

EXOIL OIL CO. PTY. LTD.

WELL COMPLETION REPORT

LUCY CREEK NO. 1

by

R. L. PEMBERTON

PR 67/7A WELL FILE - Closed

ONSHORE

**NORTHERN TERRITORY
GEOLOGICAL SURVEY**

PR67/7B

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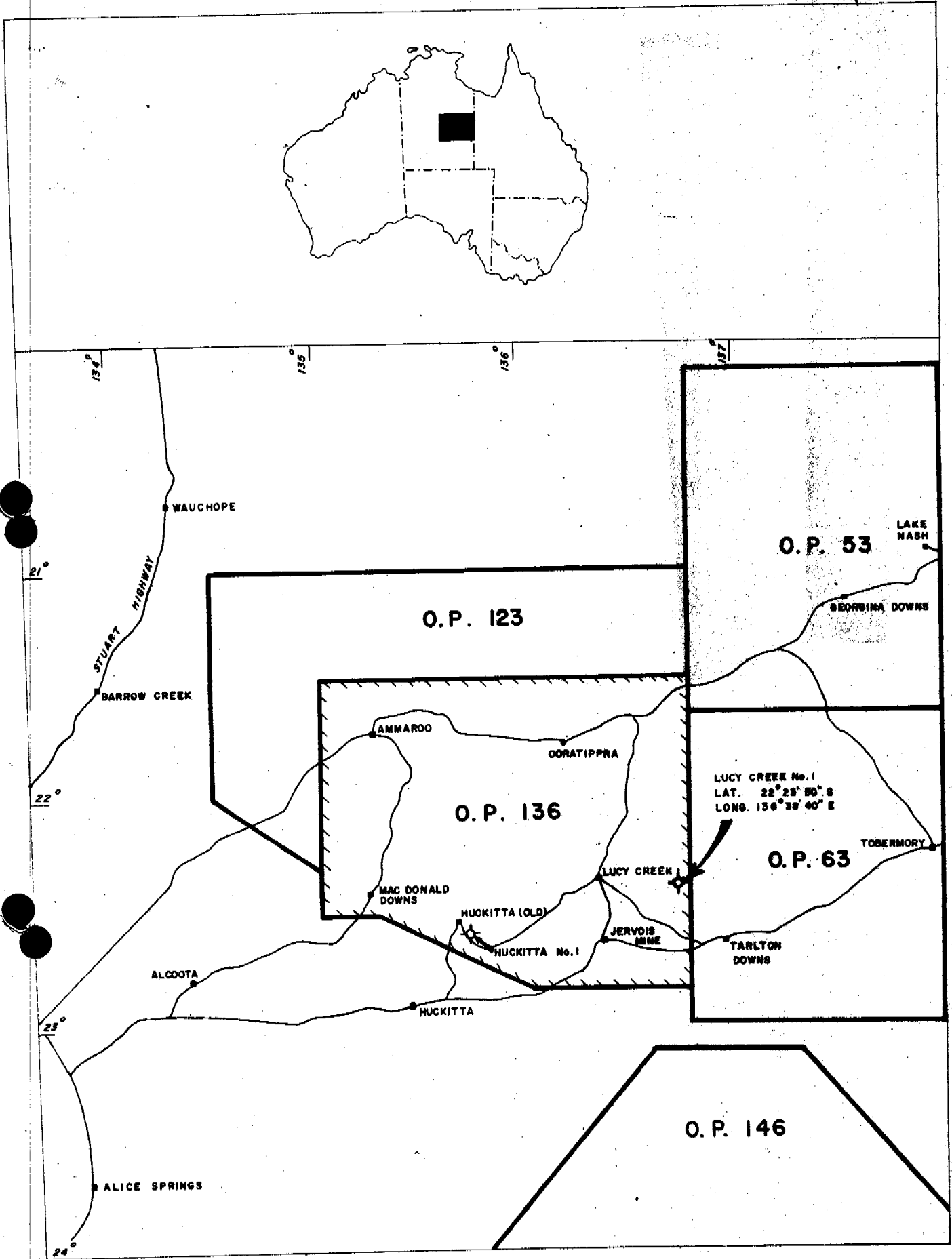
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EXOIL OIL CO. PTY. LTD.
 LOCALITY MAP
LUCY CREEK No. 1 WELL



SUMMARY

Lucy Creek No. 1 Well was drilled by Exoil Oil Co. Pty. Ltd. and Transoil (Qld) Pty. Ltd. as a stratigraphic and structural test of a closed surface anticline on the eastern side of O.P. 136 within the Georgina Basin of the Northern Territory. Drilling was carried out by Oil Drilling and Exploration Ltd. with a National T-32 rig using air and mist drilling techniques.

The well spudded in on November 6th, 1966 and was abandoned as a dry hole at ^{1105.5m} 3627 feet on November 29th, 1966.

The well penetrated ^{15.9} 52 feet of Cambro-Ordovician Tomahawk Beds, ^{714.5} 2344 feet of Upper Cambrian Arrinthrunga Formation and ^{362.7} 1190 feet of Middle Cambrian Marqua Beds before entering igneous basement. Anticipated sediments of Lower Cambrian to Upper Proterozoic were absent.

The only evidence of hydrocarbons encountered were dead oil fluorescence in flushed vuggy dolomites in the Basal Arrinthrunga, and traces of cuttings gas from samples and petroliferous odour from cores in the Marqua Beds.

The well agreed more closely with regional aeromagnetic and gravity information than with the stratigraphic prognosis.

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RESUME OF DRILLING OPERATIONS

Air drilled 17½" hole from surface to 44 feet. Cemented 15" conductor pipe at 44 feet. Air drilled 13¾" hole to 296 feet, cut core No. 1 from 296 feet to 300 feet. Attempted to run 10¾" casing; casing would not go to bottom. Cleaned out hole and air drilled 13¾" hole to 310 feet. Ran 10¾" casing to 303 feet and cemented to surface. Air drilled 9⅞" hole to 387 feet, then mist-drilled 9⅞" hole to 1860 feet, cutting routine cores. Cut core No. 6 from 1860 feet to 1868 feet. Logged hole, ran and cemented 8⅝" casing at 1860 feet. Mist-drilled 7⅞" hole ahead, cutting routine cores to 3624 feet and struck basement. Attempted to cut core 13, no penetration, cut core 14 from 3624 feet to 3627 feet with diamond core barrel. Logged and plugged hole.

INTRODUCTION

Lucy Creek No. 1 is the second exploratory well to be drilled by Exoil Oil Co. Pty. Ltd. and Transoil (Qld) Pty. Ltd. in Oil Permit 136 in the Georgina Basin of the Northern Territory of Australia. The well, situated 190 miles north-east of Alice Springs, was drilled to evaluate the reservoir and source potential and to establish the subsurface stratigraphy of the Palaeozoic and Proterozoic section in this relatively unexplored area of the Georgina Basin. The well was sited on a surface anticline having sixty square miles of areal closure and four hundred feet of vertical closure.

WELL HISTORY

GENERAL DATA:

Well Name and Number: Lucy Creek No. 1.

Name and Address of Operator: Exoil Oil Co. Pty.Ltd.,
1st Floor, Perry House,
Elizabeth and Albert Streets,
BRISBANE. QUEENSLAND.

Name and Address of Tenement Holder:

Exoil Oil Co. Pty. Ltd.,
1st Floor, Perry House,
Elizabeth and Albert Streets,
BRISBANE. QUEENSLAND.

Petroleum Tenement: Oil Permit 136,
Northern Territory of Australia

Area: 9,280 square miles

District: Tobermory

Location: 22°23'50"S; 136°38'40"E

Map Reference F 53-12

Elevation: Ground 980 feet a.s.l.

Kelly Bushing 992 feet a.s.l.

Total Depth: 3627 feet

Date Drilling Commenced: 6th November, 1966.

Date Drilling Completed: 27th November, 1966.

Date Well Abandoned: 29th November, 1966.

Date Rig Released: 29th November, 1966.

Drilling Time in Days to Total Depth: 22 days

Status: Dry and Abandoned

Total Cost: -

Subsidy Paid: -

DRILLING DATA:

Name and Address of Drilling Contractor:

Oil Drilling and Exploration Limited,
93 York Street,
SYDNEY. N.S.W.

Drilling Plant:

Make: National

Type: T-32

Motors (2): G.M.C. Twin Model 471, 225 h.p.

Drilling Plant (cont.):

Mast:

Make: Emsco
 Type: Serial 12
 Rated Capacity: 416,000 lbs.

Pumps (2):

Make:	National	Emsco
Type:	C-250	D-300
Size:	7 $\frac{1}{4}$ " x 15"	7 $\frac{1}{4}$ " x 14"
Motors:	1 Twin G.M.C. 671	1 Twin G.M.C. 671
	1 Twin G.M.C. 471	

Blowout Preventor Equipment:

Make:	Shaffer	Hydril	Shaffer
Model:	"B"	G.K.	Rotating
Size:	12"	12"	12"
Series:	900	900	900
Working Pressure:	3000 p.s.i.	3000 p.s.i.	3000 p.s.i.

Air Drilling Equipment:

<u>Unit</u>	<u>Make</u>	<u>Type</u>	<u>Size</u>	<u>Motors</u>
(2) Compressor	Ingersoll-Rand	HHE-3 Stage	1500 c.f.m. 300 p.s.i.	Waukesha 405 h.p.
(1) Booster Compressor	Ingersoll-Rand	HHE-2 Stage	3000 c.f.m. 1500 p.s.i.	Waukesha 405 h.p.
Injection Pump	Aldrich	Triplex HS-3B	1" x 2 $\frac{1}{2}$ "	Wisconsin 30 h.p.

Hole Sizes and Depths:

17 $\frac{1}{2}$ " hole from surface to 44 feet
 13 $\frac{3}{4}$ " hole from 44 feet to 310 feet
 9 $\frac{7}{8}$ " hole from 310 feet to 1860 feet
 7 $\frac{7}{8}$ " hole from 1860 feet to 3624 feet
 7 $\frac{13}{16}$ " hole from 3624 feet to 3627 feet

Casing and Cementing Details:

Size:	15"	10 $\frac{3}{4}$ "	8 $\frac{5}{8}$ "
Weight: (lbs./ft.)	Conductor	40.5	32
Grade:	-	H-40	F.J. Hydril

Casing and Cementing Details (cont.):

Range:	-	2	2
Setting Depth:	44	303	1860
Type and location of collar, shoe etc:	-	Guide shoe and float collar 30 feet up.	Guide shoe on bottom; float collar 30 feet up.
Cement Used:	50 sacks	120 sacks	110 sacks
Cemented to:	Surface	Surface	-
Method used:	Down Annulus	Displaced down pipe and down Annulus	Halliburton; plug

Drilling Fluid:

Lucy Creek No. 1 was air drilled from surface to 387 feet and mist drilled from 387 feet to 3627 feet, total depth.

While mist drilling a solution in water of foaming agent and corrosion inhibitor was continually injected at the rate of 6 to 10 barrels per hour.

Logging runs were made with a natural fill-up of formation water in the hole.

The following is a table of additives used.

Comprox	364 gallons
Sodium Bichromate	1570 lbs.
Caustic Soda	2590 lbs.

Water Supply:

Water for the drilling operation and camp was hauled by truck from a stock bore, Lucy Creek Bore 18, 1 1/2 miles from the wellsite, an adequate supply at all times being maintained. While mist drilling below surface casing, the mud tanks were kept filled with fresh water produced from the well in the event that mudding-up was required.

Perforation and Shooting Record:

No perforation or shooting was required in this well.

Plugging Back and Squeeze Cementation Jobs:

No squeeze cementation jobs were required.

In abandoning the well the following plugs were set:-

<u>Plug</u>	<u>Interval</u>	<u>Cement</u>	<u>Top Felt</u>
1	3450' - 3627'	45 sacks	3443'
2	2850' - 3000'	40 sacks	-
3	2400' - 2550'	40 sacks	2437'
4	1800' - 1950'	40 sacks	1785'
5	Surface - 140'	10 sacks	-

Fishing Operations:

None required.

