9229-T21-1E

TEXACO CANADA RESOURCES LTD.

CALGARY ALBERTA

GEOPHYSICAL REPORT

NORMAN WELLS, CARCAJOU
SEISMIC SURVEY, 1983

conducted for

TEXACO CANADA RESOURCES LTD.

by

Western Geophysical Company of Canada Ltd.

COGLA Program No. 9229-T21-1E

Exploration Agreement No. 174

prepared by

M.A. Tivey
Interpreter

January 23, 1984

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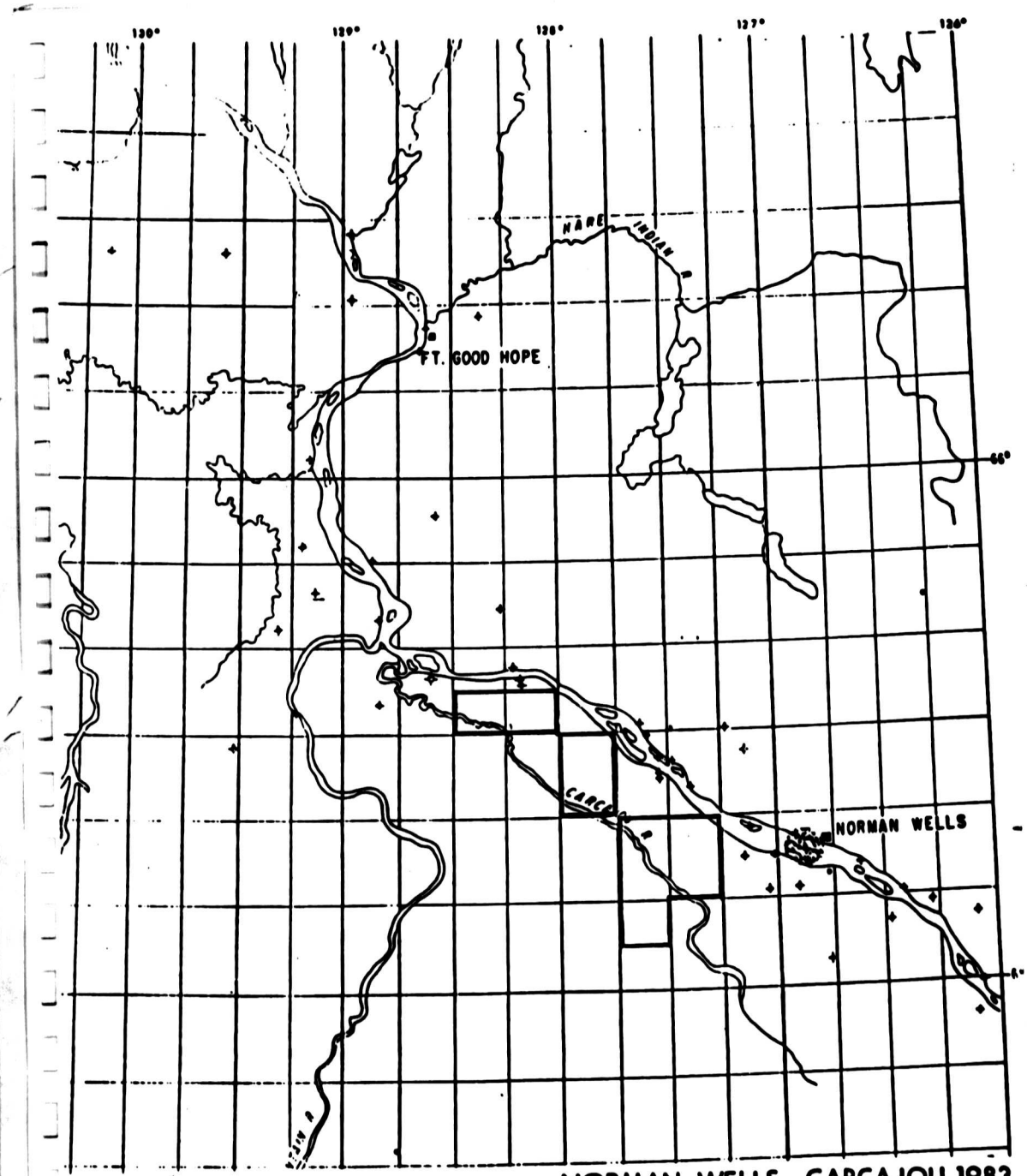
Introduction

