

9229 C4 16E

Final Report

Of the

Geophysical Operations of 2000.
Proverbs-2D program
(Flett Anticline, Line 30xb)

Chevron Canada Resources

Robert Taerum PGEOPH

20 April, 2001

Operator: Chevron Canada Resources

Contractors: Veritas; MWH Geo-Surveys Ltd.

Operations: Gravity & Seismic

Location: 55 km NNW of Fort Liard

Date: 29 July, 2000 – 17 Sept, 2000

NEB Authorization Number: 9229-C4-16E

<i>Seismic Operations</i>	3
Acquisition Dates.....	3
Size	3
Spread Parameters	3
Source Parameters	3
Recording Equipment	3
Surveying System	3
Terrain	4
Personnel	4
Weather	4
<i>Gravity Operations</i>	5
Acquisition Dates.....	5
Recording Equipment	5
Surveying System	5
Field Procedures	5
Location.....	6
<i>Project Overview</i>	7
Purpose.....	7
Topography.....	8
<i>Results and Interpretation</i>	9
Stratigraphy	9
Structure	10
Gravity	11
Seismic ties to Geology	12

Seismic Operations

Chevron Canada Resources Program Name: Proverbs

Contracting Crew: Veritas

Acquisition Dates

Operation	Start Date	End Date
Slashing	3 Aug 2000	14 Aug 2000
Survey	29 July 2000	14 Aug 2000
Drills	23 Aug 2000	7 Sept 2000
Recording	9 Sept 2000	16 Sept 2000

Size

- Length of Survey: 19.20 linear kilometres
- Average Acquisition Rate: 2.4 kilometres per day

Spread Parameters

- Number of Traces: 450
- Geophones per Group: 6
- Geophone spacing: 3.3 metre; 20 m linear array
- Shot Point Interval: 120 metres in line
- Group Interval: 20 metres
- CDP Interval: 10 metres

Source Parameters

- Source: Dynamite
- Number of Holes: 1
- Hole Depth: 20 metres
- Charge Size: 20 kilograms
- Shot Point Location: On shot Line Location
- Drilling Method: Heli-portable

Recording Equipment

- Recording System: I/O System Two
- Geophones: Geospace Model CT 10 Hz marsh phones

Surveying System

- Mix of Conventional and GPS survey techniques.
- Data collected in NAD83 and converted to NAD27.

Terrain

- Mountainous, Rugged, Variable
- Variable Ground Cover: Muskeg, Cliffs, Stunted Trees, Bush
- Isolated, Access by Helicopter and by foot.

Personnel

- 20 people on slashing, surveying and drilling
- 26 people on the seismic recording crew
- 2 people on one gravity crew

Weather

- Nineteen days (total on all operations) lost due to morning fog, rain or afternoon winds

Gravity Operations

The gravity data was acquired along side of the seismic program. A gravity reading was recorded every 6 receiver stations for a station spacing of 120 metres. In areas of rugged topography a gravity reading was taken every 3 receiver stations for a station spacing of 60 metres. The following is a summary of the gravity acquisition and processing parameters.

Chevron Canada Resources Program Name: Proverbs 2-D

Contracting Crew: MWH Geo-Surveys Ltd.

Acquisition Dates

- Start Gravity Survey: 13 August 2000
- Finish Gravity Survey: 19 August 2000
- Length of Survey: 19.2 linear kilometres
- Average Acquisition Rate: 3.9 kilometres per day

