



**CANADIAN FOREST OIL LTD.**  
**FINAL PLAN REPORT**

**Area of Exploration:** Crown Acreage northwest of Cdn. Forest I-61  
2D shot as part of EL380 program

**Operated by:** Canadian Forest Oil Ltd.

**Operation Number:** 9229-C131-2E

**Land Use Permit:** 9180-C831-3

**Type of Operation:** 2D Seismic Acquisition  
Line: 99-SAW-001

**Location:** NWT Liard  
60 56 32.47 -123 32 05.27  
60.43 44.42 -123 39 50.58

**Duration of Operation:**  
**Principle Contractor:** Schlumberger Geco Prakla & Polaris Explorer,  
both of Calgary.

**Interest Owners:** Canadian Forest Oil Ltd 100%

**Author of Report:** Kenneth I. Mitchell - Senior Geophysical Specialist  
Linda Dickson -Geophysical Technician  
Canadian Forest Oil Ltd.

**Date of Report:** September 1, 2000

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## Abstract

A 2D acquisition program in the Maxhamish, B.C. - Fort Liard, N.W.T. was conducted by Canadian Forest Oil Ltd.. Approximately 25 km of 2D Dynamite data was acquired at Sawmill Mountain, as detailed in this report.

In this summer-season program, heliportable acquisition techniques were employed in conjunction with hand cut, avoidance line clearing methods to achieve efficient, safe and low-impact seismic acquisition. Canadian Forest Oil Ltd. assigned Synterra Technologies Ltd and Geco-Prakla (Schlumberger) to oversee the entire program. Impact Exploration Services Inc. secured the original regulatory approvals in the Ft Liard area, and continued to secure amendments and revisions, including addition of the Sawmill area. Geco-Prakla was the principle acquisition contractor, however due to weather considerations and timely crew availability, Polaris Explorer Ltd were hired to assist in completing the shooting phase of the program. Beaver Enterprises provided line clearing and provide camp services. Double R Drilling performed heli shot-hole services. Deh Cho Air was the supplier of helicopter support on all aspects of the job. The approximate elapsed time taken to complete the program was 56 days.

The seismic source was 20kg of dynamite loaded at a 20 m depth. The receiver layout consisted of 480 channels in a split spread configuration at a 15 m group interval, 90 m shotpoint interval and far offset of 3600 m. Geophones used for this survey had a 10 hz resonant frequency. Sample Rate was 2 ms and record length was 6 sec.

Processing was completed by Kelman Seismic Processing of Calgary.

The data quality for this program was fair to good. Many of the lines exhibit noise interference attributed to rugged topography, multiples and near surface effects. The seismic raypaths were subjected to distortion by structures created by compressional tectonics (both near surface and deep subsurface) and near surface velocity variations. Only some of this distortion could be corrected through seismic processing. In addition, gravel deposits located by the Liard River created considerable signal-to-noise loss through poor coupling and raypath scattering. As is common in the Ft Liard area, the Nahanni reflector exhibits spurious end-of-line effects, and this is observed at the north and south ends of 99-SAW-001. The low fold portion of these lines, terminating in rugged topography over near surface gravels are prone to poor resolution of dips. Despite these issues, an interpretation of the Devonian Nahanni reflector has been generated with reasonable confidence. Since this survey was only a single strike line, no time structure map has been prepared.

**None of 99-SAW-001 was within, or immediately adjacent to, an Exploration License nor does CFOL claim any of the costs of this program against a DIAND work bonus.**

Line statistics are as follows:

| <u>Line Name</u> | <u>Work Bonus S.P. Range</u> | <u>Actual S.P. Range</u> | <u>Work Bonus Mileage</u> | <u>Actual Mileage</u> |
|------------------|------------------------------|--------------------------|---------------------------|-----------------------|
| 99-SAW-001       | s.p. 191 - 765               | s.p. 191 - 977           |                           | 25.21 km              |
|                  |                              | Total Mileage            |                           | 25.21 km              |

61-00N 123-45W

61-00N 123-30W

60-50N 123-45W

60-50N 123-30W

**99-SAW-1**

Scale: 1:0

Printed: 13-DEC-2000

Datum: NAD83

Projection: Mercator

Origin: Lon: W68°, Lat: 0°

10,000 meters

Figure 1. Location Map

**CANADIAN FOREST OIL LTD.**

## **Significant Dates and Statistics Summary**

A summary of the significant dates are chronologically listed below.