The Norman Wells and Carcajou project areas lie in the Mackenzie Plain physiographic division of the North West Territories. This relatively undeformed region is bounded by two structurally deformed areas; the Franklin Mountains to the North and East and the Mackenzie Mountains to the South and West. The regional geology consists of a Cretaceous clastic sequence directly overlying a predominantly carbonate sequence of Devonian and older age rocks. The main zone of interest and only proven hydrocarbon reservoir in the area is the Devonian Kee Scarp formation (Ramparts formation - G.S.C.). This limestone formation consists of a non-porous, laterally extensive platform member and a partially porous reef member which forms discrete buildups throughout the area. The Norman Wells oilfield is the type example with estimated proven recoverable reserves of 272 MM BBls oil.

The prime purpose of this survey was first to identify and outline the extent of the Kee Scarp reefs at Norman Wells and Carcajou. Secondly, to fulfill the work commitment on exploration agreement #174 of 100 km of seismic data, and thirdly provide possible future drilling locations.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NORMAN WELLS CARCAJOU 1983
PROJECT #9229-T21-1E
EXPLORATION AGREEMENT #174
NWT —— CANADA
SCALE : 1" = 16 MILES

List of enclosures

Map TE 7356 Norman Wells Kee Scarp-Hare Indian Isochron

Map TE 7391 Norman Wells Kee Scarp Time Structure

Map TE 7369 Carcajou Kee Scarp Time Structure

MaP TE 7370 Carcajou Kee Scarp-Hume Isochron

Seismic line W83-AP Norman Wells seismic time section

Seismic line W83-AQ Norman Wells seismic time section

Seismic line W83-ND Norman Wells seismic time section

Seismic line W83-NE Norman Wells seismic time section

Seismic line W83-NA Carcajou seismic time section

Seismic line W83-NB Carcajou seismic time section

Seismic line W83-NC Carcajou seismic time section

Seismic line W83-NF Carcajou seismic time section

Seismic line W83-AN Carcajou seismic time section

Summary of local employment and expenditures by Western Geophysical.

Field Procedures

In March 1983 Western Geophysical under contract to Texaco Canada Resources Ltd. began shooting the Norman Wells and Carcajou seismic programs. A total of 114 kms of 1200% seismic data were shot in the Norman Wells and Carcajou areas, in order to satisfy a work obligation of Exploration Agreement #174.

The recording system consisted of a 96 trace T.I. DSF V instrument utilizing 2 msec sample rate and Mark 30 Hz geophones. Since the zone of interest, the Kee Scarp formation, is much closer to the surface at Carcajou than at Norman Wells a different array and source geometry for each area was used to optimize the seismic data recorded. At Norman Wells a split spread geophone array was used with a 33.5 m group interval, 9 geophones/group and 33.5 m offset. The source consisted of 2 kg of dynamite in a 14 m deep hole at a shotpoint spacing of 134 m. A 12/128 Hz field filter was used with the notch filter "out"

At Carcajou a split spread array was used with a 15 m group interval, 9 geophones/group, and a 45 m offset. 1 kg dynamite was used in each of 2 holes over 30 m at a depth of 13 m with a shotpoint interval of 60 m. The field filter used was an 18/128 Hz with the notch filter "out".

The work was completed by April 18, 1983 and the data sent to Sefel Geophysical Ltd. in Calgary for data processing. Due to the differences in acquisition parameters and noise problems between the Carcajou and Norman Wells areas the 2 sets of data had slightly different processing streams. These processing streams are summarized in the next section.

Data Processing

Norman Wells 1983

1. DEMULTIPLEX AND BINARY GAIN REMOVAL
   RECORD LENGTH 2.5 SECONDS
   SAMPLE INTERVAL 2 MS

2. CDP GATHERS
   FOLD 1200 PERCENT

3. AUTOMATIC GAIN RECOVERY

4. INSTRUMENT PHASE COMPENSATION

5. SPIKING DECONVOLUTION
   OPERATOR LENGTH 80 MS
   PREWHITENING 1 PERCENT
   WINDOW 200 TO 1600 MS AT 34 M
   750 TO 2150 MS AT 1608 M