Recording Equipment

- One Lacoste & Romberg G model Gravity Meter
- Serial number 371

Surveying System

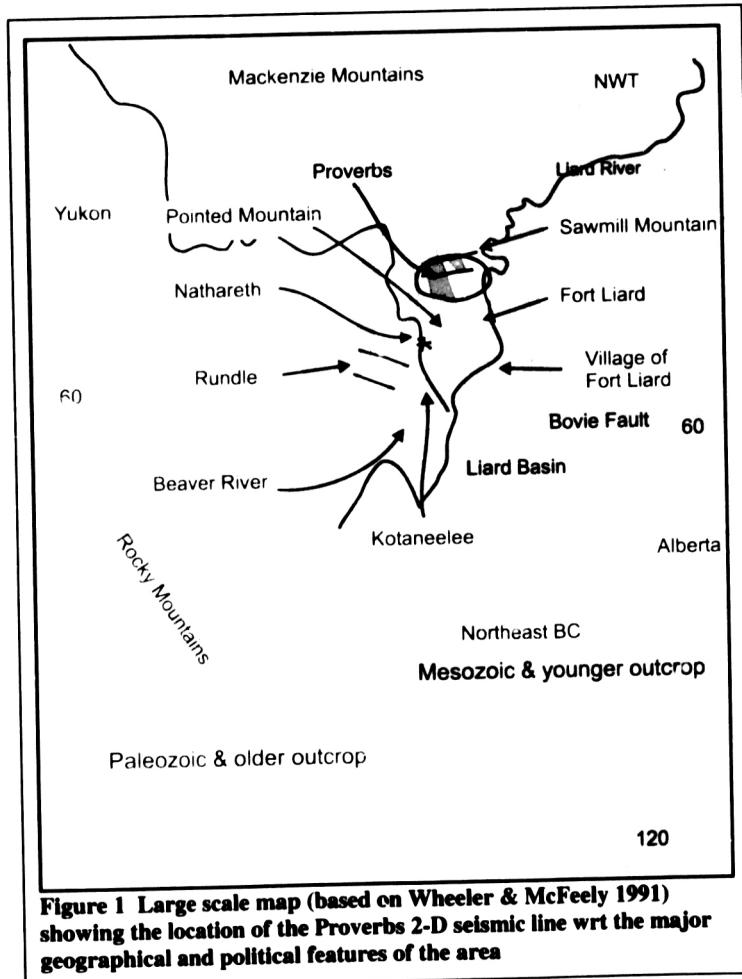
- Mix of Conventional and GPS survey techniques.
- Data collected in NAD83 and converted to NAD27.

Field Procedures

- All Readings taken within closed loops
- All Loops tied to ISGN gravity monument in Fort Liard
- Inner Terrain Corrections (Annulus A to D) visually estimated
- 216 unique stations and 8 repeat stations recorded.
- Gravity Stations are located at the Geophone station
- Elevation and coordinates of Geophone station used for Gravity

Location

The Proverbs Program is located some 50 km north of the community of Fort Liard in the southwest corner of the North West Territories. The tectonic map of figure 1 shows the location of the 2-D line with respect to the Mackenzie Mountains and Rocky Mountains. The Program is located at the southern extent of the Mackenzie Mountains where the eastern limit of the disturbed belt shifts laterally to the west meeting up with the Rocky Mountains. The gas pools Pointed Mountain, Kotaneelee, Beaver River and Fort Liard are located to the south of the Program.



Project Overview

Purpose

Surface anticlines and thrust faults on Sawmill Mountain and the Flett Anticline suggested a structurally controlled, natural gas accumulation could underlie these surface features. Thrust faulted and folded Mississippian through Cretaceous strata are exposed to form the Flett Anticline and Sawmill Mountain at surface (Douglas and Norris, 1976). Underlying some surface culminations are thrust faulted and uplifted Devonian strata that include the fractured dolomites of the Nahanni Formation, which forms the reservoir interval. Discovery of a gas accumulation requires imaging the subsurface structures that form the reservoir by using geophysical techniques such as gravity and seismic. Figure 2 shows the location of the Proverbs program on the surface geology map. The program is located on the northern down plunge edge of the Flett anticline. Depending on structural complexities an isolated uplifted Nahanni in a trap position could exist under the down plunge part of the anticline. Line 30xb was recorded during the 2000 summer. Line 48yb shown on the map was recorded in a previous program during the 1999 summer.