Side Tracked Hole:

No side-tracking was necessary.

LOGGING AND TESTING:

Drill Cuttings:

Drill cuttings were caught using a 2' diameter sample-taker fitted into the blooey line while air, mist and aerated water drilling. Samples were caught at 10 foot intervals while drilling and 5 foot intervals while coring. Cuttings were washed and dried, where required, before packaging. Sample contamination was minimal; as seen on the composite log, changes in lithology are sharp and not masked by cavings.

Cuttings were often finely divided, at times making only general descriptions possible. However, frequent cores provided good detailed lithological information.

Three cuts of all samples were made, one for Exoil Oil Co. Pty. Ltd., one for the Bureau of Mineral Resources, Canberra, and one for the Northern Territory Administration, Alice Springs.

Coring:

A normal coring programme as set out in the subsidy agreement was followed throughout the drilling operation. Core No. 12: 3520' - 3528' was cut, as required, when no core was recovered from Core 11: 3513' - 3515'. The final Core, No. 14: 3624' - 3627' was cut in basement with a diamond core head after Core 13 at 3624' failed to make any penetration with the conventional barrel. All other cores were cut with the conventional core barrel.

Coring equipment consisted of a Hughes Tool Co. 20 foot type "J" conventional core barrel with 7 $\frac{7}{8}$ " hard formation core

Coring (cont.):

heads; and a 60' x 6 $\frac{1}{4}$ " Christensen core barrel with 7 $\frac{13}{16}$ " diamond core heads.

The following table lists cored intervals and recoveries:

<u>Core No.</u>	<u>Interval</u>	<u>Cored</u>	<u>Recovered</u>	<u>% Recovered</u>
1	296' - 300'	4'	1'5"	35
2	606' - 616'	10'	3'	30
3	877' - 884'	7'	5'	72
4	1147' - 1150'	3'	3'	100
5	1504' - 1514'	10'	3'2"	32
6	1860' - 1868'	8'	7'	88
7	2173' - 2178'	5'	3'9"	75
8	2475' - 2483'	8'	8'	100
9	2693' - 2698'	5'	4'	80
10	3200' - 3209'	9'	9'	100
11	3513' - 3515'	2'	Nil	-
12	3520' - 3528'	8'	4'9"	59
13	3624' - 3624'	Nil	Nil	-
14	3624' - 3627'	3'	1'3"	42

Total footage cored: 82 feet

Total footage recovered: 53 feet 4 inches

Percentage recovery: 65%

A four inch sample from each two feet of core recovery has been sent to the Bureau of Mineral Resources, Canberra. The remainder of the core is held by Exoil in Alice Springs.

Core descriptions are found in Appendices 2 and 3.

Side Wall Sampling:

No side-wall cores were taken.

Electrical and Other Logging:

Two logging runs were made by Welex, the first prior to running 8 $\frac{5}{8}$ " casing, the second at total depth. Hole fluid in both cases consisted of a natural water fill-up. Logs were run on 2" = 100' and 5" = 100' scales.

These logs were run:-

Induction Electric Log	Run 1	370' - 1860'
	Run 2	1860' - 3622'
Acoustic-Velocity Log	Run 1	1850' - 3620'
Gamma Ray Log	Run 1	20' - 3620'

Drilling Time and Gas Log:

Rate of penetration was recorded on a geolograph recorder and is plotted on the composite log as minutes per five foot interval.

Hydrocarbon detection was provided by a pilot light burning continually at the end of the blooey line while air and mist drilling and coring. In addition, a Corelab hot-wire gas detector with gas trap fitted to the blooey line was used when large flows of water were encountered, and also to analyse gas from cuttings. Small amounts of cuttings gas were recorded over the interval 3120 to 3530 feet, but no gas was detected at the blooey line.

Formation Testing:

No conventional drill-stem test was required. Drilling with air and mist provided a continuous open hole test of formations penetrated.

Deviation Surveys:

Deviation surveys were run with a Lane Wells "Sure-shot" instrument run inside the drill pipe on a wire line.

The following table lists all surveys taken:-

97' - $\frac{1}{2}^{\circ}$	1504' - $1\frac{1}{4}^{\circ}$
276' - $\frac{3}{4}^{\circ}$	1860' - $2\frac{1}{4}^{\circ}$
405' - $\frac{1}{2}^{\circ}$	2140' - 2°
635' - 1°	2475' - 2°
935' - $\frac{1}{4}^{\circ}$	3018' - $1\frac{1}{2}^{\circ}$
1190' - $\frac{3}{4}^{\circ}$	3475' - $\frac{1}{2}^{\circ}$

Temperature Surveys:

No temperature survey was run in the well.

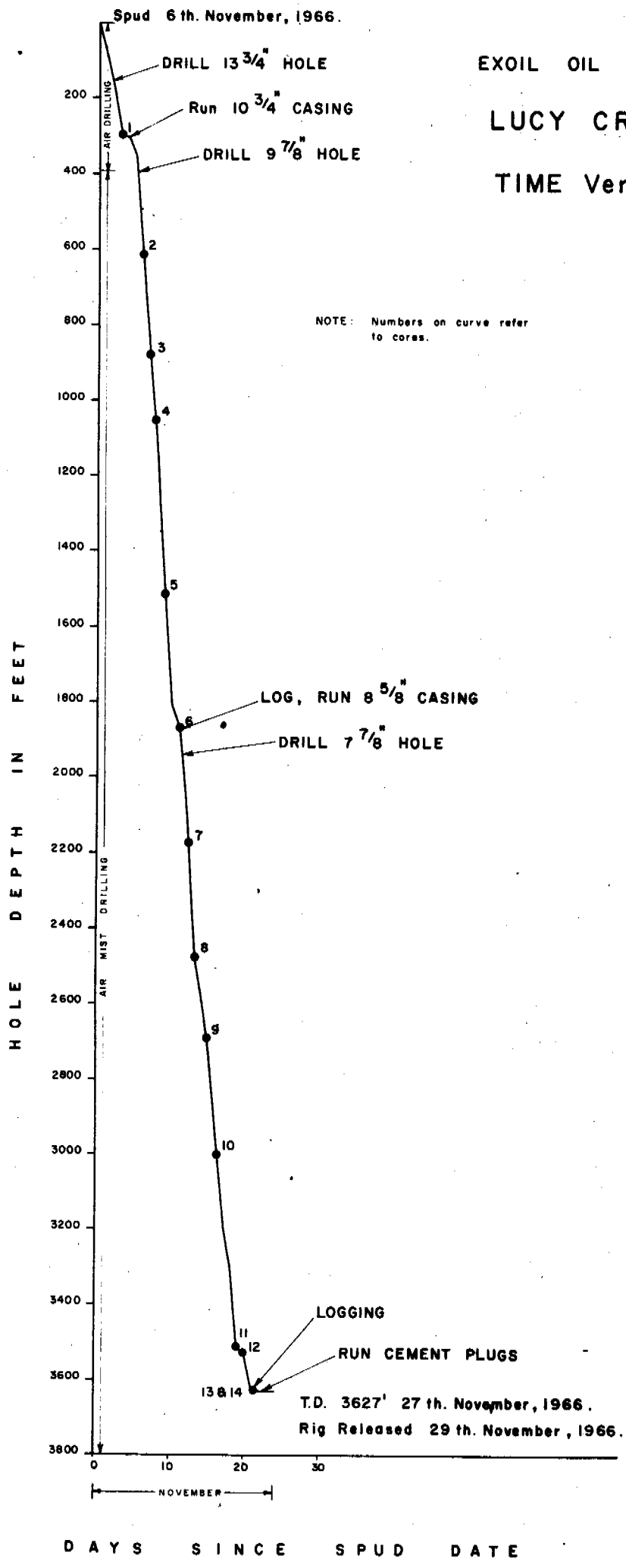
Velocity Surveys:

No velocity survey was run.

Drilling Observations:

Figure 2 shows rig time plotted against depth. A total of $556\frac{1}{4}$ hours of rig time was required to drill the well

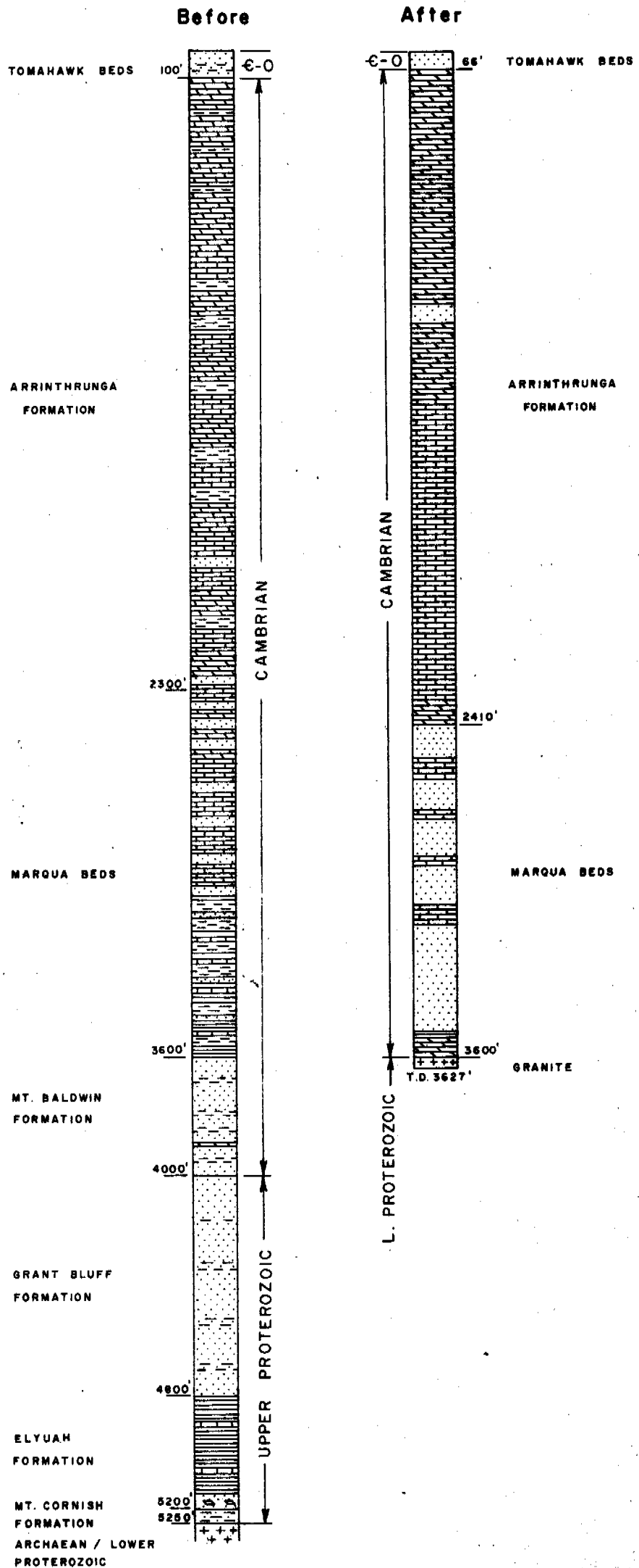
FIG. 2



EXOIL OIL CO. PTY. LTD.

LUCY CREEK No. 1

SECTIONS BEFORE AND AFTER DRILLING



Drilling Observations (cont.):

from spudding-in to rig release. The table below gives a breakdown of rig operations:-

<u>Operation</u>	<u>Hours</u>	<u>% of Total Hours</u>
Drilling (a) on bottom	247	44.5
(b) trips	58 $\frac{1}{4}$	10.5
Coring (a) on bottom	33 $\frac{3}{4}$	6.1
(b) trips	44 $\frac{1}{2}$	8.0
Conditioning Hole	19	3.4
Deviation Surveys	4 $\frac{1}{2}$	0.8
Rig Service	8	1.4
Breakdown	10 $\frac{3}{4}$	1.9
Logging	11 $\frac{1}{4}$	2.0
Casing, W.O.C., etc.	72 $\frac{3}{4}$	13.0
Abandoning	19	3.4
Other	27 $\frac{1}{2}$	5.0
Total	556 $\frac{1}{4}$	100.0

Sixteen rock bits (including one "button" bit) were used to drill 3533 feet of hole in 247 hours.