6. DATUM AND WEATHERING STATICS
   DATUM 100 M
   REPLACEMENT VELOCITY 3000 M/SEC
   WEATHERING VELOCITY 610 M/SEC

7. SURFACE CONSISTENT RESIDUAL STATICS
   WINDOW 450 TO 1600 MS
   MAX CORRELATION LAG +/- 40 MS

8. VELOCITY ANALYSIS
   CONSTANT VELOCITY STACKS

9. NORMAL MOVEOUT

10. SURFACE CONSISTENT RESIDUAL STATICS
    WINDOW 450 TO 1600 MS
    MAX CORRELATION LAG +/- 20 MS

11. MUTE
    0 MS AT 234 M
    300 MS AT 268. M
    600 MS AT 1005 M
    800 MS AT 1608 M

12. CDP STACK
    1200 PERCENT

13. BANDPASS FILTER
    12/18-90/100 HZ

14. EQUALIZATION

15. MIGRATION
    90 PERCENT ORIGINAL VELOCITIES

16. FILM DISPLAY

CARCAJOU 1983

1. DEMULTIPLEX AND BINARY GAIN REMOVAL
   RECORD LENGTH 2.5 SECONDS
   SAMPLE INTERVAL 2 MS

2. CDP GATHERS
   FOLD 1200 PERCENT

3. AUTOMATIC GAIN RECOVERY

4. DATUM AND WEATHERING STATICS
   DATUM 100 M
   REPLACEMENT VELOCITY 3500 M/SEC
   WEATHERING VELOCITY 610 M/SEC

5. VELOCITY FILTER
   ATTENUATE EVENTS WITH AN APPARENT
   VELOCITY LESS THAN 290 M/SEC

6. INSTRUMENT PHASE COMPENSATION

7. SPIKING DECONVOLUTION
   OPERATOR LENGTH 80 MS
   PREWHITENING 1 PERCENT
   WINDOW 100 TO 1500 MS AT 45 M
          300 TO 1700 MS AT 750 M

8. SURFACE CONSISTENT RESIDUAL STATICS
   WINDOW 300 TO 1300 MS
   MAX CORRELATION LAG +/- 40 MS

9. VELOCITY ANALYSIS
   CONSTANT VELOCITY STACKS

10. NORMAL MOVEOUT

11. SURFACE CONSISTENT RESIDUAL STATICS
    WINDOW 300 TO 700 MS
    MAX CORRELATION LAG +/- 30 MS

12. MUTE
    0 MS AT 135 M
    150 MS AT 150 M
    300 MS AT 750 M

13. CDP STACK
    1200 PERCENT

14. BANDPASS FILTER
    9/15-100/110 HZ

15. EQUALIZATION

16. MIGRATION
    90 PERCENT ORIGINAL VELOCITIES

17. FILM DISPLAY

Interpretation

Norman Wells

Four lines were shot in the Norman Wells Project totalling approximately 57 kms; the resulting data quality is excellent. Two wells were used to tie the seismic data in order to identify prominent seismic events. The Imperial Ray #1 well ties line W83-ND at S.P. 1261 from which the Devonian Imperial, Kee Scarp, and Hare Indian formations can be identified (see Table #1). The deeper events were identified using Esso Norman Wells (36 x) B-48 which reached final TD in the Cambrian Saline River formation. Once identified these events were then correlated around the grid of control. The seismic events are generally continuous throughout the mapped area with no major faults or folds and only one major unconformity observable at the Pre-Cambrian basement level.

The Hume event at 0.7 sec at S.P. 105 on line W83-AQ shows the regional dip of the area towards the southwest. The major feature however of these seismic sections and the exploration target is the Kee Scarp formation. All the lines show the build-up of Kee Scarp reef and line ND and AQ in particular show distinct reef flanks with structurally high, thick reef rims and a lower, thinner interior. This build-up of high velocity carbonate induces pull-up deeper down in the sections which is especially apparent at the Hume level. The Kee Scarp reef seen on this seismic data corresponds to the downdip part of the Norman Wells Reef containing the Norman Wells oilfield. Line W83-AP shows the continuation of this reef from the western bank of the Mackenzie River as far as S.P. 1561, a distance of 19 kms.