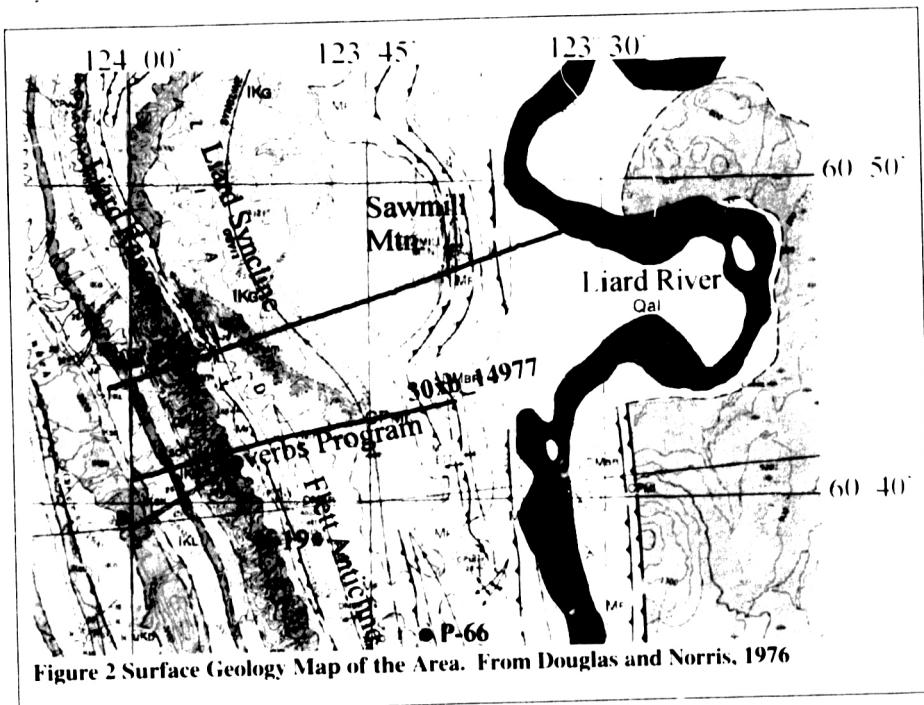


Figure 2 Surface Geology Map of the Area. From Douglas and Norris, 1976

Topography

The terrain is rugged and mountainous. At the location of the Proverbs program the Liard Range divides the watershed into the Liard River to the east and the Chinkeh Creek to the west. Vertical relief is over 900 metres with steep slopes preventing conventional access to most parts of the program. All parts of the program were accessed through the heli-portable method. Figure 3 shows a digital elevation model of the area.

