COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

PETROLEUM SEARCH SUBSIDY ACTS

Publication No. 39

LONGREACH-SILSOE SEISMIC SURVEY, QUEENSLAND 1960

BY

CREE OIL OF CANADA LIMITED

Issued under the Authority of Senator the Hon. W. H. Spooner,
Minister for National Development
1962

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

Minister: SENATOR THE HON. W. H. SPOONER, M.M.

Secretary: H. G. RAGGATT, C.B.E.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

Director: J. M. RAYNER.

This Report was prepared for publication in the Geophysical Branch

Chief Geophysicist: R. F. THYER.

FOREWORD

In 1959 the Commonwealth Government enacted the Petroleum Search Subsidy Act 1959. This Act enables companies that drill for new stratigraphic information, or carry out geophysical or bore-hole surveys in search of petroleum, to be subsidized for the cost of the operation, provided the operation is approved by the Minister for National Development.

The Bureau of Mineral Resources, Geology and Geophysics is required, on behalf of the Department of National Development, to examine the applications, maintain surveillance of the operations, and in due course publish the results.

A seismic reflection survey was carried out under the Petroleum Search Subsidy Act 1959 in the Longreach-Silsoe area of Queensland by Cree Oil of Canada Limited. This publication deals with that survey and contains the information furnished on behalf of Cree Oil of Canada Limited and edited in the Geophysical Branch of the Bureau of Mineral Resources. The final report was written by W.E. Hightower, Supervisor, Austral Geo Prospectors Pty Ltd. The survey methods and the results obtained are presented in detail.

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ILLUSTRATIONS

ABSTRACT

A seismic reflection survey was conducted for Cree Oil of Canada Limited during May 1960, by Austral Geo Prospectors Pty Ltd, in the south-central part of Area 3, Authority to Prospect No. 64P, Queensland, Australia.

Using the spot character-correlation method a single 67-mile seismic traverse was shot from Longreach to Silsoe Homestead.

Results of the survey indicate that the sedimentary sequence increases in thickness from approximately 3200 ft at Longreach to approximately 6000 ft at Silsoe Homestead.

A significant east reversal in regional west dip was recorded about 13 miles west of Longreach.

1. INTRODUCTION

A seismic reflection survey was conducted for Cree Oil of Canada Limited during May 1960, in the south-central part of Area 3, Authority to Prospect No. 64P, Queensland, Australia. The seismic traverse ran along the Longreach-Silsoe road westward from Longreach towards Vergemont.

Terrain in the area may be described as varying from flat to rolling plains with surface elevations along the route of the seismic traverse ranging from 600 to 830 ft above sea level. Much of the area is covered with sparse to dense timber. In future seismic operations in this area, a bulldozer may be required for clearing lines that deviate from the existing tracks.

Some regional gravity and regional aeromagnetic surveys have been made in the eastern part of the area by private companies and by the Bureau of Mineral Resources, but no geophysical surveys have been made in the western part. Information from the regional gravity work and from several wells in the area suggests that the sedimentary sequence increases in thickness westward from Longreach. The main purpose of this survey was to determine the extent of this increase over as great a distance as possible within the time allotted.

2. GEOLOGY

A generalised stratigraphic cross-section is shown below[1]. It is based on information from several test wells near Longreach (see Plate 4) and a deeper test well (Westland Oil Co. Ltd No. 3; 6054 ft) located approximately 110 miles south-west of Longreach, at Warbreccan. No deep wells have been drilled near the western portion of the seismic traverse.

Period	Name	Lithology	Approximate thickness
CRETACEOUS	Winton Formation	mudstone; sandstone minor limestone	0-1200 ft
	Tambo Formation	mainly shale	700-1600 ft
	Roma Formation	shale; siltstone; minor sandstone	600-1200 ft
CRETACEOUS-JURASSIC	Blythesdale Group	mainly porous sandstone; thin shale	300- 700 ft
JURASSIC	Walloon Coal Measures	mainly shale and sandstone	100- 600 ft
TRIASSIC	Bundamba Group	porous sandstone; shale	0-1200 ft
?	Drummond Beds Granite	mainly shale	450- 787+ ft

(1) Footnote by Bureau of Mineral Resources:

Recent palaeontological evidence, especially from microfloral studies, has shown that the Transition "beds" of the Blythesdale Group are Cretaceous and the remaining units of the Group are Jurassic; the evidence also shows that the Bundamba Group is Jurassic.