April 1, 1999 Application for several lines submitted under N1998B0934  
May 17, 1999 Revision 5 applied for by Impact Exploration Services no individual lines listed  
May 31, 1999 Amendment for Land Use 1998B0934 authorized to conduct seismic revision dates April 21, 1999  
June 1, 1999 Preliminary screening notification from NEB 9229-C131-2E

July 24, 1999 Geco Prakla Advance Party Manager arrives on Project #310537 (Till Sept 2)

August 24, 1999 Surveying Starts

August 25, 1999 Line Clearing commences

September 17, 1999 Line Clearing & Survey completed

October 14, 1999 Shot hole drilling commences

October 22, 1999 Shot hole drilling completed

October 23, 1999 Polaris Explorer Mobilizes to Project

October 24, 1999 initial layout

October 25, 1999 first full day of layout and shooting

October 28, 1999 shooting complete, final pickup, demob.

November 3, 1999 Inspection completed by Indian and Northern Affairs

## **Weather Summary and Topographic Conditions**

|                 |   |
|-----------------|---|
| August 26, 1999 | Fogged in crews, stand by; drill crew got out late p.m.; intermittent rain throughout day |
| August 27, 1999 | Heavy Fog till mid p.m.; crew eventually got out  |
| Sept 8, 1999    | Standby - overcast conditions - no production.  |

## **General Description of Operation and Acquisition**

### **Seismic Equipment Used**

Polaris Explorer Ltd. shot this survey using an ARAM24 Central Recording Unit. ARAM24 24-bit Delta-Sigma analog to digital converters to ensure quality system response. The system also offers integrated "Positive Operation Lights", indicate remote unit function at the moment of deployment. This facilitates the deployment crew in troubleshooting, further improving overall deployment time.

Acquisition parameters and filter settings are fully described in the "Acquisition Parameters" section, below

## Acquisition Parameters

The energy source used for this survey was dynamite. The program configuration and instruments are listed below:

**Configuration:** 3600—15°-15—3600m  
1—240°-241—480

### Instruments

Make/model: Aram 24 Mark I  
S.R. 2ms  
Length: 6 sec  
Filter: 3 -164 hz  
Notch: out  
Format: Seg-Y

### Geophones

Type: OYO GS30  
Frequency: 10 hz  
Damping:  
Number/Group 6  
Spacing : 3m  
Group Length: 15 m

### Source

Type: Dynamite  
Charge: 20 kg  
Depth: 20 m  
No inline: 1

### Spread

Fold: 4000 pct  
S.P. Int: 90 m  
Grp. Int: 15 m

## Geophysical Data Processing

The data was processed by Kelman Seismic Processing of Calgary employing a standard, structural processing runstream. (See section side labels for full detail.) Surface consistent spiking deconvolution was applied, followed by GLI refraction static analysis and correction. Normal moveout velocity analysis and corrections were run. Two passes of residual statics were performed, the last followed a moveout velocity update. An FK noise attenuation filter was applied. A Post Stack Migration using Kirchhoff summation was used on the data, providing good results, such that it was not deemed necessary to pursue Pre-Stack Migration methods at this time. A copy of the processing side label is found in Enclosure 2.

## Geophysical Interpretation

Copies of interpreted seismic data from the program are located in Enclosure 3 of this report. Copies of synthetic seismograms referenced are located in Enclosure 4.

This survey was designed to provide an initial assessment of key structural features of the Devonian Nahanni Formation. The line was programmed in an orientation that is sub parallel to the expected strike of the Nahanni in this area, as identified by surface geology and gross, regional subsurface control. Interpreted seismic lines show CFOL's correlation of the Nahanni, as jump-tied to Ranger-CFOL P66a and CFOL I-61, near-by exploratory wells on EL363 and EL365.