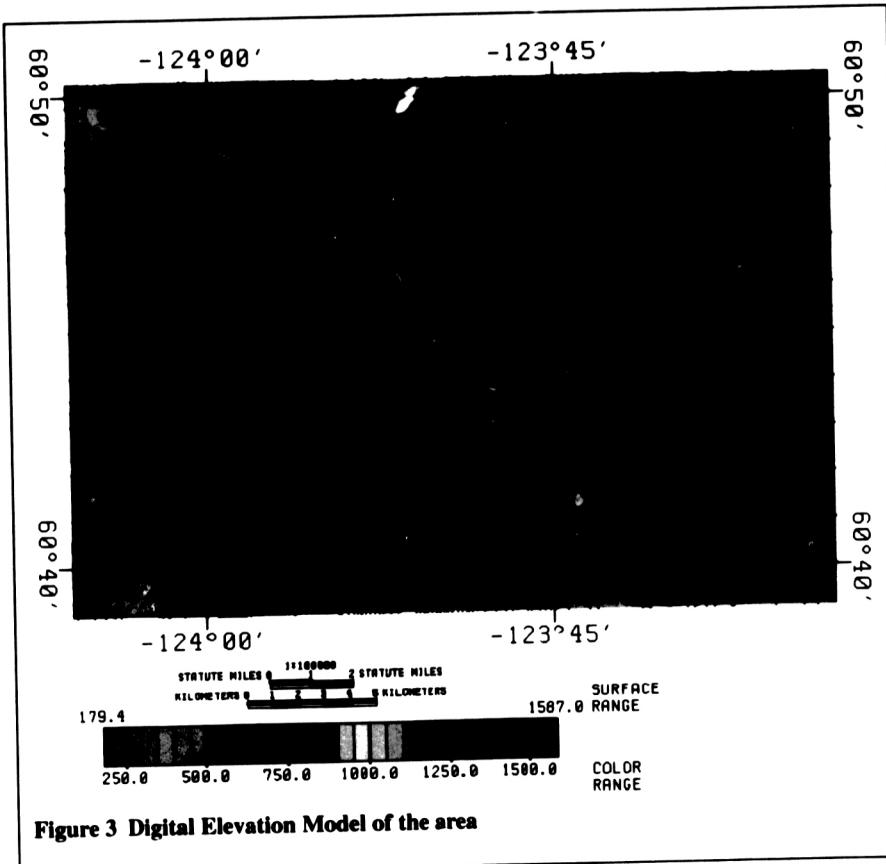
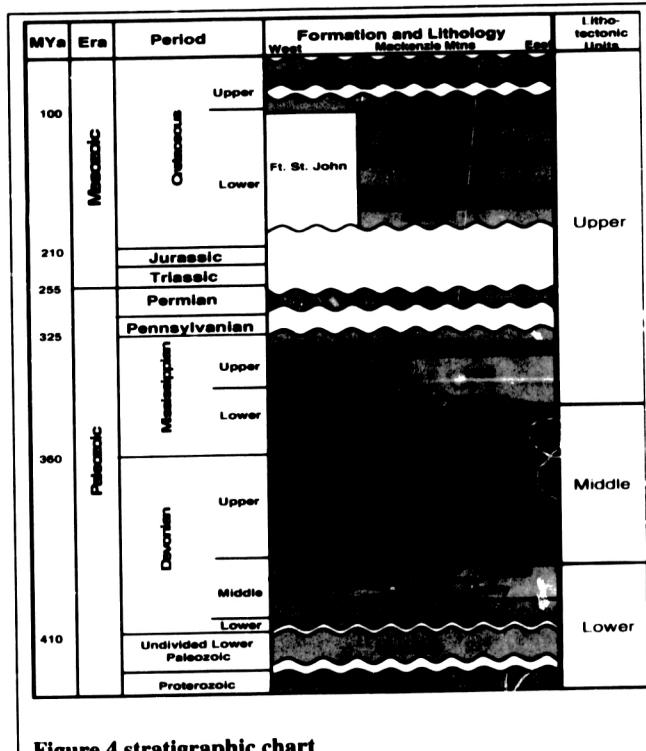


Figure 3 Digital Elevation Model of the area

Results and Interpretation

Stratigraphy

The stratigraphies discussed in this report are summarized in the stratigraphic chart that follows (figure 4). The stratigraphic column consists of three major packages. The youngest is the Mississippian through Cretaceous limestones, sandstones and interbedded shales. Structures in this upper package are responsible for most of the topographical variation in the region. The competent rocks of the Fantasque, Mattson and Flett form a resistive cap protecting mountaintops from erosion and adding to the rugged nature of the terrain. The second package is composed of a monotonous sequence of Middle Devonian through Mississippian shales and minor siltstones of the Besa River Formation. The uppermost portions of this package are exposed at the surface, locally only at surface anticlines where the upper packages has been breached. The N-19, P-66, E-54, K-29 and D-29 surface locations are all on breached anticlines where the upper-most Besa River is exposed. Due to the incompetent nature of the Besa River shales the rock is easily deformed. It acts as a major zone of structural detachment under the Fort Liard Structure. The oldest package is the Precambrian through Middle Devonian carbonates and clastics. This is the lowest and most competent package, the uppermost portion of which is the reservoir of interest.



Structure

The Flett Anticline structure is a north trending, uplifted thrust sheet, of Mattson Sandstones, Flett carbonates and Besa River shales. Uplift of the thrust sheets is interpreted to have occurred during the late stages of the Laramide orogeny, and is probably late Cretaceous or earliest Tertiary in age. The youngest strata involved in the deformation are the Wapiti Fm, believed to be Campanian-Maastrichtian in age. Figure 5 shows a compressed seismic section of line 30xb. The Nahanni section is uplifted under the Flett Anticline. The thrust fault at the Nahanni level is on strike, but down dip of the uplifted Nahanni that was penetrated by the wet well N-19.