The Tambo and Roma Formations have been given the definite age and type classification of marine Cretaceous. Marine fossils have not been identified in the pre-Cretaceous Mesozoic rocks.

"Shows" of oil and gas in wells indicate the possibility of accumulation in the Winton, Tambo, and Roma Formations and in the top sandstone of the Blythesdale Group.

Sandstones of the Bundamba Group bear fresh water. The lowest sandstone of this Group, the Precipice Sandstone, is the most productive aquifier of artesian water over most of the Great Artesian Basin. Available information suggests that accumulations of oil or gas probably do not exist in sandstones of the Bundamba Group, especially on the flanks of the basin. It is possible, however, that oil or gas reservoirs in the Bundamba Group could exist in the deeper parts of the basin, possibly as the result of migration from pre-Mesozoic marine sediments.

Little is known of the pre-Triassic sequence, but probably there are favourable pre-Triassic source and reservoir beds in the deeper parts of the basin.

3. METHODS OF OPERATION AND INTERPRETATION

Seismic records from seven shot-points at the beginning of the survey indicated that a spot character-correlation method could probably yield information sufficiently reliable to accomplish the assigned objective, which was to obtain regional information over as great a distance as possible. By using 1-mile correlation shots and skipping portions of the traverse where poor records were obtained, it was possible to traverse 67 miles.

Shot-hole depths ranged from 100 to 240 ft, the average depth increasing towards the west. The one drill used was able to average only five holes per day; two drills per crew should be used on future seismic surveys in this area.

Reflection records of good quality were obtained over most of the traverse, using simple recording techniques. In the vicinity of Shot-point 41, sandstone ridges were encountered and the reflection quality deteriorated. Five miles of traverse were skipped and three more one-mile spot shots were made. Reflection quality was still poor, so a further eleven miles of traverse was skipped. Shooting resumed at Shot-point 63 where good-quality reflections were obtained.

Field procedures are described in statistical detail in Appendix 1 of this Publication.

An up-hole velocity test at the beginning of the survey indicated the sub-weathering velocity (Ve) to be between 7,000 and 8,000 ft/sec. As use of the higher velocity would partially compensate for a possible topographic overload effect on depth computations, a sub-weathering velocity of 8,000 ft/sec [2] was used with a "normal up-hole" weathered-layer computation method to correct raw reflection times to datum.

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(2) Footnote by Bureau of Mineral Resources:

The high value of 8000 ft/sec for the sub-weathering velocity seems incompatible with the average velocity of 7600 ft/sec (Appendix 2) used for the sequence down to the top of the Blythesdale Group.

Use of 1-mile correlation shots with short spreads excluded the analysis of reflection step-out times (Δt) as a reliable method of determining average velocities to the various reflecting layers. However, an examination of the electric logs and stratigraphy from wells near Longreach suggested that three geological formations should act as good seismic reflectors. The three formations are:

(1) Blythesdale Group
(2) Unnamed Jurassic sandstone
(3) Basement - granite

These three formations were correlated to good reflection events at Longreach, and the average velocity to each formation was determined. These velocities were used to convert the time cross-section (Plate 2) to a depth cross-section (Plate 3).

Velocities used in depth conversions appear to be unusually low. However, velocities investigated elsewhere in Queensland through a similar geological sequence[3] were lower than expected. Moreover, "second leg" reflection picking was used for clarity, and the matching of such "picks" against shallow reflectors requires the use of a velocity value lower than the true velocity. Interval velocities are not affected by the above procedure and, in this instance, the values obtained on the basis of the above identifications are quite reasonable. The increase in depth from east to west, as shown by Plate 3, is probably conservative.

Appendix 2 shows the data used in calculations and interpretation.

4. DISCUSSION OF RESULTS

Interpretation of the seismic data is summarised by the two cross-sections (Plates 2 and 3). No attempt has been made to make contour maps for the three continuous seismic horizons, because there is scarcely any dip control in the north-south direction.