Average footage per bit: 221 feet

Average drilling rate: 14.3 feet per hour

GEOLOGY

Summary of Previous Work:

Geological:

Prior to 1957 geological investigations in area were of a reconnaissance nature. Several workers have visited parts of the area, notably Whitehouse (1936), Madigan (1937), Opik (1946), Hossefeld (1954) and Noakes (1956).

Since 1957, the Bureau of Mineral Resources has carried out extensive mapping of the Georgina Basin. In 1957 and 1958, Smith, Woolley, Pulley, Vine, Gough and Robertson mapped the Huckitta Sheet and the area was revisited in 1960 by Smith, Vine, Jones and Milligan. In 1958, 1959, 1960, Casey, Prichard, Smith, Woolley, Vine, Forman and Jensen mapped the Tobermory and Hay River Sheets. In 1960 and 1961, the Elkedra Sheet was mapped by Smith, Vine and Milligan, and the Sandover Sheet was mapped

in 1963 by Smith, Milligan, Nichols and Morton.

In addition to work by the B.M.R., some surface mapping and photogeological interpretation has been done by private companies.

Geophysical:

Geophysical work in O.P. 136 is limited to regional surveys by the B.M.R. These are reconnaissance helicopter gravity surveys of the Georgina and Amadeus Basins from 1957 to 1965 with stations spaced every 50 square miles; and regional airborne magnetometer surveys of the Georgina Basin in 1963 and 1964 in which east-west line were flown two miles apart.

Drilling:

The following exploratory wells have been drilled to date in the vicinity of O.P. 136. These wells are plotted on Figure 4. With the exception of B.M.R. 12 Cockroach, hydrocarbon shows were recorded in all the wells listed.

1. Amalgamated Petroleum Lake Nash No. 1
2. B.M.R. GRG 6 and GRG14 bores
3. Farmout Drillers Ammaroo No. 1 and No. 2
4. B.M.R. 12 Cockroach
5. B.M.R. 13 Sandover
6. P.A.P. Netting Fence No. 1
7. Alliance Mulga No. 1
8. Exoil Huckitta No. 1

Regional Stratigraphy:

O.P. 136 is located within south-western lobe of the Georgina Basin, bounded on the south by an Archean to Lower Proterozoic complex and on the north by a south-east trending outcropping high of Lower Proterozoic metasediments and igneous rocks of the Davenport geosyncline.

The Georgina Basin has been defined as an area of Middle Cambrian to Ordovician sedimentation. However, there is some evidence for including sediments of Lower Cambrian and to a degree Upper Proterozoic age, particularly in the permit area. On the Huckitta sheet, after a minor break in sedimentation at the close of a glacial epoch in the Upper Proterozoic, sedimentation was continuous at least into Lower Cambrian time and, on

the basis of present knowledge, quite possibly into Ordovician time.

Sediments of Upper Proterozoic age outcrop in the ranges occupying the southern margin of the Permit, possibly in the Davenport Range north of the Permit, directly east in the Tarlton Range and approximately 50 miles east south-east of the Permit along the faulted southern margin of the Toko Syncline.

In the Huckitta area, the basal unit, the Mt. Cornish Formation, with a maximum thickness of ^{381.0} 1250 feet, rests unconformably on Archaean or Lower Proterozoic basement. The formation consists primarily of blue-green tillitic boulder beds and laminated cyclic siltstones and sandstones of presumed fluvio-glacial origin, and has been correlated with the Areyonga Formation of the Amadeus Basin. In the Davenport Range to the north of the Permit a glacial epoch, possibly equivalent to 'Mt. Cornish' time, is expressed as a sequence of boulder beds, siltstones and sandstones ^{45.7} 150 feet thick lying unconformably in topographic lows on the Lower Proterozoic Hatches Creek Group. To the east and south of the Permit, on the Tobermory and Hay River Sheets, a maximum thickness of 1175 feet of green tillitic siltstones, boulder beds and laminated siltstones comprising the basal unit of the Field River Beds are a probable correlate of the Mt. Cornish Formation.

Following a period of erosion at the close of the Upper Proterozoic glacial epoch, there followed a continuous period of deposition into Lower Cambrian time. In the southern Huckitta area the Mopunga Group was laid down as a sequence of three formations, the Upper Proterozoic Elyuah and Grant Bluff Formations and the Lower Cambrian Mt. Baldwin Formation.

The basal unit, the Elyuah Formation includes the lower Oorabra Arkose Member, which reached its maximum development in the Mopunga Range where ^{1097.3m} 3600 feet of arkose was deposited, followed by ^{45.7m} 150 to ^{106.68m} 350 feet of green and red

shales. East of the Permit area in the Keepera Ridges, 1000 feet of arkoses and siltstones included in the Field River Beds and resting with presumed disconformity on boulder and tillitic beds have been equated provisionally with the Elyuah Formation.

Conformably overlying the Elyuah Formation is the Grant Bluff Formation, a distinctive sequence of alternating grey quartz sandstones, quartz greywacke, siltstones, shales and thin algal dolomite bands. In the Elyuah Range, in the extreme southern part of Permit 136, the Formation is 530 feet in thickness which increases eastward to a maximum of 1500 feet on the Tobermory and Hay River Sheets.

On the Huckitta Sheet, the Mount Baldwin Formation, containing Archaeocyathids of Lower Cambrian age, conformably and gradationally overlies the Grant Bluff. The formation outcrops in the Mopunga, Elyuah and Jervois Ranges, and comprises a maximum of ^{4167m} 1367 feet of dominantly red sediments - sandstone, greywacke, siltstone, dolomite and shale.

No outcrop of Lower Cambrian sediments has been recognised south and west of the Huckitta area. On the Tobermory and Hay River Sheets there is evidence that Middle Cambrian sediments rest unconformably on various units of the Field River Beds. Therefore the Mount Baldwin Formation may have been deposited and eroded completely before Middle Cambrian sedimentation, or deposition of Grant Bluff type sediments may have continued into 'Mount Baldwin' time.

In the northern part of the Permit no Upper Proterozoic - Lower Cambrian section is present. However, it is likely that these beds extend northward from their outcrop areas in the Mopunga, Elyuah and Jervois Ranges for a considerable distance under Palaeozoic sediments in the central Permit area.

Georgina Basin sedimentation, as stated by most writers, began in Middle Cambrian time. In south central O.P. 136, the Mt. Baldwin Formation is succeeded conformably by a

maximum thickness of 755 feet of Arthur Creek Beds, consisting of sparsely fossiliferous dolomite, chert, limestone and minor sandstone in outcrop south and west of the Huckitta Homestead. In the south-eastern portion of O.P. 136, the Arthur Creek Beds thicken to ^{307.9m} 1010 feet, become less arenaceous and consist of ^{182.9m} 600 feet of white to buff shale and siltstone with a rich fauna of trilobites and brachiopods, ^{76m} 250 feet of blue-grey fossiliferous flaggy limestone, and ^{48.8} 160 feet of white and brown sandstones grading and lensing into brown dolomite and blue limestone.

In the extreme north of the Permit area, where the Mopunga Group is missing apparently due to onlap, the Middle Cambrian Sandover Beds dip south and east unconformably off the Lower Proterozoic Hatches Creek Group and in turn are overlapped by Upper Cambrian. The beds are approximately ^{259.1} 850 feet thick and comprise in ascending order; ⁹¹ 30 to ^{36.6} 120 feet of poorly sorted pebble conglomerates and sandstones, approximately ^{152.4} 500 feet of very uniform fossiliferous lutites, approximately ^{53.3} 175 feet of bioclastic, sublithographic and algal limestones, and 50 feet of white barren siltstone.

South and east of the Permit area, lower to upper Middle Cambrian rocks of the Marqua Beds lie unconformably on Upper Proterozoic sediments on the Tobermory and Hay River Sheet areas. The Marqua Beds bear many similarities to the Arthur Creek Beds and Sandover Beds, both in fossil content and lithology, and comprise at least ^{205.7} 675 feet of limestones, cherts, shales and sandstones.

Middle Cambrian beds are conformably succeeded by Upper Cambrian Sediments of the Arringhrunga Formation and its equivalents. Around the margins of the basin this formation overlaps the Middle Cambrian and consequently lies unconformably on older formations. On the eastern side of the Permit area, the formation is about 1000 feet thick and consists of abundantly algal dolomite, limestone and dolomitic limestone

with interbedded sandstone and green siltstone. In the upper quarter of the formation a sandstone occurs which outcrops over a wide area north and north-east of Arthur Creek. This is the Eurowie Sandstone Member which attains a maximum thickness of 100 feet and is predominantly a medium grained quartz sandstone with fine grained sandstone and siltstone near the base. Halite pseudomorphs, ripple marks, cross-bedding, mud cracks and mud pellets indicate a shallow water depositional environment for this potential reservoir. In the south central portion of O.P. 136, the Arrinthrunga thickens to 3,000^{914 m} feet but the Eurowie Sandstone is missing and the boundary with the underlying Arthur Creek Beds is difficult to define. The lower Arrinthrunga to the east, consists of limestones, dolomites and minor siltstones.

East of the Permit area, on the Tobermory Sheet the Arrinthrunga Formation and its probable equivalent on the Sandover River Sheet, the Meeta Beds, outcrop sporadically over large areas largely covered with sand and alluvium. Complete sections are rare owing to this cover, but it is known that thickness of 1,000³⁰⁵ to 1,300^{396 m} feet of lithographic, oolitic, algal and clastic limestones and dolomites and minor sandstones are developed.

Conformably overlying the Arrinthrunga Formation are the Tomahawk Beds containing a rich fauna of Upper Cambrian to Lower Ordovician age. In the central Huckitta area these beds are exposed on both flanks of the Dulcie Syncline and reach a maximum thickness of 740^{225.6} feet of interbedded sandstone, and minor pipe-rock, siltstone, dolomite and limestone. On the south-western flank of the Dulcie Range, the Tomahawk Beds are followed conformably by the Ordovician Nora Formation. On the north-eastern flank of the range, the Nora Formation is not present, and the Tomahawk Beds are overlain unconformably by the Upper Devonian Dulcie Sandstone.

In the eastern part of the Permit area where its base is not exposed, a thickness of 250^{76.2} feet of Tomahawk Beds

is present, consisting of quartz sandstone and minor carbonate rocks with rapid lateral gradations between the two. East of the Permit area, the Tomahawk Beds gradually change eastward from a fossiliferous sandy facies to the less fossiliferous carbonate facies of the Ninmaroo and overlying Kelly Creek Formations.

Along the south-eastern margins of the Dulcie Range, the Tomahawk Beds are succeeded conformably by the lithologically distinctive Nora Formation which here reaches a maximum thickness of ^{112.8m} 370 feet. A strong erosional unconformity which follows the unit gives rise to much variation in its thickness, and on the north-western flank of the Dulcie Range, its complete absence. The formation consists of interbedded green fossiliferous mudstones and claystones, ferruginous sandstones, oolitic ironstone and minor fossiliferous carbonates. The sequence is also recognised in separate outcrops east of the Permit area in the Tarlton and Toko Ranges.

Uplift and slight folding took place in post-Middle Ordovician times and a prolonged period of erosion then preceded the deposition of the Upper Devonian Dulcie Sandstone. This formation consists of a maximum measured thickness of ^{651.7m} 2,138 feet of strongly crossbedded clean to silty quartz sandstone with sporadic beds of pebble conglomerate. The Dulcie Sandstone occurs as the surface truncated deposit of the Dulcie Syncline in the south-eastern portion of the Permit area and extends north-westwards beyond the boundary. Since this formation is not capped, and because of its restricted area, the Dulcie Sandstone is not thought to be significant in the search for oil.