Other formations correlated include the Flett Carbonate, Top of Besa River Shale, Top of Horn River Shales and the Cambro-Ordovician Marker. These correlations are tentative and preliminary. The Flett and Besa River are estimated from surface geologic mapping prepared by the GSC that show the Besa

River outcropping over most of the survey. The Horn River lies immediately above the Nahanni and has been jump-correlated from P-66a and N-61. The Cambro-Ordovician Marker is a seismic reflection package without any direct well log tie or penetration that has strong reflectivity below the Nahanni.

On line 99-SAW-001, the Nahanni is observed to be broken by north and south verging thrust faults. These thrust structures can be prospective if they demonstrate three-way closure against the thrust fault. Recent drilling to the Nahanni, south of this program, has encountered high-deliverability gas reservoirs and created much new industry interest in the area.

As this line is a single strike line, no time structure map can really be prepared. Without other seismic data, this line cannot establish three-way closure against a thrust fault. However, significant fault discontinuities and relative two-dimensional structure can be gleaned from the line profile of 99-SAW-001.

From knowledge of the structural style of the greater Ft Liard area, the author contemplates a model of multiple, curvilinear faults (observed from plan view). These scallop-shaped faults tend to coalesce into several, larger scale fault traces that define the main structural trends in the area. 99-SAW-001 demonstrates the northerly (north to north west) and southerly (south to southeast) vergence of a typical scallop-shaped thrust. From surface geology, and area knowledge, the author speculates that an east-verging component of the thrust faults observed on 99-SAW-001 is likely to be found. If further corroborating information becomes available about the Nahanni structure in dip orientation, this could be an attractive, three way dip closure against a thrust fault.

The 2D seismic data, alone, cannot predict reservoir quality of these Nahanni structures. However, it is anticipated that the best relative permeability on any of these structures will occur where the Nahanni is located closest to the leading edge of a thrust fault. Here, open fractures will be relatively most intense and therefore should enhance reservoir quality. Empirically, it has been observed that loss of Nahanni reflector coherency and continuity near the thrust fault zone is indicative of fracture porosity.

In discussing the potential for Nahanni gas in the Sawmill area, caution is in order with regard to the elevation of the Nahanni: any potential closures may be breached. The Amoco N-19 well is a tangible example of this risk. At N-19, the top-sealing Besa River Shales are likely fractured with numerous thrust faults and thin compared to the same shale at areas with known Nahanni production. N-19 yielded a significant, wet Nahanni reservoir. Further, it is known that the Nahanni formation outcrops at Nahanni Butte, a mere 20 km north of 99-SAW-001. The potential Sawmill Nahanni prospect, if present, may not be a commercial success due to trap and seal issues.

We recommend additional acquisition of seismic data, especially in an east or northeast dip orientation to further delineate this structure. However, we are extremely reluctant to incur any further expenditures until there is much more clarity and certainty that there will actually be an issuance of P&NG rights in this area.



**CANADIAN FOREST OIL LTD.**

## **FINAL PLAN REPORT**

**Area of Exploration:** EL 380 2D  
(Lines: 99-EL380-10, 12, 14, 16, 18, 20)

**Operated by:** Canadian Forest Oil Ltd.

**Operation Number:** 9229-C131-2E

**Land Use Permit:** 9180-C831-4

**Type of Operation:** 2D Seismic Acquisition

**Location:** NWT Liard  
60.18408 -123.35988  
60.52840 -123.68720

**Duration of Operation:** July 16, 1999 to September 9, 1999

**Principle Contractor:** Schlumberger Geco Prakla of Calgary

**Sub Contractors:** Polaris Explorer Ltd of Calgary

  

**Interest Owners:**

|                               |     |
|-------------------------------|-----|
| Canadian Forest Oil Ltd       | 40% |
| Berkley Petroleum Corporation | 30% |
| Paramount Resources Ltd       | 30% |

**Author of Report:** Linda Dickson -Geophysical Technician  
Kenneth I. Mitchell - Senior Geophysical Specialist  
Canadian Forest Oil Ltd.