Plate 2, the cross-section showing time data corrected to a datum plane 500 ft above sea level, presents the most diagnostic analysis of the results. Records have been analysed by two additional interpreters and on some points their interpretations differ from that shown; however, the basic interpretations are in agreement and no positive arguments can be made for changing any of the values originally determined.

The reflection identified as rising at the base (?) of the Cretaceous or top of the Blythesdale Group is the dominant one and is of excellent character quality over most of the area covered, but there are places where interpreters may disagree in correlation by one "leg" or "cycle". The correlating quality of the deeper mapping reflections (designated "unnamed Jurassic sandstone" and "basement-granite") is lower than that of the "Blythesdale" reflection, and the probability of error in correlations increases with increasing depth. Generally, the records are of excellent correlation quality; using correlation field techniques, reliable depth maps can probably be prepared for the area.

Speculation of the presence of faulting is shown on the time cross-section (Plate 2). In several places there is good evidence of faults, and continuous-profile lines would be

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(3) Footnote by Bureau of Mineral Resources:

The Quilpie area of Queensland, 200 miles south of Longreach, has a similar stratigraphic sequence; the average velocities there are even lower than the ones used in this survey.

expected to disclose a fairly complex fracture system. Fault speculations are removed from the depth cross-section (Plate 3).

Plate 3 indicates that the total sedimentary thickness increases from approximately 3200 ft near Longreach (Shot-point 1) to about 6000 ft at the western end of the traverse (Shot-points 71, 72, 73). The interval between the "Blythesdale Group" and the "unnamed Jurassic sandstone" increases from 570 ft to about 750 ft. The interval between the "unnamed Jurassic sandstone" and "basement-granite" increases from 360 ft to approximately 1500 ft. Thus, approximately 1100 ft of the total 2800 ft or more of sedimentary thickening appears to be the result of increased thickness of Lower Jurassic and pre-Jurassic rocks. Geology of this general area indicates the possibility of Permian sediments being present in the areas of thick Lower Jurassic and pre-Jurassic rocks.

"Basement" is known to be granite at Longreach. However, it does not necessarily follow that basement would also be granite at the western end of the traverse.

Electric log correlations of Longreach Oil Ltd Wells Nos 1, 2, 3, and 4 are shown on Plate 4. This chart is copied directly from a report (August 1959) by V.G. Swindon of Mines Administration Pty Ltd for Carpentaria Oils Pty Ltd. The illustration is included for the specific purpose of showing the reflecting horizon identificatons and the stratigraphy encompassed between the No. 1 and No. 3 reflection horizons ("Blythesdale" to "basement").

Plate 5 also has been borrowed from the report by Swindon. Data and contours have been copied with only a few alterations from the original map except for the area covered by seismic data. The scale of the map is too small to show much detail. Significant depths from the seismic survey have been plotted. The high area between Shot-points 18 and 21 is shown as a horst without an attempt to insert contour values. No proof was obtained for the two faults shown, and the horst interpretation is used only because of the flat-top nature of the "high". If this interpretation is correct, it is quite probable that a detailed seismic survey of the area would reveal far more complex structure than can be postulated from regional data.

The three seismic mapping horizons reveal little, if any, shift in the position of structure with depth. The westward increase in the Lower Jurassic or pre-Jurassic sequence is gentle and appears to be augmented by down-to-the-west step fauling at "basement" level. Most of the "basement" folds and faults shown on the time cross-section appear to be repeated in later sediments. Hence they are post-"basement" in origin; some of the movements are of fairly recent geological age. No marked angular unconformities are shown by the seismic results.

5. CONCLUSIONS AND RECOMMENDATIONS

The most pronounced structural feature revealed by the survey is located between Shot-points 18 and 21 inclusive. In this area the interval between reflecting horizon 2 and reflecting horizon 3 ("unnamed Jurassic sandstone" to "basement-granite") is approximately 200 ft thicker than the corresponding interval encountered at Longreach Oil Ltd No. 2 Well (see Plate 4). The upper formations in the vicinity of Shot-points 18 to 21 should be encountered at approximately the same depth as those at Longreach Oil Ltd No. 2, and basement could be expected at a depth of approximately 3500 ft below the surface. If the oil and gas "shows" of the Longreach areas are considered important, the anomalous dips shown in this locality would provide an excellent starting point for a detailed seismic survey.