FORMATIONS PENETRATED

Stratigraphic Table

<u>Age</u>	<u>Formation</u>	<u>Top</u> <u>Depth</u>	<u>Subsea</u>	<u>Thickness</u>
Cambro-Ordovician	Tomahawk Beds	Surface	+980'	52'+
Upper Cambrian	Arrinthrunga Formation	66'	+928'	2344'
Middle Cambrian	Marqua Beds	2410'	-1416'	1190'
Precambrian	Granite	3600'	-2606'	27' penetrated

Detailed Stratigraphy

Tomahawk Beds Surface - 66' (thickness 52') ^{15.8}

Age: Cambro-Ordovician

Sandstone, tan and ochre, silty, calcareous, micaceous very fine to fine grained, friable and porous, partly gypsiferous with interbedded yellow and green argillaceous siltstone, and ochre sandy shale. Bottom of interval contains much red, yellow and black mottled chert. ? *weathered* ?

Arrinthrunga Formation 66' - 2410' (thickness 2344') ^{214.5}

Age: Upper Cambrian

Top: Picked on Gamma Log at a pronounced shift to low radio-activity. In samples at first appearance of dolomite.

^{20.1} ^{275.8}
66' - 905' Dolomite, buff, light to medium grey and brown, rarely green, pink and red, crypto-crystalline to medium crystalline, occasionally slightly sandy. One bed of grey and green dololomite occurs at 884'. Two cherty zones occur in the lower 60' of the interval. Rare beds of intercrystalline and vuggy porosity are present. In the lower half of the interval, the dolomite is interrupted by occasional beds of clean light grey fine to medium grained calcareous and siliceous sandstone and thin beds of varicoloured shale.

^{300.8}
905' - 987' Sandstone, clean, white, very fine to fine grained, well sorted, calcareous, grading occasionally to siltstone.

Towards the bottom of the interval, sandstone is interbedded with buff, crypto-crystalline, cherty dolomite. This interval is lithologically similar to, but occurs stratigraphically lower than, the Eurowie Sandstone Member (Smith, 1964 page 43 - 45)

987' - 1280' Interbedded dolomite, sandstone, siltstone, shale and Limestone. Dolomite is light grey and brown micro-crystalline to medium crystalline with scattered vuggy intervals. Below 1200 feet dolomite predominates. Oolitic and pelletoid beds are present at 1220 feet and 1260 feet. Sandstones occur in beds up to 15 feet thick concentrated in the middle of the interval. They are light grey, minor green, generally fine grained but occasionally poorly sorted fine to coarse, dolomitic and siliceous. Siltstone, in beds up to 10 feet thick, are green and dark grey, dolomitic, sandy and argillaceous. Red, green and black shale is present as thin beds and fine laminations. Limestone which occurs only in the lower part of the interval is light brown, micro-crystalline, partly oolitic.

1280' - 2316' An interval of limestone in beds up to 120 feet thick with thinly interbedded, often gradational siltstone, sandstone, shale and dolomite. Limestones are predominately light to medium grey and brown, occasionally stained red, pink and green. Texture varies from crypto-crystalline to medium and rarely coarsely crystalline, with several calcarenitic intervals and rare oolitic beds. Vuggy and intercrystalline porosity is common throughout the interval. Locally the limestone contains varying amounts of sand, and grades rarely to light grey calcareous sandstone. Thin beds of red, green and grey shale are present throughout. A few thin beds of grey, brown and green dolomite, often clastic in origin appear to be gradational with limestone.

2316' - 2410' Dolomite, light grey to dark brown, micro-crystalline to coarse crystalline with excellent vuggy and intercrystalline porosity throughout. Thin varicoloured shale and siltstone occur as before.

Marqua Beds 2410' - 3600' (thickness 1190')

Age: Middle Cambrian

Top: A prominent pick on the Induction, Gamma and Velocity logs readily correlated with B.M.R. No. 12 Cockroach. In samples an abrupt change from dolomite to sandstone.

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2410' - 3535' Sandstone 70% and Limestone 30% with minor shale interbeds. Sandstones are white varying to dark grey and brown often finely laminated with black shale towards the base of the interval. Sandstones are normally very fine grained, very often approaching and grading to siltstone. Rare beds are medium grained. Calcareous cement content is often high, sandstone grading at times to sandy limestone. Poor to fair intergranular porosity is often evident. Limestone beds are up to 80 feet thick. Limestone is light to dark grey and brown, often very sandy, crypto-crystalline to very fine crystalline, generally tight. Shale content increases with depth. The bottom 50 feet of the interval consists of interbedded black micaceous, carbonaceous shale and sandstone in roughly equal amounts.

3535' - 3600' Dolomite, very light grey and brown, fine crystalline, pyrite, partly porous.

Granite ¹⁰⁹⁷ 3600' - 3627' (27' penetrated)

Age: Precambrian

For description see Appendix 3.

Structure

The Lucy Creek No. 1 area is a structurally high region bounded to the east and west by prominent synclines. Southerly closure is provided by a flank of Ninmaroo Limestone while to the north gross closure exists in the confluence of the two bounding synclines. Surface dips are usually in the order of 1-3 degrees on the flanks of the high except to the north-west where the eastern flank of the western bounding syncline runs into a steep monocline (see Figure) the total closed area is some 60 square miles with a vertical component of approximately 400 feet.

The crest of the regional high is thrown into a series of sharp folds and impersistent collapse structures in the incompetent lower Tomahawk sandstones. At least two anticlines have been demarcated, separated by a median saddle, all aligned roughly parallel to the major bounding synclines. The Lucy Creek site was selected on the easternmost culmination which shows a

secondary closure of 100 feet vertically and three square miles areally.

Flat dips were recorded in all cores recovered except Core 12 which showed 4° . Hole deviation was minimal throughout, reaching a maximum of $2\frac{1}{4}^{\circ}$ at 1860 feet. These observations confirm that the well penetrated the crest of Lucy Creek structure.

The 4° dip in Core 12 which is 80 feet stratigraphically above granite may well be an original depositional dip in the Marqua Beds building on the granite.

As there is no regional or well evidence to suggest Cambrian or post-Cambrian igneous activity, it is concluded that the Lucy Creek No. 1 structure was formed on an existing Precambrian granite high.

Post-Devonian structural activity which strongly folded the incompetent Tomahawk Beds had no discernable effect on the more competent underlying Cambrian carbonates, but may have brought the Lucy Creek No. 1 structure to its present configuration.

POROSITY AND PERMEABILITY OF SEDIMENTS PENETRATED

Both middle and Upper Cambrian strata were found to contain good reservoir beds. In the Arrinthrunga formation, limestones and dolomites often contain good vuggy and inter-crystalline porosity. Permeabilities are indicated by a complete loss of returns from 130' to 310' and increasing water production with depth. The basal Arrinthrunga dolomite at 2316' to 2410', with excellent vuggy porosity, produced water at the rate of 1300 barrels/hr. The Velocity Log over this interval shows porosity exceeding 20%.

Within the Marqua Beds, limestones are tight and only poor to fair intergranular porosities were observed in cores and cuttings. Velocity log porosities of the sandstones range from 3% to 15%.

RELEVANCE TO OCCURRENCE OF PETROLEUM

No significant hydrocarbons were encountered at Lucy Creek No. 1, although small shows were recorded in both the Arrinthrunga Formation and the Marqua Beds.

Strong yellow fluorescence with no cut, suggestive of dead oil staining was obtained in cuttings from a vuggy dolomite at the base of the Arrinthrunga over the interval 2316' - 2410'.
A strong water flow was encountered in this interval.

In the Marqua Beds, between 3120' and 3520' one to two units of cuttings gas were ground from samples, and a petroliferous odour was detected when samples were heated. Faint yellow fluorescence was present in samples from 3210' to 3520'.

No hydrocarbons were produced from these intervals and there were no other shows. It can only be concluded that if oil or gas has been present at Lucy Creek No. 1, the reservoir formations have been very thoroughly water-flushed.

CONTRIBUTIONS TO GEOLOGICAL CONCEPTS

General

Lucy Creek No. 1 provided new stratigraphic information in a part of the Georgina Basin hitherto unexplored in the subsurface. Lithologic detail of strata was provided by the routine cores cut, and Electric, Gamma and Velocity logs have provided valuable information for subsurface correlations.

A normal Middle and Upper Cambrian sequence much as anticipated was encountered. However, the absence of any Lower Cambrian and Upper Proterozoic section, and the presence of granite basement at 3600 feet was unexpected, as available outcrop and subsurface information had strongly suggested their presence.

In this regard, the Bureau of Mineral Resources' reconnaissance gravity data and aeromagnetic interpretation agree reasonably well with the drilling results.

Two well sections (Figs. 6, 7), intersecting at Lucy Creek No. 1 have been prepared to collate existing drilling and geophysical information. Section 1 between Ammaroo No. 2 and Netting Fence No. 1 wells is roughly parallel to the dominant

north-westerly structural trend in the Georgina Basin. Section 2 between Huckitta No. 1 and Lake Nash No. 1 wells is approximately normal to this trend. Several points become evident from these sections.

All the wells in Section 1 bottomed in granite basement and no proven Lower Cambrian - Upper Proterozoic sediments were encountered. In Section 2, Upper Proterozoic - Lower Cambrian strata are absent at Lucy Creek No. 1 but appear to the south-west and north-east. It is thus evident that all the wells along Section 1 are located in an area which, prior to the Middle Cambrian comprised a high basement area, probably an upthrown basement block or system of fault blocks, the bounding faults trending north west, with the adjacent Huckitta - Jervois Range and Mulga No. 1 - Lake Nash No. 1 areas being downthrown blocks. This agrees with the observed north-westerly trend of basement rocks and later posthumous (?) epi-Devonian structures in this part of the basin (Smith 1965, p.14) and supports Smith's (1964, p.59; 1965, p.14) theory of strong tectonic activity before initiation of Middle Cambrian sedimentation.

This suggests that the arbitrary pick of 207 feet of Lower Cambrian strata in the B.M.R. 13 Sandover well is probably incorrect. This pick is not supported by fossil evidence and the unit is lithologically similar to the basal dolomite unit of the Marqua Beds at Lucy Creek No. 1.

CORRELATIONS:

An unfortunate feature of wells drilled in the Georgina Basin is the scarcity of fossils found, and the consequent difficulty in establishing definite time units and making precise well correlations.

Free use of Electrical, Sonic and Gamma-Ray logs for correlation has been made in the sections prepared and slight variations from previous correlations have therefore been made. For simplicity's sake logs are not included on the sections, but log correlations are noted. The B.M.R. 12 Cockroach well has been used as reference and, where possible, correlations tied to it.

In Cockroach, the base of the Ninmaroo has been picked arbitrarily at an E-log change at 485 feet (Nichols and Bell, 1960, p.12). There is also a good break on Gamma-Ray and Sonic logs at this depth, which ties with Netting Fence No. 1 at 2028 feet. The original pick for the base of the Ninmaroo was 2381 feet (Mines Administration Pty. Ltd., 1965). The writer agrees with Nichols (1966, p.6) who pointed out that a pick of the base of the Ninmaroo is invalid when placed within a carbonate sequence. It is therefore felt that the present pick is justified in an attempt at standardizing well correlations.

Insufficient logs are available to attempt a correlation with the Ninmaroo in Mulga No. 1

Log correlation within the Arrinthrunga is difficult. However, a distinctive rapidly oscillating Sonic and Gamma-Ray pattern with an abrupt change to flatter curves below the Arrinthrunga is evident in some wells.

The top of the Middle Cambrian Marqua Beds is a distinctive pick on the Electric log. The change in character of the Gamma-Ray and Sonic curves noted above is also abrupt. Good correlation with Lucy Creek No. 1 exists down through the Marqua Beds to 3402 feet in Lucy Creek No. 1 and 3710 feet in Cockroach.

The top Marqua Beds pick can be carried to 4220 feet in Netting Fence No. 1. This gives a thickness of 2192 feet of Arrinthrunga equivalent, which, although not compatible with regional thickening of other units towards the Toko Syncline, is consistent with 2236 feet at Cockroach and 2344 feet at Lucy Creek No. 1.