**Date of Report:** March 31, 2000



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| 4e     99-EL380-18  |             |
| 4f     99-EL380-20  |             |
| 4g     99EL380-003 **   |             |
| 4h     FVL-FTL-13 **  |             |
| 4i     FTL-51 **  |             |
| Interpreted Map   | Enclosure 5 |
| F-25  | Enclosure 6 |
| ** (lines included only because they are referenced on map. They are not part of the final submission.) |             |

## Abstract

A 2D acquisition program in the Maxhamish, B.C. - Fort Liard, N.W.T. was conducted by Canadian Forest Oil Ltd. in conjunction with its partners over EL 380. Approximately 54 km of 2D Dynamic data was acquired under this seismic program approval.

In this summer season program, heliportable acquisition techniques were employed in conjunction with hand cut, avoidance line clearing methods to achieve efficient, safe and low-impact operations. Canadian Forest Oil Ltd. assigned Jack Bull of Synterra Technologies Ltd and Geco-Prakla (Schlumberger) to oversee the entire program. Impact Exploration Services Inc. were contracted to secure necessary regulatory approvals. Geco-Prakla was the principle acquisition contractor, however due to weather considerations and timely crew availability, Polaris Explorer Ltd were hired to assist in completing the shooting phase of the program. Beaver Enterprises were hired to do the line clearing and provide camp services. Double R Drilling provided heli shot-hole services. Deh Cho Air was the supplier of helicopter support on all aspects of the job. The approximate time taken to complete the program was 56 days.

The seismic source was 20kg charge of dynamite loaded at a 20 m depth. The fold was 4000 with shotpoint interval of 90 m and group interval of 15 m. The six-geophone strings were individually spaced at 3 m, and group length was 15 m. Geophones used for this job had a 10 Hz configuration. Sample Rate was 2 ms and record length was 6 sec.

The data quality for this program was fair to good. Many of the lines exhibit noise interference attributable to rugged topography, multiples and near surface effects. The seismic raypaths were subjected to distortion by compressional tectonic structures (both near surface and deep subsurface) and near surface velocity variations. Only some of this distortion could be corrected through seismic processing. In addition, gravel deposits located by the Liard River created considerable signal to noise loss through poor coupling and raypath scattering. As is common in the Ft Liard area, the Nahanni reflector exhibits spurious end-of-line effects, especially at the west end of the program. The low fold portion of these lines, terminating in rugged topography are prone to poor resolution of dips. Despite these issues, an interpretation of the Devonian Nahanni time structure has been generated with reasonable confidence.

Processing was completed by Kelman Seismic Processing of Calgary. Data was then transferred to a SeisX workstation for in-house interpretation.

The following Portions of lines were deemed to be within 3 kilometers of EL 380 and would qualify for DIANDS work bonus program:

| Line Name                   | Work Bonus S.P. Range | Actual S.P. Range | Work Bonus Mileage | Actual Mileage |
|-----------------------------|-----------------------|-------------------|--------------------|----------------|
| 99-EL380-10                 | s.p. 191 - 765        | s.p. 191 - 977    | 8.9 km             | 11.79 km       |
| 99-EL380-12                 | s.p. 106 - 605        | s.p. 101 - 605    | 7.7 km             | 7.56 km        |
| 99-EL380-14                 | s.p. 89 - 533         | s.p. 89 - 533     | 6.7 km             | 6.66 km        |
| 99-EL380-16                 | s.p. 98 - 875         | s.p. 101 - 947    | 12.0 km            | 12.69 km       |
| 99-EL380-18                 | s.p. 47 - 691         | s.p. 47 - 545     | 7.0 km             | 7.47 km        |
| 99-EL380-20                 | s.p. 101 - 557        | s.p. 83 - 605     | 7.4 km             | 7.83 km        |
| Approximately Total Mileage |                       |                   | 50.0 km            | 54.0 km        |

## Significant Dates and Statistics Summary

A summary of the significant dates are chronologically listed below with the increase / decrease of personnel noted alongside. Others requested statistics are quoted as requested.