The thickest part of the sedimentary sequence in Area 3 of Authority to Prospect 64P probably lies in the south-western portion of the Authority. Seismic data disclose no major reversal in regional west dip in the western portion of the area explored. Additional regional surveying will have to be done before it will be possible to select an area for a detailed seismic survey of the deeper portions of the basin.

Reliable structural data can probably be obtained with a simple seismic correlation field technique. However, if a complex fault or fracture pattern exists, and if faulting is a factor in oil and gas accumulation in this area, then the reshooting eventually necessary to outline the fault pattern might offset the early gains in coverage obtained by a correlation survey. The good quality of the records and the depth of the reflecting horizons of interest would allow the use of fairly long geophone spreads in a continuous-profile survey. If a bulldozer is necessary for clearing many of the off-the-road traverses, the continuous-profile method of shooting would be the most suitable survey method. However, for regional lines along the existing roads or tracks, the one-mile spot-correlation method would be adequate.

Experience suggests that some fairly complicated shooting techniques may have to be used to obtain reliable results in some areas of sandstone outcrop.

Two drills should be used on each seismic crew on future surveys in the area.

6. ACKNOWLEDGEMENTS

The author is indebted to a number of persons, each of whom has made a material contribution toward the contents of this report. Specific acknowledgements to a few of the persons and organisations who have assisted the author in the interpretation of records and in preparation of this report are listed below:

V.G. Swindon	Advised on he geology of the area, previous exploration and geophysical activities, petroleum prospects, etc., through his report on the Longreach area.
H.A. Lukowitch:	Directed seismic field work, made preliminary interpretations of seismic data, and assisted in preparing this report.
Geo Prospectors, Inc.	Through the personages of H.S. Eshelman, H.M. Thralls, and others, all data were checked, and the material arranged into report form.

7. REFERENCES

SWINDON, V.G. 1959 Report on the Longreach Area (Area 3) of ATP 64P, Queensland. Mines Administration Pty Limited, Report No. Q/64P/68.

APPENDIX 1

FIELD PROCEDURES

Geophones	S.I.E. S-16; 18 c/s.
Number per trace	3
Connexion	Series
Spacing in group	15 ft
Amplifiers	S.I.E. G-22A
Number of channels	48; 24 mixed, 24 unmixed
Normal Filter Settings	31-60 c/s
Mixed or unmixed	Mixed and unmixed each record
Spreads used	Straddle; 870 ft each side of shot-point
Method used	Spot holes spaced one mile apart for all except seven 1320-ft continuous shot-points (Shot-points 1 to 4 and 8 to 10).
Distance from shot-point to close geophone stations	100 ft
Relation of far geophone stations to interlocking shot-points	At interlocking shot-points for 7 continuous profile holes; spot holes do not interlock.
Normal gelignite charge	5 to 10 lb
Operational difficulties	Most deep holes required water drilling; water was scarce along most of traverse.

APPENDIX 2

CALCULATION AND INTERPRETATION DATA

Well ties	Tied to Longreach Oil Ltd No. 2 at Longreach
Type of correction used	Normal up-hole
Interlock ties	No interlock ties on spot holes; datum-to-datum ties on continuous holes.
Elevation datum	500 ft above sea level
Elevation velocity (Ve)	8000 ft/sec
Horizons Converted to Depth	
Horizon	Top of Blythesdale Group
Average velocity used	7600 ft/sec
Time range	564 to 948 milliseconds
Horizon	Unnamed Jurassic sandstone
Average velocity used	8100 ft/sec
Time range	663 to 1078 milliseconds
Horizon	"Basement-granite"
Average velocity used	8600 ft/sec
Time range	713 to 1356 milliseconds