In the Mulga No. 1 well a plausible top Marqua Beds pick has been made at 1570 feet which differs from Alliance's (1965) top at 1714 feet. Again, a log pick is justified because the boundary is within a dolomite sequence, with no fossil control.

To the west of Lucy Creek No. 1 there appear to be no log correlations and previous formation tops have been used, with the exception of B.M.R. 13 Sandover well in which the Mount Baldwin Formation has been deleted for reasons cited above.

Geophysical

Several interesting features are illustrated by the gravity and magnetic basement profiles (Figs. 6, 7):

- 1) The magnetic basement profiles agree reasonably well with actual basement depths found in subsequent wells.
- 2) A rough inverse relationship occurs between gravity and magnetic basement profiles, i.e. gravity "highs" tend to coincide with magnetic basement "lows", and vice-versa.
- 3) All wells drilled to basement found acid igneous rock.
- 4) Several deep magnetic basement "troughs" are interpreted in which evidence suggests a thick fill of unprospective Proterozoic sediments may be developed. In the most prominent "trough", in the vicinity of Mulga No. 1, 7500 feet of Proterozoic sediments are indicated. This is quite possible, as Smith (1965, p.7) has measured 7500 feet of Upper Proterozoic sediments in the adjoining Hay River Sheet area.

These observations suggest that more detailed aeromagnetic and gravity surveys may be well suited for locating local basement highs over which Cambrian structures or reefs may be developed. In this regard the following points are noted.

- 1) As all wells drilled to basement in the area have encountered low density acid igneous rocks, it is reasonable to assume that they underlie much of the Georgina Basin.
- 2) The Georgina Basin is unique in that most of the Palaeozoic section is composed of high density carbonate rocks.
- 3) The combination of high density sediments overlying low density basement should make it possible for detailed gravity methods to pin-point new areas where basement is high, Upper Proterozoic section is thin or absent and favourable Cambrian sediments have been arched into productive structures.

- 4) There is no record of post-Lower Proterozoic igneous activity anywhere in the Georgina Basin and consequently little possibility of magnetic horizons being present within the sedimentary section to complicate magnetic interpretation.

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SAMPLE DESCRIPTIONS

14 -	20 feet	100% <u>Sandstone</u> tan, very fine to fine grained, silty, micaceous, fine gypsum crystals, black mottling, slightly calcareous, <u>porous</u> .
20 -	40 feet	80% <u>Sandstone</u> as above, ochre iron stained colour. 20% <u>Siltstone</u> green-yellow, fine, friable, micaceous partings.
40 -	50 feet	60% <u>Siltstone</u> light yellow, argillaceous, fine sandy, micaceous. 40% <u>Sandstone</u> light yellow, very fine, grading with <u>Siltstone</u> (sample contaminated with cement).
50 -	60 feet	80% <u>Shale</u> ochre, sandy, becomes gummy with water. 20% <u>Sandstone</u> as above. Trace gypsum.
60 -	70 feet	70% <u>Sandstone</u> ochre-red, very fine to fine grained, dirty, silty, many black coated nodules (?) of green shale, sandstone. 30% <u>Chert</u> rusty red, yellow and black, often mottled.
70 -	80 feet	20% <u>Chert</u> . 20% <u>Shale</u> , red, green, ochre, soft. 30% <u>Sandstone</u> . 30% <u>Dolomite</u> , buff, very fine crystalline.
80 -	90 feet	90% <u>Dolomite</u> , flesh coloured, fine crystalline, dense. 10% <u>Shale</u> , yellow and green as above.
90 -	130 feet	100% <u>Dolomite</u> as above, trace very fine sandy.
130 -	296 feet	No Sample - air returns lost to formation.
296 -	300 feet	<u>CORE NO. 1.</u>
300 -	310 feet	No sample.
310 -	320 feet	100% <u>Dolomite</u> medium grey, fine crystalline, dense, trace quartz grains and small rounded, frosted quartz pebbles.
320 -	330 feet	100% <u>Dolomite</u> , grey as above.
330 -	350 feet	100% <u>Dolomite</u> , becoming partly light grey - buff.
350 -	360 feet	100% <u>Dolomite</u> as above, trace crystalline pyrite clusters and medium to rarely coarse crystalline dolomite.
370 -	380 feet	100% <u>Dolomite</u> as above, medium grey and brown.
380 -	390 feet	100% <u>Dolomite</u> , light grey-buff, very fine to partly coarse crystalline. <u>Slight intercrystalline porosity</u> in coarse grained dolomite.
390 -	470 feet	100% <u>Dolomite</u> as above, samples very finely divided with advent of mist drilling.
470 -	490 feet	No sample.
490 -	500 feet	<u>Dolomite</u> finely divided, as above.
500 -	510 feet	90% <u>Dolomite</u> , light grey and brown and green argillaceous, fine to medium crystalline, dense trace crystalline gypsum, trace dolomitic red and green <u>Shale</u> . 10% <u>Sandstone</u> , very fine, tight, rarely poorly sorted with coarse rounded grains, tight.

510 - 530 feet	10% <u>Shale</u> red, silty, micaceous. 10% <u>Sandstone</u> , green, very fine, hard and tight, siliceous. Sandstone also minor white and purple - trace small rounded pebbles. 80% <u>Dolomite</u> as above, trace gypsum.
530 - 540 feet	100% <u>Dolomite</u> , trace <u>Shale</u> and <u>Sandstone</u> .
540 - 550 feet	100% <u>Dolomite</u> , buff, brown, minor green, pink fine to medium crystalline dense, <u>trace good vuggy porosity</u> .
550 - 570 feet	100% <u>Dolomite</u> , medium to light, grey fine crystalline, dense, minor green.
570 - 606 feet	100% <u>Dolomite</u> , becoming brown.
606 - 616 feet	<u>CORE NO. 2.</u>
616 - 630 feet	100% <u>Dolomite</u> , brown as in Core No. 2. Sample very fine.
630 - 640 feet	No sample.
640 - 650 feet	100% <u>Dolomite</u> , light brown, grey, flesh coloured fine to medium crystalline; green crypto-crystalline, argillaceous, rare round sand grains; trace red <u>Shale</u> .
650 - 660 feet	100% <u>Dolomite</u> (sample very fine) rare sand grains.
660 - 670 feet	100% <u>Dolomite</u> vari-coloured, as above.
670 - 690 feet	100% <u>Dolomite</u> , samples very fine.
690 - 700 feet	100% <u>Dolomite</u> , brown, grey, green as above.
700 - 710 feet	100% <u>Dolomite</u> , sample fine.
710 - 720 feet	100% <u>Dolomite</u> mostly medium grey and brown, medium crystalline also green argillaceous and silty; trace red and green <u>Shale</u> .
720 - 730 feet	100% <u>Dolomite</u> - mostly red stained fine crystalline to granular (sample very fine) dolomitic(?)
730 - 770 feet	100% <u>Dolomite</u> , grey-brown, fine granular to crystalline (very fine sample) rare very fine sand grains.
770 - 790 feet	70% <u>Dolomite</u> as above, partly red stained. 30% <u>Shale</u> red, micro-micaceous.
790 - 800 feet	30% <u>Sandstone</u> (loose) very fine to fine, angular to rounded. 20% <u>Shale</u> red. 50% <u>Dolomite</u> .
800 - 810 feet	20% <u>Sandstone</u> , 20% <u>Shale</u> , 60% <u>Dolomite</u> .
810 - 820 feet	90% <u>Dolomite</u> brown, grey, red, green, partly silty and argillaceous, crypto-to medium crystalline. 10% <u>Shale</u> , red, silty.
820 - 830 feet	20% <u>Sandstone</u> (loose very fine to fine grained, angular to rounded, grey silty cement, grey and reddish. 10% <u>Shale</u> , red, 70% <u>Dolomite</u> .
830 - 840 feet	20% <u>Sandstone</u> . 80% <u>Dolomite</u> .
840 - 850 feet	100% <u>Dolomite</u> .

850 - 860 feet	80% <u>Dolomite</u> , 20% <u>Chert</u> , orange, dolomitic (grades to Dolomite?).
860 - 870 feet	10% <u>Shale</u> red, micaceous. 90% <u>Dolomite</u> , white, very fine crystalline, with fine sandy streaks.
870 - 877 feet	100% <u>Dolomite</u> , white as above, trace purple.
877 - 884 feet	<u>CORE NO. 3.</u>
884 - 900 feet	100% <u>Dolomite</u> , medium to dark brown, minor light grey and greenish, very fine crystalline, appears partly fine granular (dololutitic), fine sandy streaks.
900 - 910 feet	100% <u>Dolomite</u> , mostly white lithographic, siliceous, appears to grade to <u>Chert</u> .
910 - 920 feet	10% <u>Shale</u> , dark grey, micaceous. 70% <u>Sandstone</u> (loose in sample) fine to medium sub-rounded to rounded, some frosted and faceted grains, well sorted, white and clear quartz, dolomitic. 20% <u>Dolomite</u> , cherty as above.
920 - 930 feet	100% <u>Sandstone</u> as above, white, very fine to medium grained.
930 - 940 feet	100% <u>Sandstone</u> as above, very fine grained, dolomitic.
940 - 960 feet	100% <u>Sandstone</u> as above, very dolomitic, very fine, grading to <u>Siltstone</u> .
960 - 970 feet	60% <u>Sandstone</u> white, fine grained, 40% <u>Dolomite</u> , buff, crypto-crystalline with 10% orange chert. Trace <u>Shale</u> , red and green, micaceous.
970 - 990 feet	40% <u>Sandstone</u> , 60% <u>Dolomite</u> .
990 - 1000 feet	30% <u>Sandstone</u> , 70% <u>Dolomite</u> .
1000 - 1010 feet	90% <u>Dolomite</u> , light grey and brown, very fine crystalline, granular. 10% <u>Sandstone</u> .
1010 - 1060 feet	100% <u>Dolomite</u> .
1060 - 1070 feet	95% <u>Dolomite</u> light grey, brown and green, crypto-crystalline to micro-crystalline, tight. Fine sandy streaks. 5% <u>Sandstone</u> green, dolomitic, sandy, argillaceous, trace orange chert.
1070 - 1090 feet	80% <u>Dolomite</u> . 10% <u>Siltstone</u> , green, dark grey, sandy, argillaceous. 10% <u>Sandstone</u> grey, very fine, dolomitic, tight.
1090 - 1100 feet	100% <u>Dolomite</u> .
1100 - 1120 feet	70% <u>Dolomite</u> as above, mostly light grey, micro-to fine crystalline, argillaceous, silty. 20% <u>Siltstone</u> , green, dark grey, argillaceous, sandy. 10% <u>Sandstone</u> very fine light grey, rare medium and coarse grains, siliceous and dolomitic.
1120 - 1140 feet	70% <u>Dolomite</u> , 20% <u>Sandstone</u> , 10% <u>Siltstone</u> and <u>Shale</u> , black.
1140 - 1147 feet	40% <u>Sandstone</u> light grey and green, very fine, siliceous, tight. 10% <u>Shale</u> and <u>Siltstone</u> , green and dark grey - black. 50% <u>Dolomite</u> .
1147 - 1150 feet	<u>CORE NO. 4.</u>