April 1, 1999 Application for several lines submitted under N1998B0934

May 17, 1999 Revision 5 applied for by Impact Exploration Services no individual lines listed

May 31, 1999 Amendment for Land Use 1998B0934 authorized to conduct seismic revision dates April 21, 1999

No line names listed

June 1, 1999 Preliminary screening notification from NEB 9229-C131-2E

July 21, 1999 A copy of authorization received space Lines 99-EL380-1, 2,3,4a, 4,45e were revised and the line names were changed to 99-EL-380-10, 12, 14, 16, 18 and 20 plus the addition of the 3D

July 16, 1999 Surveying Starts

July 16, 1999 DC Surveys - catpush/survey started

July 24, 1999 Geco Prakla Advance Party Manager starts on Project #310537 (Till Sept 2)

July 26, 1999 Beaver Enterprises started clearing / slashing

July 28, 1999 Survey Crew arrived, start up beginning with line 99-EL380-18.

July 29, 1999 moved line 14, sent Revision plots to Synterra

July 30, 1999 slashing started on line 16 (4 crews) and one crew on line 12 (5 Crews)

August 11, 1999 Flight with Rick Turner from NEB to inspect Manahamish

August 22, 1999 Beaver Enterprises complete clearing (42 Slashers used for this job)

August 25, 1999 Eagle Surveys Ltd line completed (4 surveyors used)

August 25, 1999 Layout Crew started for Line 20

August 26, 1999 Geco Records line 20

September 1, 1999 Mobilized Dynamite Crew from Calgary to Ft. Liard (Polaris Exploration Ltd)

September 1, 1999 Started Drilling

September 9, 1999 Demobilized Dynamite Crew from Ft. Liard to Calgary (Polaris Exploration Ltd)

November 3, 1999 Inspection completed by Indian and Northern Affairs

## Weather Summary and Topographic Conditions

July 24, 1999 dense fog in am work delayed  
July 28, 1999 Heavy Rain in morning, very low cloud cleared at 11:00 am. Steep terrain on 99-EL380-18 sp 373-499 and Line 20 sp 379-493  
July 29, 1999 Rain, cool, overcast. Very dangerous cliff on Line 20 sp 493-605  
July 30, 1999 Warm and sunny. Very rough terrain and cliff needed hang ropes on line 20  
July 31, 1999 Sunny, late start due to safety meeting. Very rough terrain thru creek area on line 20 sp 401-469  
August 1, 1999 Very hot waited on beach for helicopter. Good day working in river flats  
August 2, 1999 Hot, worked on line 99-EL380-16  
August 3, 1999 Survey crew found steep terrain and weather conditions were hot, working on line 14 and 16  
August 4, 1999 Weather is warm  
August 7, 1999 Weather is warm, had a bear encounter  
August 8, 1999 Thunder storms and heavy rain overnight, low cloud and rain in morning, stand by till 10:30 weather day declared  
August 9, 1999 Shut down due to fog and rain  
August 10, 1999 Stand by due to weather, heavy fog in morning, cleared off in late afternoon  
August 11, 1999 Clearing and warm, working on 99-EL380-10 very wet  
August 12, 1999 Weather was good - escaped bear valley with no sightings  
August 13, 1999 Scout large swamp on line 10 and river crossing on line 16  
August 15, 1999 Weather is great, conquered big hill on 99-EL380-10, lots of bugs no bears  
August 18, 1999 Finish surveying line 99-EL380-16 weather is good  
  
August 26, 1999 Fogged in crews, stand by, drill crew got out late p.m., intermittent rain throughout day  
August 27, 1999 Heavy Fog till mid p.m., crew eventually got out  
August 29, 1999 Drill crews could not get out till noon due to fog  
Sept 8, 1999 Standby - overcast conditions - no production

## General Description of Operation and Acquisition

### Seismic Equipment Used

Geco-Prakla (Schlumberger) employed an I/O System II for acquisition of Line 99-EL380-20 only. This system is an advanced delta sigma technology data acquisition system offering numerous advanced recording and signal processing features found on no other recording system. Amongst these features are

- Full 24 bit analog to digital recording
- Spectral Shaping Filter (SSF)
- Enhanced Hi-Line Pickup Eliminator
- Total Self Calibration Testing
- Increased Spatial Sampling
- Reduced field battery power requirements
- 32 available low cut frequencies and appropriate low cut filters

Polaris Explorer Ltd. shot the remaining lines of this survey using an ARAM24 Central Recording Unit. ARAM24 24-bit Delta-Sigma analog to digital converters to ensure quality system response. The system also offers integrated "Positive Operation Lights", indicate remote unit function at the moment of deployment. This involves the deployment crew in troubleshooting, further improving overall deployment time.

