3B

RANGER OIL LIMITED

REPORT ON A SEISMIC SURVEY

CONDUCTED ON

EL 362

FORT LIARD AREA, N.W.T.

9229-B59-5E

COVERING THE PROGRAM CONDUCTED BETWEEN

FEBRUARY 1997 - APRIL 1997

SUBMITTED TO THE NATIONAL ENERGY BOARD

CALGARY, ALBERTA

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by

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NEB AUTHORIZATION #s - 9229-BO59-005E

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I ABSTRACT

A 28.6 km 2D Vibroseis seismic survey was conducted to the northwest of Ranger's EL 362 from February 24 to April 4, 1997 (see Index Map). This program was designed to delineate the thrusted structures of the Middle Devonian Nahanni formation, specifically the porous Manetoe facies which is the reservoir rock in the Pointed Mountain field to the southwest.

After a lengthy processing sequence including post-stack time migration and pre-stack time migration, a time structure map was prepared on the Nahanni carbonate. The processing of these lines took over a year to complete due to experimentation with different statics solutions. These tests were to attempt to properly correct for the extremely deep (+500 m/sec) near-surface fluvial channels filled with low velocity material. (<2000m/sec)

The resultant map shows a complex series of thrusted Nahanni features with potential structural closures colored in orange. the areal extents appear less than what we predicted at our Liard structure (tested by P-66A) but the shallower drilling depth (approx 1600m) could make the targets economically viable.

II INDEX MAPS

124 45' 124 30' 124 15' 124 00' 123 45' 123 30' 123 15'

60 50'

60 40'

60 30'

60 20'

60 10'

60 00'

E.L.362

E.L.365

E.L.363

E.L.364

E.L.366

N-19

P-66A

E-64

D-29

F-28A

POINTED MTN.
MGIP 360 BCF

KOTANEELEE
MGIP 177 BCF

BEAVER RIVER
MGIP 146 BCF

Liard River

Ft. Liard

Liard Highway

Yukon

N.W.T.

British Columbia

25 Kilometers

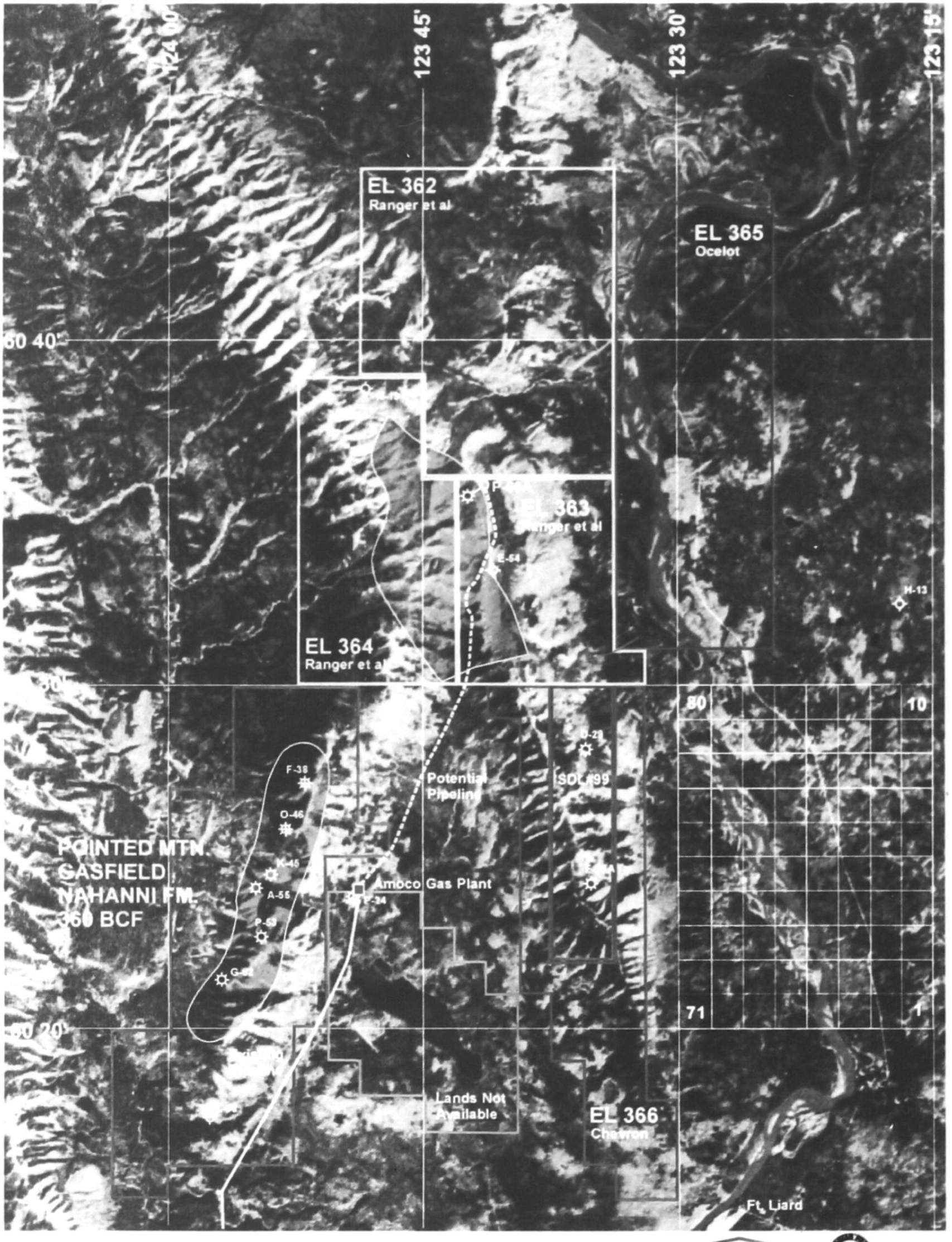
Existing Gas Field
Existing Pipeline
Lands Owned Prior to Nov/94
Ranger Lands Post Nov/94
Others Lands Post Nov/94
Ranger Prospect