- 1150 - 1160 feet 70% Dolomite as in Core 4. Trace black Shale.
30% Sandstone as in Core 4.
- 1160 - 1170 feet 80% Sandstone light grey, poorly sorted, very fine to coarse. Many rounded, frosted, very coarse grains, slightly silty and calcareous, trace intergranular porosity. 20% Dolomite as above, grading partly to brown Limestone trace black Shale.
- 1170 - 1180 feet 80% Dolomite light grey, very fine to fine grained, sandy, silty, slight intergranular and fine vuggy porosity. Quartz crystal clusters indicate large vugs, grades with Sandstone. 40% Sandstone very fine to fine grained, dolomitic, calcareous, silty, trace intergranular porosity, grades to Siltstone.
- 1180 - 1190 feet 80% Dolomite becoming medium crystalline, light grey-brown, tight. Trace brown crypto-crystalline. Limestone. 10% Sandstone, 10% Shale, red, silty and Siltstone, vari-coloured.
- 1190 - 1200 feet 30% Siltstone green, minor red, etc. dolomitic, sandy. 10% Sandstone. 60% Dolomite becoming fine dolarenitic, trace pin point porosity.
- 1200 - 1210 feet 90% Dolarenite very fine, light grey to brown, partly recrystallized, sugary texture, sandy, trace porosity, quartz euhedra indicate vuggy porosity. 10% Siltstone.
- 1210 - 1220 feet 80% Dolarenite, 20% Shale, black and Siltstone, varicoloured as above.
- 1220 - 1230 feet 30% Shale black, micaceous, silty, splintery. 30% Dolarenite as above, partly porous. 40% Limestone, light to medium brown, crypto- to fine crystalline, partly oolitic.
- 1230 - 1260 feet 10% Shale. 90% Dolarenite, calcareous, grading to Limestone.
- 1260 - 1280 feet 20% Shale, dark grey to black, silty. 80% Dolomite calcareous, mostly dolarenitic to fine crystalline, partly oolitic to pelletoid, scattered good intercrystalline and micro-vugular porosity, grades partly to Limestone.
- 1280 - 1290 feet 90% Limestone grey-brown, micro-crystalline, dense, partly red argillaceous and silty, slightly gypsiferous. 10% Shale red.
- 1290 - 1300 feet 90% Limestone as above, partly coarse crystalline with traces poor intercrystalline porosity. 10% Shale.
- 1300 - 1320 feet 100% Limestone as above, partly sandy, fine vuggy streaks trace white crystalline gypsum. Trace pelletoid - partly red stained, argillaceous.
- 1320 - 1330 feet 90% Limestone as above, more red stained, trace intercrystalline porosity. 10% Shale/Siltstone red, sandy.
- 1330 - 1360 feet 90% Limestone becoming fine calcarenitic, dolomitic, red stained, sandy argillaceous, trace porosity. 10% Shale/Siltstone, trace crystalline pellets.
- 1360 - 1390 feet 90% Limestone (samples very fine) red stained, as above. 10% Shale, mostly red, also black.

- 1390 - 1400 feet 20% Shale/Siltstone, green, red, etc. 20% Sandstone, very fine to fine, sub-rounded to rounded, white, silty matrix, calcareous, no visible porosity. 60% Limestone, mostly brown, micro-crystalline, abundant rounded small pellets.
- 1400 - 1410 feet 10% Sandstone, as above. 90% Dolomite (dolarenite?) light grey, fine granular, sandy and silty, scattered poor intergranular porosity, trace Shale, black.
- 1410 - 1420 feet 90% Dolomite calcareous, grading to Calarenite light grey and brown, sugary texture fine sandy and silty. Rare quartz euhedra indicate vugs. Minor Dolomite, crypto-crystalline. 10% Shale, black, red and grey, silty.
- 1420 - 1440 feet 80% Limestone light brown crypto-crystalline, fine sandy, tight. 10% Siltstone red and green. 10% Shale red and dark grey-black.
- 1440 - 1450 feet 90% Limestone as above, trace quartz grains. 10% Shale and Siltstone.
- 1450 - 1460 feet 90% Calcarenite light grey, very fine sucrosic, vuggy porosity, and Limestone as above. 10% Shale.
- 1460 - 1470 feet 90% Limestone, medium to light brown becoming predominate. 10% Shale black.
- 1470 - 1480 feet 100% Calcarenite light grey as above, minor Limestone, trace pyrite.
- 1480 - 1490 feet 80% Calcarenite and Limestone. 20% Siltstone, red, micaceous, argillaceous.
- 1490 - 1504 feet 90% Calcarenite and Limestone. 10% Siltstone and black Shale.
- 1504 - 1514 feet CORE NO. 5.
- 1514 - 1530 feet 90% Limestone as in Core 5. 10% Shale black, red.
- 1530 - 1540 feet 50% Siltstone red, sandy, argillaceous, slightly calcareous, 50% Limestone.
- 1540 - 1550 feet 100% Limestone medium to light brown crypto-crystalline to dark brown, fine sugary, tight. Trace brown chert and white gypsum, trace red and black Shale, trace sandy.
- 1550 - 1560 feet 100% Limestone light brown and grey, crypto-crystalline to very fine sucrosic.
- 1560 - 1570 feet 90% Limestone as above. 10% Siltstone, red as before.
- 1570 - 1580 feet 70% Limestone. 30% Siltstone, red and green-grey, sandy, calcareous, argillaceous.
- 1580 - 1590 feet 90% Limestone light grey, micro-to very fine crystalline. 10% Shale and Siltstone dark grey and red.
- 1590 - 1600 feet 100% Limestone, light grey, becoming very fine calcarenitic, some vuggy porosity, trace gypsum spar.
- 1600 - 1610 feet 100% Limestone as above, minor dark grey, argillaceous.

1610 - 1620 feet	100% <u>Limestone</u> medium brown, micro-crystalline, trace sandy, tight.
1620 - 1630 feet	100% <u>Limestone</u> , becoming light grey, very fine calcarenitic, trace sandy, trace gypsum spar - <u>slight vuggy porosity inferred.</u>
1630 - 1640 feet	100% <u>Limestone</u> becoming brown, micro-crystalline again.
1640 - 1650 feet	100% <u>Limestone</u> both types as above.
1650 - 1660 feet	100% <u>Limestone</u> as above, minor reddish silty and very dark grey, argillaceous.
1660 - 1670 feet	No sample.
1670 - 1680 feet	70% <u>Limestone</u> . 30% <u>Siltstone</u> , red, argillaceous, grading with <u>Limestone</u> and minor red <u>Shale</u> .
1680 - 1690 feet	60% <u>Limestone</u> . 40% <u>Siltstone</u> .
1690 - 1700 feet	100% <u>Limestone</u> grey, micro-crystalline to very fine granular, <u>no visible porosity</u> , trace <u>Siltstone</u> .
1700 - 1720 feet	80% <u>Limestone</u> grading to <u>Dolomite</u> (Calcarenite/Dolarenite), light grey, very fine to fine grained, silty, trace white chert, <u>fine vuggy porosity</u> . 20% <u>Siltstone</u> , red, purple, grey, green, argillaceous, limey; and <u>Shale</u> , red, micaceous.
1720 - 1730 feet	100% <u>Calcarenite/Dolomite</u> light grey as above, <u>fine vuggy porosity</u> . very fine sandy.
1730 - 1740 feet	60% <u>Limestone</u> light grey, partly reddish, micro-crystalline, dense. 40% <u>Siltstone</u> and <u>Shale</u> , red, limey, grading partly to <u>Limestone</u> .
1740 - 1750 feet	80% <u>Limestone</u> . 20% <u>Siltstone</u> .
1750 - 1760 feet	90% <u>Limestone</u> . 10% <u>Siltstone</u> trace red stained fine quartz grains.
1760 - 1780 feet	70% <u>Limestone</u> . 30% <u>Siltstone</u> red, minor green.
1780 - 1800 feet	100% <u>Limestone</u> light grey, micro-crystalline, partly fine sandy, <u>tight</u> .
1800 - 1810 feet	80% <u>Limestone</u> , some red iron stained. 20% <u>Siltstone</u> , red, sandy, calcareous.
1810 - 1820 feet	No sample.
1820 - 1830 feet	80% <u>Limestone</u> . 20% <u>Siltstone</u> .
1830 - 1840 feet	30% <u>Shale</u> red, micaceous. 30% <u>Siltstone</u> , red. 40% <u>Limestone</u> as above.
1840 - 1860 feet	60% <u>Limestone</u> as above (samples very fine) sandy. 40% <u>Sandstone</u> (loose) very fine grained, probably largely sand in Limestone.
1860 - 1868 feet	<u>CORE NO. 6.</u>
1868 - 1880 feet	No sample. Attempting to dry hole, no returns.
1880 - 1900 feet	80% <u>Limestone</u> light grey, as in Core 6, heavily cement contaminated. 20% <u>Shale</u> , red; silty as in Core 6.

1900 - 1920 feet	100% <u>Limestone</u> as above. Heavy cement contamination.
1920 - 1930 feet	No sample.
1930 - 1940 feet	70% <u>Limestone</u> light to medium brown, crypto-micro-crystalline, dense, partly red stained. 30% <u>Siltstone</u> , red, calcareous grading to <u>Shale</u> .
1940 - 1970 feet	60% <u>Limestone</u> . 20% <u>Shale</u> . 20% <u>Siltstone</u> .
1970 - 1980 feet	60% <u>Shale</u> , red, silty, slightly calcareous. 40% <u>Limestone</u> as above.
1980 - 1990 feet	70% <u>Limestone</u> , predominately red to pink stained, as above. 30% <u>Shale</u> .
1990 - 2000 feet	90% <u>Limestone</u> , trace very fine sandy streaks. 10% <u>Shale</u> .
2000 - 2010 feet	80% <u>Limestone</u> trace sandy as above, mostly light grey. 20% <u>Shale</u> , red.
2010 - 2020 feet	100% <u>Limestone</u> as above.
2020 - 2030 feet	90% <u>Limestone</u> , increasing sand content (10-20%) 10% <u>Shale</u> , red.
2030 - 2040 feet	30% <u>Limestone</u> . 40% <u>Shale</u> , red, minor green, micaceous. 30% <u>Siltstone</u> , red, minor green.
2040 - 2050 feet	90% <u>Limestone</u> , becoming medium grey, greenish, micro-crystalline, silty, very fine sandy. 10% <u>Shale</u> , red, micaceous.
2050 - 2080 feet	80% <u>Limestone</u> , becoming lighter, very fine sandy. 20% <u>Shale</u> , red, green and dark grey, micaceous.
2080 - 2090 feet	50% <u>Limestone</u> , partly red stained. 50% <u>Shale</u> , red, micaceous.
2090 - 2100 feet	70% <u>Limestone</u> , 30% <u>Shale</u> .
2100 - 2110 feet	70% <u>Limestone</u> , light grey, becoming dolomitic, and more sandy, grading with <u>Sandstone</u> . 30% <u>Sandstone</u> , light grey, very fine grained, calcareous, grains angular to sub-angular.
2110 - 2120 feet	80% <u>Limestone</u> as above. 10% <u>Sandstone</u> . 10% <u>Shale</u> , red.
2120 - 2130 feet	90% <u>Limestone</u> , dolomitic, medium brown and grey, micro-crystalline, minor green <u>Dolomite</u> . 10% <u>Shale</u> as above.
2130 - 2140 feet	100% <u>Limestone</u> , mostly light grey-brown, dolomitic.
2140 - 2173 feet	100% <u>Limestone</u> as above grading to <u>Dolomite</u> ; minor red and green, trace gypsum.
2173 - 2178 feet	<u>CORE NO. 7.</u>
2178 - 2220 feet	100% <u>Limestone</u> (extremely finely ground up) light grey-brown, slightly silty.
2220 - 2230 feet	90% <u>Limestone</u> . 10% <u>Siltstone</u> , red and green, sandy, calcareous,
2230 - 2270 feet	100% <u>Limestone</u> as above.