## Survey Equipment Used

The Geco-Prakla survey equipment employed was a combination of conventional survey methods and real time GPS. The equipment includes Wild T1, T16 and DI-41 theodolites or Topcon GTS-3B Total Stations with integral infra-red distomats and electronic data recorders. Data reduction was assisted by the Precise positioning software which produced SEGP1 formatted survey. The GPS equipment was a Trimble 4000SE/See receiver with an antenna, radio modem and supporting software. The software enables upload and download of preplots as well as transformation from WGS-84 to a local datum (NAD 27) and map projection (UTM).

The system configuration features a reference receiver located at a known point that broadcasts via the Radio modem, the code and carrier phase data in a compressed format to rover receivers. The rover receivers receive the broadcast to enable computation of a refined position. The real time GPS crew used 1 master GPS unit and rover GPS units complete with modem and radio link. The results of this survey methodology provided spatial accuracy approximately  $\pm 1$  meter.

## Acquisition Parameters

The principle energy source for these lines were dynamite. The program configuration and instruments are listed below:

**Configuration:** 3600—15°-15—3600m  
1—240°-241—480

### Instruments

Make/model: Aram 24 Mark I  
S.R. 2ms  
Length: 6 sec  
Filter: 3 - 164 Hz  
Notch: out  
Format: Seg-Y

### Source

Type: Dynamite  
Charge: 20 kg  
Depth: 20 m  
No inline: 1

### Geophones

Type: OYO GS30  
Frequency: 10 Hz  
Damping:  
Number/Group 6  
Spacing: 3m  
Group Length: 15 m

### Spread

Fold: 4000 pct  
S.P. Int: 90 m  
Grp. Int: 15 m

## Geophysical Data Processing

The data was processed by Kelman Seismic Processing of Calgary employing a standard, structural processing runstream. (See section side labels for full detail.) Surface consistent spiking deconvolution was applied, followed by GLI refraction static analysis and correction. Normal moveout velocity analysis and corrections were run. Two passes of residual statics were run, the last followed a moveout velocity update. An FK noise attenuation filter was applied. A full Pre-Stack Migration using Kirchhoff summation was used on the data. The resulting product was then archived to tape and loaded onto a Solo-X workstation for interpretation purposes. Copies of the processing procedures are found in enclosure 1.

## Geophysical Interpretation

Copies of interpreted seismic data from the program are located in enclosure 4 of this report. Although this program only included the lines 99-EL380-10,12,14,16,18,20, the following additional lines are included in this report: 99-EL380-003, FTL-51, FTL-13. All of these lines contribute to the mapping presented in enclosure 5. Detail of the acquisition of 99-EL380-003 was reported to the NEB previously in CPOL's report on Operation Number 9229-C131-1E. FTL-51 and FTL-13 are part of a speculative seismic survey database owned by EXPLOR Data Ltd, that was purchased by CPOL.

This survey was designed to provide data for mapping of the Devonian Nahanni Formation. Interpreted seismic lines provide the correlation of this reflector, as tied to the well F2./ F-25a, the original Nahanni discovery well on SDL99.

The Nahanni is observed to be broken by east verging thrust faults. These thrust structures can be prospective if they demonstrate three-way closures against the fault. The most attractive of these prospective structures are observed on the SDL99 trend, where Nahanni gas was discovered in the mid 1980's. Recent development drilling on SDL99 has "discovered" high-deliverability gas and created much new interest in the area.

Other, smaller, east-bounded-fault closures are recognized on EL380, and these are significantly lower in time structure than the structures to the west.

The map of the Nahanni demonstrates a scallop-style plan view of the faulting that is common in the Ft Liard area. These scallops tend to coalesce into several, larger scale fault traces that define the main structural trends in the area.

The 2D seismic data, alone, cannot predict reservoir quality of these structures. However, it is anticipated that the best relative permeability on any of these structures will occur where the Nahanni is located closest to the leading edge of a thrust fault. Here, open fractures will be relatively most intense and therefore should enhance reservoir quality.