The Kee Scarp-Hare Indian formation isochron map TE 7356 was made in order to determine the extent and morphology of the Norman Wells reef. The 15 ms contour defines the edge of the reef with 10 ms representing platform thickness of Kee Scarp. The 50 ms contour defines "thicks" which are interpreted as porous reef rim facies. These "thicks" surround a slightly thinner interior lagoonal facies which is commonly not porous. This map thus defines the most favorable areas for possible hydrocarbon bearing porous zones.

The Kee Scarp time structure map TE 7391 shows the regional dip of the Kee Scarp towards the west-southwest, the updip end being the Norman Wells oilfield. The high reef rims identified on seismic and the isochron map appear as excursions of the structural contours from the regional trend. Only the 660 ms contour shows a possible structural anomaly with about 5-10 ms closure, located on the eastern edge of the exploration agreement area.

Carcajou

Five lines were shot in the Carcajou Project, approximately 57 km. The data quality varies from excellent to poor on a single line, the deterioration in quality is attributed to poor surface conditions such as marshes and small ponds, and in the case of line AN hot sulphur springs.

For the most part however, major seismic events can be readily correlated around the grid of control. Two wells in the project area were used to correlate and identify the major seismic events, Maida Creek F-57 and Maida Creek G-56. Maida Creek F-57 ties line W83-AN at shot point 169; the correlations have been tabulated in Table #2.

The seismic sections show a slightly more complex geological picture than at Norman Wells. The top of the Canol appears to be an unconformity with reflectors dipping to the northwest. The Kee Scarp event itself shows a distinct reef flank to the southeast and several anomalies on top of the reef. These anomalies have been interpreted to be of a stratigraphic nature such as patch reefs, oolite sand shoals, or successive reef margins although there is some possibility of a thrust fault origin. Once again, thick, high velocity Kee Scarp reef results in pull-up on the Hume and underlying events.

Since the Hare Indian pick is very tenuous a Kee Scarp to Hume isochron was chosen to map the extent of the Carcajou Kee Scarp reef. Map TE 7370 shows a northeast-southwest trending reef build-up with the 115 ms contour picked as the reef edge. The map shows a well developed eastern reef flank and a rather less distinct western flank. The reef is bounded to the north by a reverse fault in the Mackenzie River and to the south by the Imperial Hills anticline. Lines W83-NB and W83-NC suggest that the reef may extend further to the west off the exploration agreement area. On the main reef body there are a number of thick reef anomalies possibly reef rim or patch reef features. They vary between 130 and 150 ms thick or about 400-500 ft. thick.

The Kee Scarp time structure map TE 7369 shows a regional southwest dip upon which the reef is superimposed bowing the contours towards the south. The reef flanks show up as a bunching up of the structural contours. There are a number of structural closures but the largest at S.P. 333 on W83-NA corresponds to an isochron "thick". There is 29 ms of closure or about 275 ft. with the closing contour being 325 ms. This map shows that the Maida Creek F-57 well was drilled on structurally the highest point of the reef without much regard for any stratigraphic criteria. The isochron map on the other hand shows that the Maida Creek G-56 was drilled more as a stratigraphic test, however it appears to have missed the most favourable location.

Summary and Conclusions

In conclusion a number of structural and isochron anomalies in the Norman Wells and Carcajou areas have been identified. The Norman Wells reef appears to be a typical atoll type reef with reef rims and interior lagoon. The Carcajou reef however remains more complex in nature with the paleo-environment and facies not as clearly defined as at Norman Wells.

Additional control is being recommended for both of these areas and it is anticipated this work will be conducted in March and April, 1984

additional control
completed by 84/4/16 under
program nr. 9229-A31-1E

Table #1

Norman Wells Seismic Correlation

Formation	Imperial Ray #1 top (metres)	W83-ND S.P. 1261 (secs)
Imperial	592	0.350
Kee Scarp	994	0.590
Hare Indian	1133	0.645
Hume	1274 *	0.740
Ronning	1675 *	0.880
Cambrian Saline River	2161 *	1.030
Precambrian	2243 *	1.110

* estimated depth from jump tie with Norman Wells (36x) B-48

Table #2

Carcajou Seismic Correlation

Formation	Maida Creek F-57 tops (metres)	W83-AN S.P. 169 (secs.)
Imperial	925	0.165
Kee Scarp	1518	0.270
Hare Indian	1930	0.310
Hume	2431	0.390
Ronning	3542	0.505
Cambrian Saline River	4347 *	0.745
Precambrian	4603 *	0.865

* estimated from interval velocity calculations