Ranger Oil Limited

Liard Area, N.W.T

Index Map

June 1998



June 1998

LIARD AREA, N.W.T

124 00'
123 45'
123 30'
123 15'
60 40'
60 30'
60 20'
80
10
71
1

EL 362
Ranger et al

EL 365
Ocelot

N-19

P-66A

EL 363
Ranger et al

E-54

H-13

EL 364
Ranger et al

D-29

SDL#99

Potential
Pipeline

F-38

O-46

K-45

A-55

P-53

G-62

POINTED MTN.
GASFIELD
NAHANNI FM.
360 BCF

Amoco Gas Plant

F-24

F-25A

Existing
Pipeline

L-98

Lands Not
Available

EL 366
Chevron

Ft. Liard

0 5 10 Km.

June 1998

RANGER et al LANDS-POST NOV/94

OTHERS LANDS-PRE NOV/94

OTHERS LANDS-POST NOV/94

RANGER OIL

LIARD AREA, N.W.T

REGAT

124 00'

123 45'

123 30'

60 50'

60 40'

- NEB Seismic
- Reprocessed NEB Line
- BFR Participation Shoot (1995)
- 1995 Program (24.5 km.)
- 1996 Program (40 km.)
- 1997 Program (28 km.)
- 1997 Program (July)

NAP-002

NAP-003

NAR-004

NAD-002 (OTK-2)

NAK-001

NAK-002

NAD-003 (OTK-3)

NAR-961 (trade)

EL 365
Ocelot/Unocal

NAC-007

NAD-009 (OTK-4)

NAC-008

NAJ-001 (CAM-1)

NAJ-002 (CAM-2)

NAD-005 (OTK-5)

NAJ-003 (CAM-3)

OTK-4
NAB-003

Mount Flett Airfield

N-19

NAB-004 (Tested s.w. Upper Thrust Sheet)

NAJ-004 (CAM-4)

NAC-002

NAQ-005

ROL
EL 362
EL 363

P-66A

CAM-5

NAB-001 (OTK-6)

NAC-003

NAC-005

NAD-006 (OTK-6)

BFR Template

Chevron/ROL
EL 364

E-56

ROL/Cdn. Forest

Liard River

Liard Highway

M	N	O	P
L	K	J	I
E	F	G	H
D	C	B	A

RANGER OIL — Ranger Oil Limited

LIARD - N.W.T

Exploration Licenses 362, 363, & 364

KW/JS | June 1998

III OPERATIONS REPORT FOR LINE NAP – 002, 3, 4

(SHOT IN Mar/Apr 1997)

1. Introduction

NEB authorization #9229-BO-59-005E on EL 362.

In March/April 1997 a seismic survey for Ranger Oil Limited was undertaken by Geco-Prakla (Party 1267) in the Fort Liard area of the Northwest Territories. This section covers pertinent operational information from the survey required by the Canada Oil and Gas Geophysical Operations Regulations.

The survey consisted of three 2D lines totalling 28.6 km over fairly flat, muskeg covered terrain next to the meandering Liard River. The lines, labeled NAP-002, NAP-003, NAP-004, appear on the accompanying location map. Lines NAP – 002 and 003 actually crossed the Liard River.