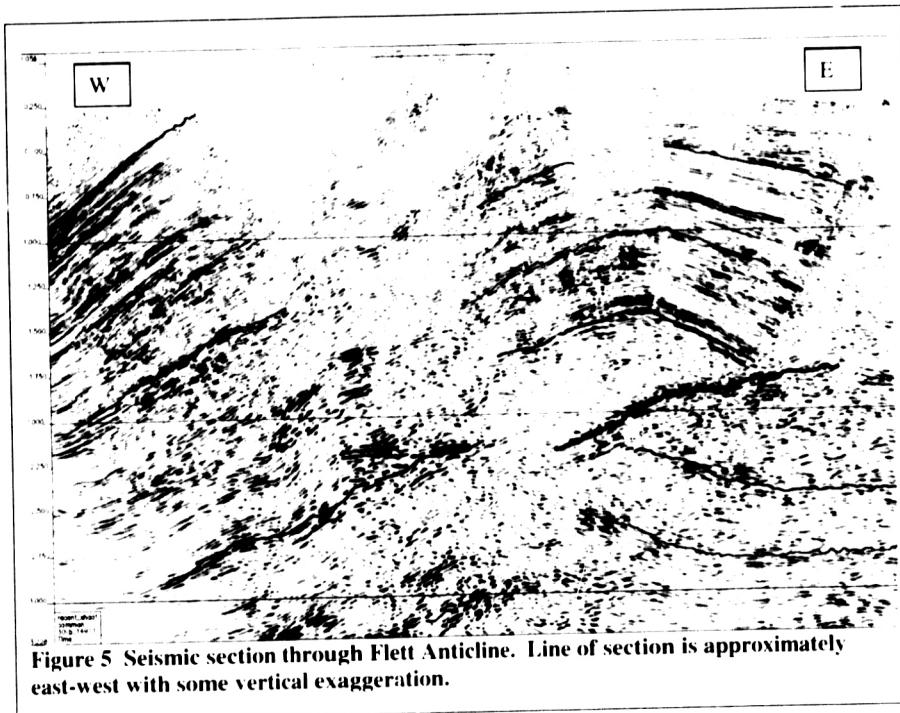
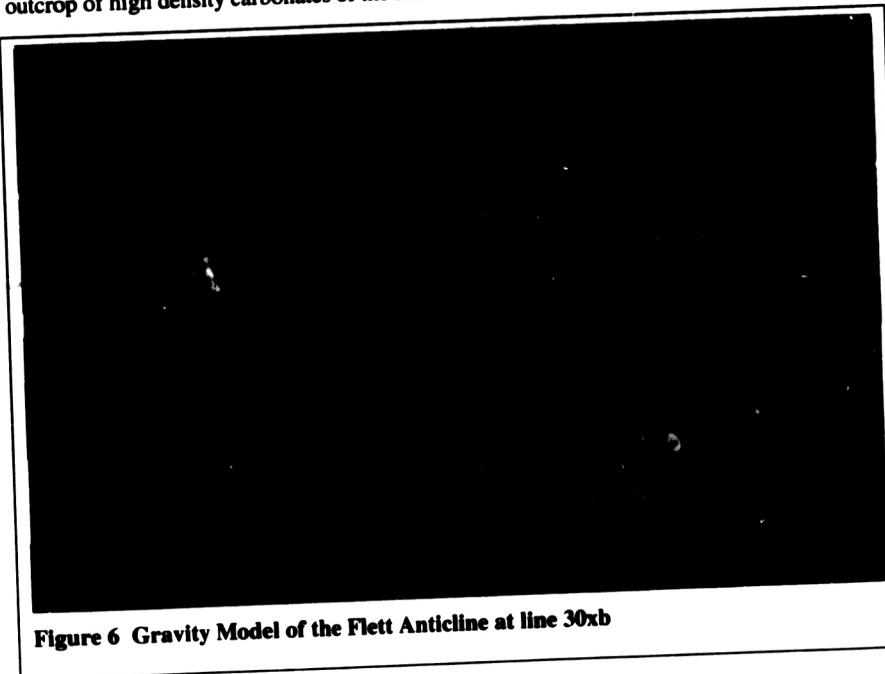


Figure 5 Seismic section through Flett Anticline. Line of section is approximately east-west with some vertical exaggeration.

