and plunge information on the structure. One line extends to the west to cover the fault system postulated northeast-southwest.

2. **Kee Scarp area -  $64^{\circ}40'$ ,  $125^{\circ}45'$**

61 km on 5 lines is recommended to detail the possible Kee Scarp development and fault zone.

3. **Jungle Ridge -  $65^{\circ}N$ ,  $125^{\circ}45'$**

8 km on 1 line is recommended through the location. If this cannot be shot before the drilling program it should be abandoned.

The total program of 104 km (65 miles) could be commenced in early December 1983 to allow for winter drilling. This program is illustrated on the enclosed shot point map.



## APPENDIX A

### FIELD PARAMETERS

#### Recording

Sample Rate	2 milli-seconds
Record Length	3 seconds
Recording Filter	12-128 Hz
Sub-surface Coverage	1200%
Number of Groups	96
Group Interval	33.5 metres
Geophone Array	9 at 3.7 metres
Seismometers per Group	9
Shot Point Location	134 metres
Spread	1608-33.5-0-33.5-1608 m
Holes per Location	1
Hole Depth	14 metres
Dynamite Charge	2 kilograms (single cap)
(After April 1, 1983)	4 kilograms (single cap)

APPENDIX B  
STATISTICAL DATA

Dates

Mobilization Date..... March 4, 1983  
Start of Recording..... ~~March 11, 1983~~  
Completion of Recording..... April 14, 1983  
Demobilization Date..... April 14, 1983

PRODUCTION

Recording

Total operating days..... 42 Camp (Mar.4 - Apr.14)  
Total recording days..... 34  
Total moving days..... Ø  
Total weather days..... Ø  
Total testing days..... Ø  
Total down days..... 1 (shift change)  
Production profiles shot..... 3739  
Kilometres shot..... 497.408  
Profiles per day..... 109.97  
Kilometres per production day..... 14.63  
Total days moving mob/demob..... 1

APPENDIX C

EQUIPMENT AND PERSONNEL

Technical

Amplifiers	Texas Instruments	DFS V
Tape Systems	Texas Instruments	DFS V
Oscillograph	Tektronic	465
Camera	S.I.E.	ERC-10C
Remote Firing System	Input-Output	Encoder/Decoder
Cables	Seismic Cable with 58 foot group interval 24 outlets per cable	1392
Geophone Strings	Mark Products Ltd. 710 OHM coil 9 at 3.7 metres Array	Model L-28 14 Hz

Vehicles

<u>Number</u>	<u>Use</u>	<u>Type</u>
1	Party Manager	F-250 4x4
1	Party Manager/Rec. Shift	F-250 4x4 Crew Cab
1	Recorder	FN-110
1	Shooting	CF-60
4	Cable Trucks	FN-110 Crew Cab



<u>Number</u>	<u>Use</u>	<u>Type</u>
1	Survey Truck	CF-60 Crew Cab
1	Drilling Rig	CF-110 Hillbrand C-1000 Air/Water
5	Drilling Rigs	CF-110 Mayhew Model 1000-Air
1	Drilling Rig	CF-110 Mayhew Model 1000 Air/Water
2	Camp Water Trucks	FN-110 Gin Poles
1	Drill Water Truck	FN-110
2	Mobile Shops	FN-110
1	Expediter Truck	F-250 4x4
1	Supply Truck	F-250 4x4
3	Survey Snowmachines	Polaris Gemini
1	3000 Gallon Fuel Truck	LT-9000 Tandem

#### Camp - Drilling

1	Kitchen - Diner	Sleigh mounted
1	Utility	Sleigh mounted
1	Office-Sleeper	Sleigh mounted
2	Sleepers	Sleigh mounted
1	Power-Shop-Storage	Sleigh mounted
2	Fuel Sloops (6000 gallon)	Sleigh mounted
1	Powder Magazine	Sleigh mounted
1	Incinerator	Sleigh mounted



Camp - Recording

1	Kitchen - Diner	Sleigh mounted
1	Power-Shop-Storage	Sleigh mounted
1	Utility-Sleeper	Sleigh mounted
2	Sleepers	Sleigh mounted
2	Fuel Sloops (6000 gallon)	Sleigh mounted

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DOZER CREWS

Vehicles

5	D7F Caterpillar Tractors	c/w hydraulic blades
1	D6D Caterpillar Tractor	wind and mushroom shoes
1	Bombardier	Foreman's vehicle
1	FN-60 Nodwell	Cat Push's vehicle
1	Evinrude Snowmachine	Cat Push's vehicle

Camp

1	Kitchen-Diner-Utility	Sleigh mounted
1	Sleeper	Sleigh mounted
1	Shop-Power Unit	Sleigh mounted
2	Fuel Sloops (6000 gallon)	Sleigh mounted

Fuel Haul Camp

1 Kitchen-Diner-Sleeper-Power Unit Sleigh mounted



DOZERS

MacMillan Construction Ltd.  
Peace River, Alberta

Borek Construction Ltd.  
Dawson Creek, B.C.

Arctic Circle Enterprises Ltd.  
Fort Good Hope, N.W.T.

HELICOPTER

Kenting Helicopters  
Calgary, Alberta

CAT PUSH

Redgrove Survey and Leasing Ltd.  
Calgary, Alberta



## APPENDIX D

### PROCESSING

Processing of seismic data was done by Petrel Consultants Ltd.

#### Processing Sequence

1. Demultiplex
2. Gather
3. Amplitude Recovery
4. Deconvolution - Spiking
  - .8 - 2.2 gats
  - 072 operator
  - 5% pre-whitening
5. N.M.O.
6. Statics
7. Stack
8. Common Offset
9. R.N.M.O.
10. Automatic Residual Statics
11. Mute
12. 1200% Stack
13. Filter
14. Trace Equalization
15. Migration
16. Display

Both normal and reverse sections, migrated and unmigrated were displayed at 7.5 inches/second