Heavy snow during the course of the survey resulted in the use of tow cats and the delay of several days.

Fort Liard was used as the main staging area and base for all expediting and supplying of fuel, explosives, groceries, supplies and parts.

All data acquired during this survey was processed in Calgary by Kelman Seismic Processing.

2. Statistical Data

1.0 Personnel

Recording Crew Personnel

1	Supervisor
1	Party Manager
1	Relief PM
2	Field Administrators
1	Vibe Technician
2	Observers
1	Cable Repair
9	Total in Basic Crew

Survey Personnel

The surveying was done by GNG surveys Ltd.

1	Head Surveyor
1	Surveyor
2	Total in Basic Crew

Camp

Supplied by Beaver Enterprises.

One (1) 48 man camp not fully enclosed with 3 sleepers, a kitchen, wash car, office trailer and recreation room. The camp was located at the Hire North yard north and east of the town of Fort Liard. Cat crews and survey crews stayed here throughout the program. The recording crew stayed April 1 to 4. A support vehicle for camp was used for transportation and water hauling.

Line Clearance

Supplied by Beaver Enterprises (9 employed) and Cooper Barging (4 employees) for cat work.

Total Personnel

9	**Recording Crew Personnel**
2	**Survey Personnel**
13	**Field Positions**
0	**Additional Employment**
24	**Total Personnel**

2.0 Equipment

Recording Equipment

1 INPUT/OUTPUT SYSTEM TWO digital telemetry system, comprising:

110	MRX's with solar batteries
165	Spare battery modules
2	Battery Charging Systems
3	ALX's (Advance Line Taps)
1	LIM's (Line Input Module)
1	SCM (System Control Module)
1	SIM (System Interface Module)
1	CSM (Correlator/Stacker Module)
2	SCSI (3480 Cartridge Drivers)
1	OCM (Operator Control Module)
2	HHT's (Hand Held Terminal)
1	Printer

1 TOR GEOscience SRM-48P Digital Filed Monitor w/VibraSig monitoring.

700 Strings of 10Hz geophones (9 phones/string)

115 Tescorp RSC interconnect cables (6 takeouts @ 42m or 84m)

1 Pelton Advance II ESG

Vehicles – Recording Crew

1 Air Conditioned Recording Cabin mounted on a F700 4x4. Separate diesel driven 17 kVA generator supplying power of air conditioning and instrumentation.

1 Party Manager Unit - F250 4x4

4 Line Units – F350 4x4

1 Transport Units – F700 4x4 (or equivalent)

1 Support Unit – F250 4x4

1 Mechanic Unit – F250 4x4

2 Personnel Carriers

1 Battery Charging Unit

1 Cable/Geophone Repair Trailer

2 Snowmobiles/Quads

1 Vibrator Technician Unit

1 Fuel Unit and Spare Parts Trailer

4 Mertz M18H/D Buggy Vibrators

Communication/Office Equipment

16 VHF mobile radio transceivers fitted to vehicles

8 VHF handheld radio transceivers

1 Facsimile machine

1 Photocopier

1 Portable computer

2 IBM Compatible P.C.'s for administration and cost control

Vibrators and Control Electronics (Version 5.1 Hardware)

4 Mertz M18HD Vibrators with Advance II Electronics (Version 5E)
1 Vibrator Technician's Unit
1 Vibrator Fuel/Support Unit

4 Mertz M18 HD P-wave Vibrator units mounted on 4x4 buggy each fitted with the following:

- Pelton Advance II Vibrator Control Electronics (Version 5E)
- Geo-Prakla's Zero Leak Fueling System
- Mandatory Escape Hatches and Catwalks for Safety
- Automatic Low Press Hydraulic Shut Down Systems
- Automatic Air-bag Filling System

- 20,000 lb Hydraulic winch
- Air Conditioning
- VHF Mobile Radios
- HD modifications increasing peak fore to >50,000 lbs

Four high output vibrators (Mertz M-18HD) are mounted on 612 buggies. These units have a peak force in excess of 50,000 lbs over a frequency range of 5-250 Hz.

The vibrators are equipped with Pelton Advance II control electronics which feature enhanced ground force control and phase locking, non-linear sweep (dB/oct and segmented dB/Hz) capability and vibrator QC options.

Pelton DR servo Valve Enhancement equipped on all Geco-Prakla M-18 Vibrators

3.0 Significant Dates

February 24	Cutting started.
April 1	Recording commenced.
April 4	Recording completed.

4.0 Production Statistics

	Fort Liard
Total VPs	718
Days Worked	4
Kms Recorded	28.6
Weather Days	0
Total Days	4
Total Hours	62.5

3. Field Procedures

1.0 Conditions

Other than heavier than usual snowfall, conditions were reasonable with no recording shifts lost due to weather.