Gravity

Figure 6 shows the reduced gravity data and a depth model that is based partly on the seismic data and on the surface geology map (Douglas and Norris, 1976). The gravity data shows a general decrease in value to the west due to the thickening of the lower density phanerozoic wedge to the west. The gravity high near the centre of the line is a consequence of the Flett Anticline. The high gravity values are due to the uplift of the high-density Mattson and Flett formations. The gravity low to the east is due to low-density fluvial deposits in the Flett Creek. The gravity high to the far east is due to outcrop of high density carbonates of the Flett Formation.



Seismic ties to Geology

Line 30xb does not directly tie any nearby wells. The well N-19 is the closest well but the well bore spudded in Besa River shale and does not contain any Mattson or Flett. The Mattson and Flett horizons were based on surface geology. The Exshaw and Nahanni horizons were based on character. The Exshaw is a bright trough in the middle of the Besa River interval while the Nahanni is the lower most peak of a triplet that represents the Muskwa. The base of the Nahanni is the first significant trough below the Nahanni peak and the Basement horizon is based on truncated angular events terminating against a series of parallel events below the Nahanni interval.

Gravity Operations

The gravity data was acquired along side of the seismic program. A gravity reading was recorded every 6 receiver stations for a station spacing of 120 metres. In areas of rugged topography a gravity reading was taken every 3 receiver stations for a station spacing of 60 metres. The following is a summary of the gravity acquisition and processing parameters.

Chevron Canada Resources Program Name: Proverbs 2-D

Contracting Crew: MWH Geo-Surveys Ltd.

Acquisition Dates

- Start Gravity Survey: 13 August 2000
- Finish Gravity Survey: 19 August 2000
- Length of Survey: 19.2 linear kilometres
- Average Acquisition Rate: 3.9 kilometres per day

Recording Equipment

- One Lacoste & Romberg G model Gravity Meter
- Serial number 371

Surveying System

- Mix of Conventional and GPS survey techniques.
- Data collected in NAD83 and converted to NAD27.

Field Procedures

- All Readings taken within closed loops. Repeat stations or closed loops are read within 2 hours of the initial reading.
- All Loops tied to ISGN gravity monument in Fort Liard
- Inner Terrain Corrections (Annulus A to D) visually estimated
- 360 unique stations and 12 repeat stations recorded.
- Gravity Stations are located at the Geophone station
- Elevation and coordinates of Geophone station used for Gravity

Field Processing

- Conversion from dial readings to gravity values are computed in the field using the calibration factor provided by the instrument manufacturer.
- Instrument drift and Tidal effects are estimated and applied to the data in the field.
- Instrument drift at each station is linearly interpolated between drift values estimated at each repeat station.
- The Terrain Corrections of the inner annuli B, C and D are estimated by the operator in the field (maximum radii = 170m). Density = 2.0 gm/cc.

In-house Processing

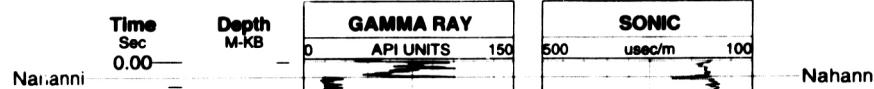
- Latitude correction based on International Gravity Formula 1967B.
- Bouguer density = 2.55 gm/cc
- Outer Terrain corrections applied from 170m to 37,000m using density = 2.55 gm/cc.

Data Accuracy

- Instrument error estimated at 0.03 mGal
- Vertical accuracy is better than 10 cm, giving a free air error of less than 0.03 mGal.
- Error of final processed data is estimated at 0.1 mGal

N-019/60-40/123-45

KB = 778.25M



Time Scale = 22.636 cm/sec
Date = Apr-12-2002 14:12:19