APPENDIX 3

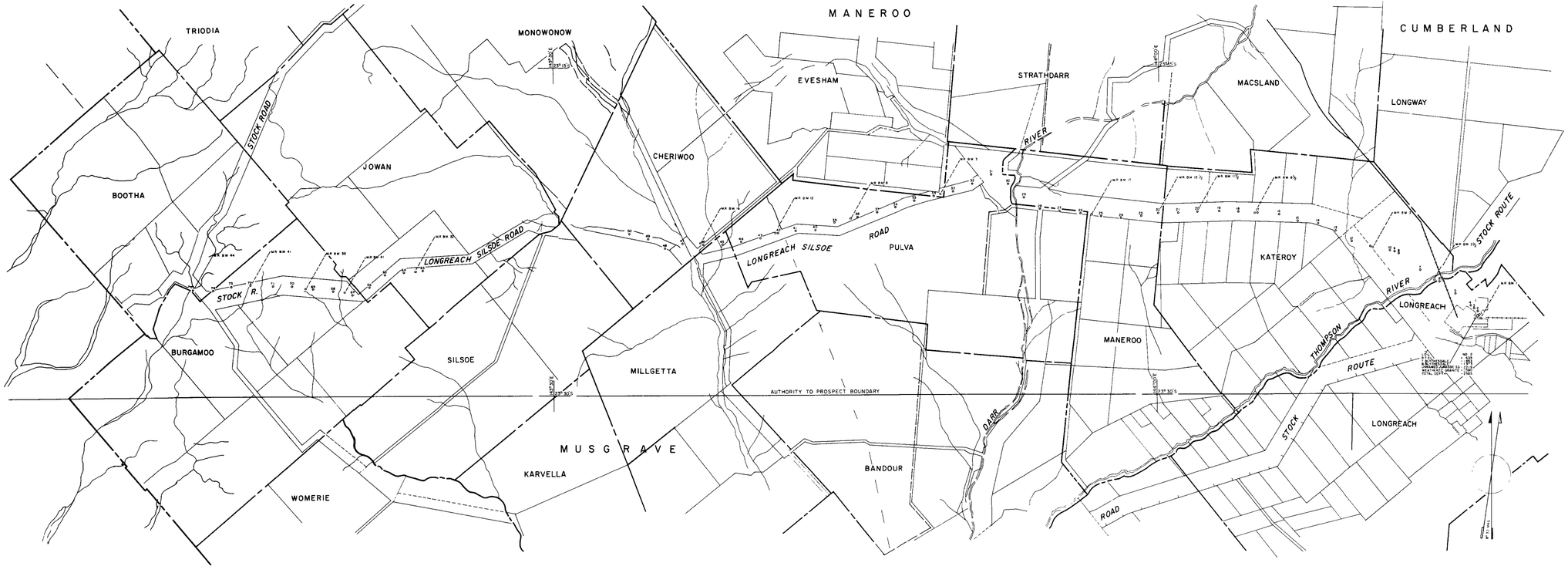
PERSONNEL AND EQUIPMENT

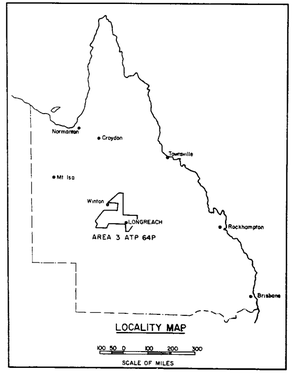
Crew headquarters	Longreach, Queensland
Party Chief	H.A. Lukowitch
Observer	B.O. Sidman
Party Manager and Driller	G.P. Hughes
Surveyor	C.J. Morrow
Recording unit	S.I.E. G-22A seismic system with S.I.E. RO-22A 50-trace camera mounted on a 1960 F-600 Ford truck. Shooting truck (1960 F-600 Ford) included water tank, explosives storage compartments, blaster, etc.
Drill unit	Mayhew-1,000 combination air-water drill mounted on International L-192 truck.
Survey unit	1960 F-100 Ford pickup; theodolite, etc.

APPENDIX 4

STATISTICS

Starting date, field work	2nd May 1960
Finishing date, field work	15th May 1960
Recording time	
Drive to and from field	12.0 hours
Field	116.0 hours
Move	48.0 hours
Holidays	0.0 hours
Loss due to bad weather	30.0 hours
Loss due to equipment failure	0.0 hours
Holes shot	57 holes
Miles of traverse shot	60 miles
Number of drills used	1 drill
Drill time	
Drive to and from field	12.0 hours
Field	120.5 hours
Move	48.0 hours
Holidays	0.0 hours
Loss due to bad weather	30.0 hours
Loss due to equipment failure	0.0 hours
Holes drilled	58 holes
Total footage	9,960 ft
Bits used	Ten 4 1/2" three-blade inserted bits. One 4 1/4" rock bit. One 5 5/8" inserted Kelly bit.
Drilling chemicals used	None