2.0 Topography

The Topography of the area was low ground, lots of muskeg, located at the base of the eastern slopes of the Liard Range. Two lines crossed the Liard River.

3.0 Survey

The survey was done by conventional methods, using theodolite, EDM and chainage.

4.0 Camp

One camp was in operation for this survey and was located at the Hire North yard which is north east of the town of Fort Liard. Access to the survey area was achieved via the Fort Simpson highway.

5.0 Data Acquisition

5.1 Recording Parameters

	NAP 002, 003, 004
Program Size	28.6 kms
Record Length	5 sec
Sample Rate	2 ms
No. of Groups Active	323
Receiver Interval	20 m
Phones/Group	9
Source Interval	40 m
No. Source Points	718
No. of Sweeps	4
Sweep Length	12 secs
Field Filter	out - 207 hz
Notch Filter	out
Sweep Frequency	10 – 100 hz
Boost	3 db/octave
Sweep Taper	0.25 sec
No. of Vibrators	4

5.2 Spread Configuration

3220 - x - 3220
6440m Total Spread

4. Data Processing Parameters

1.0 Seismic Data Processing Sequence

The data acquired from the Liard River area was processed by Kelman Seismic Processing. To all three lines in the survey, the following sequence was applied:

Demultiplex:

Process sample rate:	2.0 ms
Process record length:	5.0 sec

Amplitude Recovery:

Exponential gain curve	K[T]PWR[N][EXP[AT]] K=1 A=0 N=2

Trace editing

Phase compensation

Type:	Instrument and geophone

Vibroseis Phase Compensation

Method:	Clauder wavelet to minimum phase

Deconvolution

Type:	Surface consistent spiking
Operator Length:	80 ms
Prewhitening:	1%
Design gate:	800 - 2200 ms at 20m offset 1400 - 2300 ms at 3220m offset
Offset range:	600 - 1600 m

Partial Spectral Balancing:

Frequency	10 - 100 Hz

Equalization:

Design gate	Same window as decon.

Statics (Refraction)

Method	GLI
Frequency spacing	Every shot
Datum elevation	500 m
Weathering velocity	762 m/sec
Replacement Velocity	4000 m/sec

Sort:
To common depth point

Velocity Analysis:

Type:	Constant percentage moveout

Statics (Residual):

Type:	Automatic surface consistent
Correlation Window:	300 - 3000 ms
Maximum Shift:	+/- 32 ms
Correlations per trace	15
Number of iterations	2

Velocity Analysis:

Type:	Constant percentage moveout

Statics (Residual): Second Pass

Type:	Automatic surface consistent
Correlation Window:	300 - 3000 ms
Maximum shift:	+/- 16 ms
Correlations per trace	15
Number of iterations	2

Normal Moveout Correction:
Datum referenced to plotted weathering replaced surface.

Pre-Stk Mig. Vel. Analysis:

Type	Constant percentage moveout

Mute Pattern:

Distance	440 640 3220 m
Time	-300 500 800 ms

Equalization:

Design window	500 ms AGC

Full Pre-Stack Time Migration:

Type	Kirchoff summation

Datum referenced, to plotted weathering replaced surface, separately at shot and receiver

Stack:

Spike Suppression	3:1 threshold
Fold	50

Filter:
Frequency 10/15 - 45/55 Hz

Equalization:
Design window 600 ms AGC

Display Parameters

Film Display:

Horizontal: 40 Traces/Inch (400m/inch)
Vertical: 5 Inches/second (400m/inch)
Approx 1:1 scale

IV SAFETY PROGRAM

For the advance crews, general safety meetings were held one a week and each crew was involved in a start-up safety meeting before going to the field.

For the recording crew safety briefings were held every morning by Scott Anderson and there was a startup meeting at the beginning of the job.

Several spot safety briefings were held throughout the job pertaining to general health and safety and hazards on the program to be aware of.

V TECHNICAL DISCUSSION and INTERPRETATION

1. Data Quality

The data quality was generally poor near the Liard River due to two main factors: (1) river noise and (2) deep paleo-channels filled with low velocity drift. The key parameters that led to improved data quality were:

IN ACQUISITION

- high fold/short group interval 80 FOLD, 20m GI
- 4 vibrators
- a I/O digital telemetry system - 24 bit recording

IN PROCESSING

- comparison of the GLI method of statics vs the First-Break method showed the former handled the huge channels more effectively,
- note that the prestack time migration is not a large improvement over the post stack migration.