- 2270 - 2290 feet 10% Sandstone, very fine grained, grey, calcareous (finely divided). 90% Limestone as above, partly sandy, partly darker brown and greenish.
- 2290 - 2300 feet 20% Shale and minor Siltstone, red, micaceous. 80% Limestone, light grey-brown, very fine crystalline to granular, partly red stained.
- 2300 - 2310 feet 90% Limestone. 10% Shale, red and green.
- 2310 - 2320 feet 100% Limestone.
- 2320 - 2330 feet 100% Dolomite, light grey and brown, micro-crystalline and very fine dolarenitic, very fine sandy, with very sandy streaks, traces gypsum spar.
- 2330 - 2340 feet 100% Dolomite as above mostly micro to very fine crystalline, silty, good fine vuggy porosity. 30% Strong yellow fluorescence, no cut. DEAD OIL STAINING. Abundant gypsum and dolomite fine euhedra.
- 2340 - 2350 feet 100% Dolomite, partly fine dolarenitic. Porosity as above. 30% yellow fluorescence as above, no cut.
- 2350 - 2360 feet 100% Dolomite, as above. Fine intercrystalline and micro-vuggy porosity as above, 10% yellow fluorescence. 30% Dolomite, khaki coloured, very fine crystalline, sandy and silty, tight.
- 2360 - 2370 feet 100% Dolomite light grey to dark brown fine to very coarse crystalline. Excellent (20-30%) vuggy and intercrystalline porosity, trace pyrite fracture filling.
- 2370 - 2390 feet 100% Dolomite, mostly light grey, coarse crystalline, excellent porosity as above, mostly vuggy.
- 2390 - 2410 feet 100% Dolomite, as above, samples fine, porosity inferred from euhedra dolomite, trace quartz grains.
- 2410 - 2420 feet 90% Dolomite porous as above, becoming partly sandy. 10% Shale and Siltstone, red, green, light grey, 1% yellow fluorescence.
- 2420 - 2430 feet 70% Sandstone very light grey, fine to medium grained, subangular, dolomite cement, very poor intergranular porosity. 30% Dolomite as above, becoming quite sandy and grading to the Sandstone, trace pyrite clusters.
- 2430 - 2440 feet 70% Dolomite, 30% Sandstone.
- 2440 - 2450 feet 90% Sandstone, light grey, very fine grained, dolomite cement.
- 2450 - 2475 feet No sample.
- 2475 - 2483 feet CORE NO. 8.
- 2483 - 2490 feet 30% Sandstone as in Core 8. 60% Limestone dolomitic, light grey-brown, granular, 10% Shale, red.
- 2490 - 2500 feet 90% Sandstone. 10% Dolomite, light grey.
- 2500 - 2520 feet 100% Sandstone, as above, rich calcareous cement.

2520 - 2540 feet	100% <u>Limestone</u> medium brown, very sandy, crypto-crystalline, tight.
2540 - 2590 feet	100% <u>Limestone</u> as above becoming less sandy, trace gypsum.
2590 - 2600 feet	40% <u>Limestone</u> . 60% <u>Sandstone</u> as above, very fine, calcareous, grey-brown.
2600 - 2650 feet	100% <u>Sandstone</u> as above.
2650 - 2660 feet	30% <u>Sandstone</u> . 70% <u>Limestone</u> medium brown, crypto-crystalline, sandy, tight.
2660 - 2670 feet	50% <u>Limestone</u> . 50% <u>Sandstone</u> .
2670 - 2680 feet	90% <u>Limestone</u> . 10% <u>Sandstone</u> .
2680 - 2693 feet	80% <u>Limestone</u> . 20% <u>Sandstone</u> .
2693 - 2698 feet	<u>CORE NO. 9.</u>
2698 - 2710 feet	90% <u>Sandstone</u> . 10% <u>Limestone</u> medium brown, micro-crystalline to crypto-crystalline, dense.
2710 - 2770 feet	100% <u>Sandstone</u> .
2770 - 2780 feet	50% <u>Sandstone</u> . 50% <u>Limestone</u> medium to dark brown, crypto-crystalline.
2780 - 2790 feet	90% <u>Limestone</u> as above, some vein calcite, partly very argillaceous, trace pyrite. 10% <u>Sandstone</u> .
2790 - 2800 feet	70% <u>Limestone</u> . 30% <u>Sandstone</u> , white to medium brown fine to medium grained, calcareous, <u>some good intergranular porosity</u> , trace pyrite.
2800 - 2810 feet	80% <u>Sandstone</u> grey, very fine grained, calcareous. 20% <u>Limestone</u> , brown as above. Trace black <u>Shale</u> .
2810 - 2830 feet	90% <u>Sandstone</u> , as above, slightly micaceous. 10% <u>Limestone</u> .
2830 - 2840 feet	40% <u>Siltstone</u> dark grey, dark red-brown, sandy, slightly calcareous, grading to <u>Sandstone</u> . 30% <u>Sandstone</u> as above. 30% <u>Limestone</u> medium brown very sandy, crypto-crystalline, trace gypsum spar.
2840 - 2850 feet	10% <u>Shale</u> , black, micromicaceous. 60% <u>Sandstone</u> . 30% <u>Limestone</u> as above grading with <u>Sandstone</u> .
2850 - 2880 feet	90% <u>Sandstone</u> medium to dark grey, calcareous, silty, slightly argillaceous, very fine grained, tight, friable. 10% <u>Limestone</u> .
2880 - 2890 feet	90% <u>Sandstone</u> as above, minor <u>Sandstone</u> , light grey, siliceous, very fine to fine grained, hard, tight.
2890 - 2930 feet	100% <u>Sandstone</u> (samples very fine) very fine grained, calcareous, silty, grades almost to <u>Siltstone</u> .
2930 - 2960 feet	100% <u>Sandstone</u> as above, partly very light grey, siliceous, trace <u>Limestone</u> and black <u>Shale</u> .
2960 - 2970 feet	10% <u>Siltstone</u> , dark grey, sandy, calcareous. 10% <u>Limestone</u> medium brown, sandy, micro-crystalline. 80% <u>Sandstone</u> medium brown, very calcareous, silty, very fine grained, <u>tight</u> .

Minor Sandstone, light grey, very fine grained with scattered intergranular porosity - some milky, very coarse crystalline dolomite (caving?).

- 2970 - 2990 feet 100% Sandstone/Siltstone very fine, calcareous, argillaceous, medium to dark grey. Sample very finely divided.
- 2990 - 3010 feet 80% Limestone medium dark brown, grading from Siltstone above, argillaceous, very silty, crypto-crystalline. 20% Siltstone as above.
- 3010 - 3020 feet 70% Sandstone/Siltstone as above. 30% Limestone as above. Some milky crystalline dolomite.
- 3020 - 3030 feet 90% Sandstone medium dark grey, extremely fine grained, silty, calcareous, argillaceous, micaceous, tight, grades almost to Siltstone, trace pyrite. 10% Limestone brown crypto-crystalline.
- 3030 - 3040 feet 100% Sandstone as above.
- 3040 - 3050 feet 90% Sandstone grades partly to Siltstone. 10% Limestone.
- 3050 - 3060 feet 10% Shale, black, silty, micaceous. 90% Sandstone, grading partly to Siltstone.
- 3060 - 3070 feet 70% Limestone dark brown, very silty, argillaceous, crypto-crystalline; tight, black argillaceous laminations. 20% Sandstone grading with Limestone. 10% Shale partings, black, micaceous.
- 3070 - 3090 feet 10% Shale. 90% Limestone as above grades partly to Siltstone.
- 3090 - 3100 feet 80% Limestone, trace black Shale partings. 20% Sandstone (as before) medium brown, calcareous, silty, argillaceous, very fine grained, tight.
- 3100 - 3110 feet 70% Sandstone. 20% Shale, black, micaceous, very silty, sandy, slightly calcareous. 10% Limestone.
- 3110 - 3120 feet 90% Sandstone, black, Shale partings. 10% Limestone.
- 3120 - 3200 feet 100% Sandstone, black shale partings. NOTE: Faint petroliferous odour when samples heated 3120' - 3180'; 1-2 units cuttings gas.
- 3200 - 3209 feet CORE NO. 10.
- 3209 - 3220 feet 100% Sandstone as in Core 10 with black Shale laminae.
- 3220 - 3230 feet 80% Sandstone, becoming more argillaceous. 20% Shale partings, black, micaceous, carbonaceous.
- 3230 - 3250 feet 90% Sandstone as above, grades imperceptibly to Siltstone. 10% Shale.
- 3250 - 3260 feet 80% Sandstone. 20% Shale, as above, silty.
- 3260 - 3270 feet 70% Sandstone. 30% Shale, black as above, grades to Siltstone.
- 3270 - 3290 feet 80% Sandstone. 20% Shale.
- 3290 - 3300 feet 90% Sandstone. 10% Shale.

3300 - 3320 feet	90% <u>Sandstone</u> as above, partly medium grey, cleaner. 10% <u>Shale</u> trace pyrite.
3320 - 3330 feet	40% <u>Limestone</u> , brown, sandy, crypto-crystalline, dense and tight. 50% <u>Sandstone</u> . 10% <u>Shale</u> .
3330 - 3340 feet	20% <u>Limestone</u> . 20% <u>Shale</u> . 60% <u>Sandstone</u> .
3340 - 3350 feet	80% <u>Sandstone</u> . 10% <u>Limestone</u> . 10% <u>Shale</u> .
3350 - 3360 feet	100% <u>Sandstone</u> .
3360 - 3380 feet	80% <u>Sandstone</u> , trace pyrite. 20% <u>Shale</u> .
3380 - 3390 feet	90% <u>Sandstone</u> . 10% <u>Shale</u> , traces of brown <u>Limestone</u> .
3390 - 3420 feet	70% <u>Sandstone</u> . 30% <u>Shale</u> , trace pyrite, <u>Limestone</u> .
3420 - 3440 feet	80% <u>Sandstone</u> . 20% <u>Shale</u> .
3440 - 3450 feet	90% <u>Sandstone</u> . 10% <u>Shale</u> .
3450 - 3480 feet	80% <u>Sandstone</u> . 20% <u>Shale</u> .
3480 - 3513 feet	70% <u>Sandstone</u> . 30% <u>Shale</u> .
3513 - 3515 feet	<u>CORE NO. 11.</u>
3515 - 3520 feet	70% <u>Shale</u> , black, micaceous, silty. 30% <u>Sandstone</u> as above.
N.B. 3209 - 3520 feet	<u>Scattered faint yellow fluorescence throughout interval to Core 12. Petroliferous odour when heated and 1 - 2 units gas from cuttings.</u>
3520 - 3528 feet	<u>CORE NO. 12.</u>
3528 - 3540 feet	20% <u>Shale</u> , black, finely divided, trace pyrite. 30% <u>Sandstone</u> , finely divided, very fine grained. 50% <u>Dolomite</u> , very light grey, very fine crystalline. Samples from here on down give strong sulfurous odour when heated.
3540 - 3550 feet	90% <u>Dolomite</u> as above, fine crystalline, trace sandy. 10% <u>Shale</u> , trace pyrite.
3550 - 3580 feet	100% <u>Dolomite</u> , sulfurous odour.
3580 - 3600 feet	100% <u>Dolomite</u> as above becoming partly brown, fine crystalline pyrite.
3600 - 3610 feet	70% <u>Dolomite</u> light grey and brown, very fine crystalline (sample very finely divided), trace black <u>Shale</u> , trace pyrite. 30% <u>Sandstone</u> (loose in samples), clear quartz, fine grained, angular, some red staining.
3610 - 3620 feet	20% <u>Dolomite</u> . 80% <u>Granitic material</u> , crystalline quartz with included black ferromagnesian minerals, partly pink stained, minor pink feldspar - finely divided in sample.
3620 - 3624 feet	100% <u>Granite minerals</u> , quartz, feldspar, biotite and other ferromagnesian - overall dark red coloured sample.
3624 - 3624'1"	<u>CORE NO. 13.</u>
3624'1"-3627 feet	<u>CORE NO. 14.</u>

CORE DESCRIPTIONSLUCY CREEK NO. 1CORE NO. 1: 296' - 300' recovered 1'5"

Coring Times: 53, 30, 30, 28 mins./ft.

Dolomite, dark grey, fine crystalline, dense and tight. Scattered irregular stylolites indicate dip approximately horizontal. Blocky core pieces indicate formation fractured.

CORE NO. 2: 606' - 616' recovered 3'

Coring Times: 6, 7, 8, 7, 11, 10, 11, 15, 13, 16 mins./ft.

Dolomite, medium brown, fine to medium crystalline, dense. Thin grey green argillaceous Dolomite beds. Rare thin patches of brown chert. Dip apparently flat.