REFLECTION SEISMOGRAPH SURVEY
OF THE
LONGREACH-SILSOE AREA
QUEENSLAND

SHOT-POINT LOCATION MAP

FOR
CREE OIL OF CANADA LTD.
BY

Austral
Geo Prospectors Pty. Ltd.
Brisbane, Queensland

0 2 4 6 8
MILES

MAP DATUM Sea Level

PLATE I

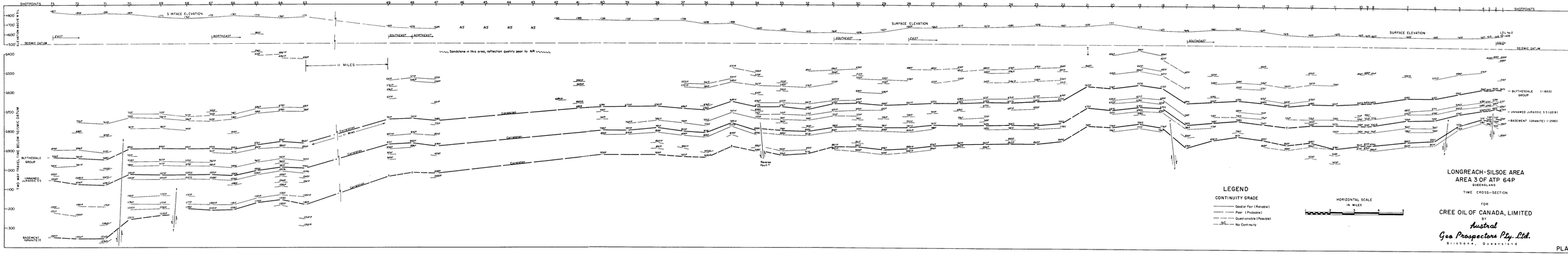
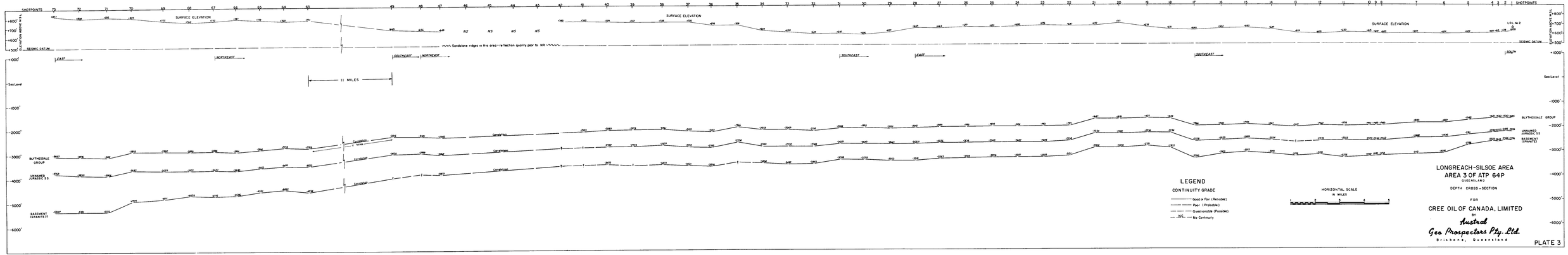

SHOTPOINTS
SURFACE ELEVATION
SEISMIC DATUM
EAST
NORTHEAST
SOUTHEAST
NORTHWEST
NS
Sandstone in this area, reflection quality poor to NR
11 MILES
Cretaceous
Reverse Fault ?
BLYTHESDALE GROUP
UNNAMED JURASSICS
BASEMENT GRANITE
TWO-WAY TRAVEL TIME BELOW SEISMIC DATUM
ELEVATION ABOVE M.S.L.
LEGEND
CONTINUITY GRADE
Good or Fair (Reliable)
Poor (Probable)
Questionable (Possible)
No Continuity
HORIZONTAL SCALE
IN MILES
LONGREACH-SILSOE AREA
AREA 3.0F ATP 64P
QUEENSLAND
TIME CROSS-SECTION
FOR
CREE OIL OF CANADA, LIMITED
BY
Austral
Geo Prospectors Pty. Ltd.
Brisbane, Queensland