2. Reflection Identification

The reflections carried on the NAP lines (see interpreted sections included) were:

Red	Base of surface alluvial channel
Green	Mid Besa River marker
Purple	Top Nahanni Carbonate
Yellow	Pre Devonian (Cambrian Clastics)
Red	Pre Cambrian

These reflections are correlated from the NAK – 001, 002 lines shot by Ranger in March 1996. NAK – 002 ties the SE end of NAP – 004 and NAK – 001 ties NAP – 004 at SP 309. The Nahanni reflection on NAK – 002 has been tied in via lines NAD – 005, NAB – 003, NAD – 010 and NAQ – 005 into Ranger's P-66A well. This well encountered the Nahanni top at –2230m (subsea) at the TWT of 1345ms on the prestack time migration section. The Nahanni reflector in most of the Liard area is characterized by a strong trough followed by a wide doublet trough. This reflection is the main strong event after a tremendous thickness of Besa River shales (up to 2500m).

The other reflectors are characterized by:

The base of alluvial channel: The first strong undulating reflection with intra channel parallel reflectors above it.

The Mid-Besa River Shale: The main reflector above the Nahanni.

The Cambrian Clastics: First of 3 or 4 strong low frequency reflectors below a dim zone of approx 300 msec below the Nahanni top.

The PreCambrian: Base of the Cambrian ringing section and above a chaotic zone of discontinuous reflectors.

3. Velocity Control

Velocity control in the area is poor, since the velocities of the four seismic tie wells were unreliable, six other wells with better sonics were used for velocity control:

b-21-K/94-0-14
c-51-B/94-0-14
MURPHY NETLA M-31
AMOCO E. FLETT H-13
ARROWHEAD N-02
IMPERIAL NETLA C-07

- see previous report by J.R. Sluggett on the Fort Liard Area
- we also have good velocity control from the P-66A Fort Liaard well (see attached synthetic)

4. Interpretation

Refer to the previous report by J.R.Sluggett regarding the description of structural features in the Liard area.

The Liard Plateau is a complex structural area where pre-Laramide normal faulting has been overprinted with several ages of Laramide thrusting from west to east. There is evidence of out-of-sequence thrusting on line NAB – 4 to the south which complicates the interpretation since thrusted highs can be sheared off by a later thrust.

The NAP – 002, 3, 4 lines were located to detail a structural feature seen on the eastern ends of lines NAK – 001 and 002.

As can be seen on the Nahanni Time Structure map there are several thrust – created closures coloured in orange. As interpreted, these can be divided into the following structures:

Structure A	High pt 1095msec @ SP 285 on line NAP – 004 approx 4 sections (10km²) in area
Structure B	High pt 1095msec @ SP 301 on line NAK – 002 approx 3.5 sections (9km²) in area
Structure C	High pt 915msec @ SP 421 on line NAK – 002 approx 1 section (2.5km²) in area
Note	this is the only location possible on EL 362 and is not a prime location since the areal extent is so small
Structure D	High pt 715msec @ SP 201 on line NAK – 001 approx 2.5 sections (5km²) in area
Structure E	High pt 730msec @ SP 653 on line NAP – 004 approx 8 sections (20km²) in area
Note	The seismic processing datum used was 500m

It appears that with the complexity of the faults as presently mapped there is a definite need to shoot 3D seismic to confirm closures, areal extents, fault leakage and migration paths. Any or all of the above locations have risks associated with the general regional trend climbing to the North. We know that the Nahanni outcrops further North so this is a definite risk.

VI CONCLUSIONS

- The severe, deep alluvial channels created major problems in processing and in creating a proper structural picture on the Nahanni target. Data quality nevertheless was fair.

- A Time Structure Map prepared on the Nahanni Carbonate indicates several closed thrusted features, which as we have learned from the successful Ranger et al P-66A well to the South, could hold hydrocarbons. The depths to these features range from 1160m (730msec) on line NAP – 004 to 2100m (1095msec) on line NAK - 002.

- Velocity control derived from sonic logs from nearby wells give a rough estimate of velocities. These velocities were verified from the prestack time migration processing panels

- Porosity in the Nahanni can not be mapped directly but the numerous faults should create an extensive fracture system.

VII LIST OF ENCLOSURES

1. TIME STRUCTURE MAP - NAHANNI 'LIARD SHEET' 1:50,000
2. SHOT POINT LOCATION MAP 1:50,000
3. SYNTHETIC SEISMOGRAM on P-66A
4. INTERPRETED SECTION FOR LINE NAP - 002
5. INTERPRETED SECTION FOR LINE NAP - 003
6. INTERPRETED SECTION FOR LINE NAP - 004