PLATE 2


SHOTPOINTS
SURFACE ELEVATION
SEISMIC DATUM
Sandstone ridges in this area - reflection quality poor to NR
EAST
NORTHEAST
SOUTHEAST
NORTHEAST
SOUTHEAST
EAST
SOUTHEAST
SOUTH
11 MILES
Sea Level
BLYTHESDALE GROUP
UNNAMED JURASSIC S.S.
BASEMENT (GRANITE?)
Carboniferous
LEGEND
CONTINUITY GRADE
Good or Fair (Reliable)
Poor (Probable)
Questionable (Possible)
No Continuity
HORIZONTAL SCALE IN MILES
LONGREACH-SILSOE AREA
AREA 3 OF ATP 64P
QUEENSLAND
DEPTH CROSS-SECTION
FOR
CREE OIL OF CANADA, LIMITED
BY
Austral
Geo Prospectors Pty. Ltd.
Brisbane, Queensland
PLATE 3

L.O.L. 3

L.O.L. 4

L.O.L. 2

L.O.L. 1

GENERALISED SECTION

-1000
-1200
-1400
-1600
-1800
-2000
-2200
-2400
-2600
-2800

-800

TOP BLYTHESDALE GROUP

TOP UNNAMED JURASSIC SANDSTONE

TOP GRANITE (WEATHERED)

REFLECTION EVENT NO. 1

REFLECTION EVENT NO. 2

REFLECTION EVENT NO. 3

ROMA FORMATION — CRETACEOUS

BLYTHESDALE GROUP — JURASSIC - CRETACEOUS

JURASSIC (? WALLOON C.M.)

GRANITE

T.D. -2861

T.D. -2647

T.D -2585

T.D.-2356

LONGREACH TO CLEEVE APPROX 8.5 MILES

L.O.L 1 (CLEEVE)

L.O.L 3 LOW L L.O.L. 2 LONGREACH 2 L.O.L. 4

N

PLAN SHOWING

RELATIVE POSITIONS OF BORES

FEET 0 2000 4000 FEET

ELECTRIC LOG CORRELATION OF THE LOWER PART OF LONGREACH OIL LIMITED Nos 1-4

V. G. SWINDON - MINES ADMINSTRATION PTY LTD

JUNE 1959

DATUM: Sea Level
General Ground Level
630' Longreach: 712' Cleeve

Electric Log Scales:
S.P. ← 100 mV →
Resistivity ← 40 ohm M²/M →
Sections Drill Stem Tested.

PLATE No. 4

NOTE THE CONTOURS OF THE ORIGINAL MAP HAVE BEEN MODIFIED BY THE ADDITION OF SEISMIC DATA TO THE WEST OF THE TOWN OF LONGREACH.

THE PRESENT MAP IS COPIED FROM THE FOLLOWING BUT IS MODIFIED AS NOTED.

CARPENTARIA OILS PTY LTD

MAP SHOWING

LOCATION OF BORES WITH SHOWINGS OF OIL OR GAS

LONGREACH - WINTON AREA, QUEENSLAND

V G SWINDON - MINES ADMINISTRATION PTY LTD.

AUGUST 1959

L E G E N D

- ● OIL, WAX OR SHALE SAMPLE ANALYSED
- ◐ OIL, WAX OR SHALE NOT ANALYSED, MAINLY DRILLER'S REPORTS
- ☼ WET GAS SAMPLE ANALYSED
- ☼ DRY GAS SAMPLE ANALYSED
- ○ GAS REPORTED, NOT ANALYSED
- ~ CONTOURS ON BASE OF MARINE CRETACEOUS SHALES (DATUM SEA LEVEL).

REFLECTION SEISMOGRAPH SURVEY
OF THE
LONGREACH-SILSOE AREA
QUEENSLAND
SHOWING CONTOURS ON
BASE OF MARINE CRETACEOUS
FOR
CREE OIL OF CANADA LTD.
BY

Austral
Geo Prospectors Pty. Ltd.
Brisbane, Queensland

MILES
0 2 4 8 16 24 32

MAP DATUM. Sea Level

PLATE 5