CORE NO. 3: 877' - 884' recovered 5'

Coring Times: 6, 14, 10, 12, 12, 19, 20 mins./ft.

1'6" Dolomite, purple, very argillaceous, slightly silty, very fine crystalline, massive, dense and tight.

3'6" Dolomite, dark brown crypto - very fine crystalline, with thin beds (1") of medium brown Dolomite, crypto - to very fine crystalline. Thin wavy black argillaceous partings. Small patches of pink anhydrite and white gypsum in lower one foot of core.

Dip 0° - 3°.

CORE NO. 4: 1147' - 1150' recovered 3'

Coring Times: 70, 60, 60 mins./ft.

1'6" Sandstone light grey, very fine grained, siliceous, slightly dolomitic, very hard and tight. Crudely bedded and grading with grey sandy Dolomite. Core broken up. Few thin laminae of black Shale and rare small patches of pink anhydrite.

1'6" Dolomite light grey, fine sandy, slight silty and trace micaceous, micro-crystalline, tight. Thin wavy laminae of black Shale increasing towards bottom of core.

Dip 0°.

CORE NO. 5: 1504' - 1514' recovered 3'2"

Coring Times: 22, 17, 15, 14, 10, 12, 16, 12, 16, 14 mins./ft.

6" Limestone, medium brown, microcrystalline, very rare oolites. Good vuggy porosity throughout. Rare thin veins of clear gypsum spar. Massive.

2' Limestone medium to dark grey and brown, slightly silty, thin bedded. Few stylolites and black Shale laminae, bedding often crenulated. Interval dense and tight except for bottom 4" which contains several large vugs.

8" Limestone as in top 6". In top of interval a large patch of dirty, dark brown Limestone containing about 40% vug space. Rare irregular black Shale laminae.

Dip 0°.

No fossils evident.

No oil or gas indications.

CORE NO. 6: 1860' - 1868' recovered 7'

Coring Times: 12, 10, 9, 10, 5, 6, 9, 11 mins./ft.

5'8" Limestone light to medium grey, micro-crystalline, partly very sandy (very fine sand). Partly soft and marly. Rare very small vugs and small pink anhydrite patches. Rare black Shale partings.

8" Shale, red, silty, calcareous, with thin Limestone bands.

8" Limestone, medium grey and pink, micro-crystalline, tight.

Dip 0°.

No oil or gas indications.

CORE NO. 7: 2173' - 2178' recovered 3'9"

Coring Times: 20, 12, 14, 14, 14 mins./ft.

1' Limestone, light brown, dolomitic, slightly siliceous, micro-crystalline, massive, tight.

9" Limestone, medium brown, dolomitic, micro-crystalline, and Dololutite, light green, crudely fine bedded, often crumpled and contorted with irregular black argillaceous laminae. Well developed stylolites - worm trails on bedding planes (?).

2' Limestone, dolomitic medium brown, micro-crystalline, Dolomite, calcareous, light red, micro-crystalline, and Dololutite green as above; irregularly thinly interbedded. Bedding often contorted. Few stylolites. Rare small white gypsum patches.

Dip 0°.

No oil or gas indications.

CORE NO. 8: 2475' - 2483' recovered 8'

Coring Times: 20, 10, 14, 15, 14, 17, 18, 17 mins./ft.

Sandstone, medium brown, very fine grained sub-angular, very equigranular and homogeneous throughout. 100% quartz grains - very clean, dolomite cement (breaks down to loose sand when boiled in HCl). Massive.

Occasional very fine black shale partings.

Scattered very poor intergranular porosity throughout, and few small vugs.

Dip 0°.

No oil or gas indications.

CORE NO. 9: 2693' - 2698' recovered 4'

Coring Times: 35, 25, 30, 38, 48 mins./ft.

Sandstone, calcareous, medium grey, extremely fine grained, with darker, more argillaceous streaks throughout. Also thin irregular lighter grey streaks and lenses grading to sandy, micro-crystalline Limestone. Few irregular laminae of black Shale. Formation is hard, dense, tight and massive.

Dip 0°.

No oil or gas indications.

CORE NO. 10: 3200' - 3209' recovered 9'

Coring Times: 10, 10, 6, 8, 8, 10, 9, 9, 9, mins./ft., bit locked.

Sandstone, medium to dark brown, fine colour banding. Very silty; calcareous with fine white mica flakes disseminated throughout. Very fine grained, grades almost to a Siltstone.

Entire core finely laminated with numerous black micaceous Shale partings.

A 3" bed in the interval 3206' - 3207' grades to very dark grey-black sandy, carbonaceous Siltstone.

Cored interval is hard, dense and tight.

Petroliferous odour on freshly broken surface.

Scattered patches very faint yellow fluorescence, with no cut obtained.

4 units cuttings gas. 1.5 units heavies.

CORE NO. 11: 3513' - 3515' recovered 0'

Coring Times: 18, 32 mins./ft.

Cuttings sample over interval 70% Sandstone, 30% Shale as above.

CORE NO. 12: 3520' - 3528' recovered 4'9"

Coring Times: 17, 14, 12, 12, 12, 10, 14, 17 mins./ft.

4' Shale, black, micaceous, silty, hard and platy.

9" Sandstone medium to dark grey, banded, very fine grained, silty, argillaceous, hard and tight, with fine laminae of black Shale.

Dip 4°.

Petroliferous odour on fresh broken surface, 2 units of cuttings gas. No fluorescence.

CORE NO. 13: 3624' - 3624'1" recovered 0'

Coring Times 1" in $\frac{3}{4}$ hour.

CORE NO. 14: 3624'1" - 3627' recovered 1'3"

Coring Times: 122, 78, 78 mins./ft.

Acid intermediate igneous rock - perhaps a micro-granite; dark red coloured, finely crystalline. Approximate composition:- quartz 40%, feldspar 30%, ferromagnesian and biotite 30%, fine fractures or joints filled with calcite and quartz.

PETROPREP.LUCY CREEK No. 1. Core 14. 3625'.MINERALOGY:

Amphibole: Anhedral and subhedral, rarely euhedral, grains av. 0.3 - 1.0mm. Strongly pleochroic from pale yellow to dark green. Often associated with opaque mineral forming discreet "clots".

K-feldspar: Anhedral, interlocking grains av. 0.2 - 0.4 mm. Well developed microcline twinning. Some perthite.

Plagioclase: Anhedral grains up to 2 mm, av. 0.5 - 0.8 mm. Strong normal zoning in some grains. Most grains partly altered to carbonate, chlorite and other finely divided alteration products.

Quartz: Anhedral interlocking grains av. 0.2 - 0.4 mm.

Opaque mineral: Anhedral grains up to 0.5 mm. often associated with amphibole. Also as minute euhedral grains up to 0.01 mm. Magnetite?

Apatite: Narrow rods up to 0.02 mm. length.

Chlorite: As an alteration product.

Biotite: Rare flakes.

MODE:

K-feldspar	55
Quartz	15
Amphibole	12
Plagioclase	8
Opaque mineral	8
Chlorite	} 2
Biotite	
Apatite	

 100

TEXTURE:

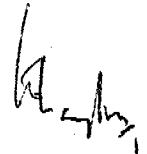
Allotriomorphic - granular. The texture is dominated by the anhedral, interlocking nature of the quartz and feldspars.

NAME:

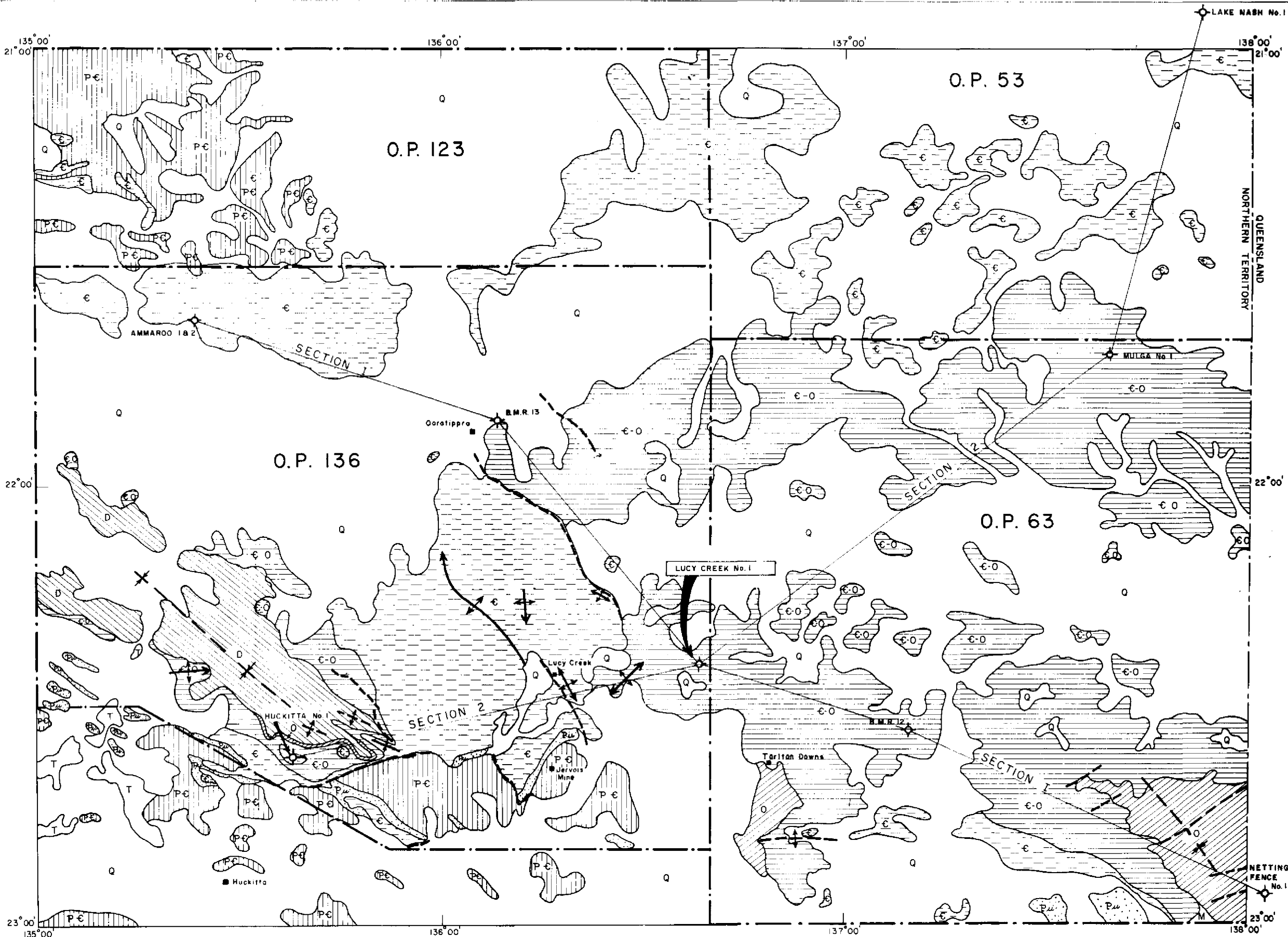
Alkaline microgranite.

ORIGIN:

Probable origin as a product of late-stage igneous crystallisation.


Dr. W. Layton

GEOLOSITE ASSOCIATES



LEGEND

- | | | | |
|---|------------------|-----|---------------------|
| Q | QUATERNARY | C-O | CAMBRO - ORDOVICIAN |
| T | TERTIARY | C | CAMBRIAN |
| M | MESOZOIC | Pu | UPPER PROTEROZOIC |
| D | DEVONIAN | Pc | UNDIFFERENTIATED |
| O | L - M ORDOVICIAN | | |

EXOIL OIL CO. PTY. LTD.

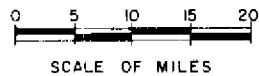
REGIONAL GEOLOGY, O.P. 136

Showing Subsurface Sections

LUCY CREEK No. 1

NORTHERN TERRITORY
GEOLOGICAL SURVEY

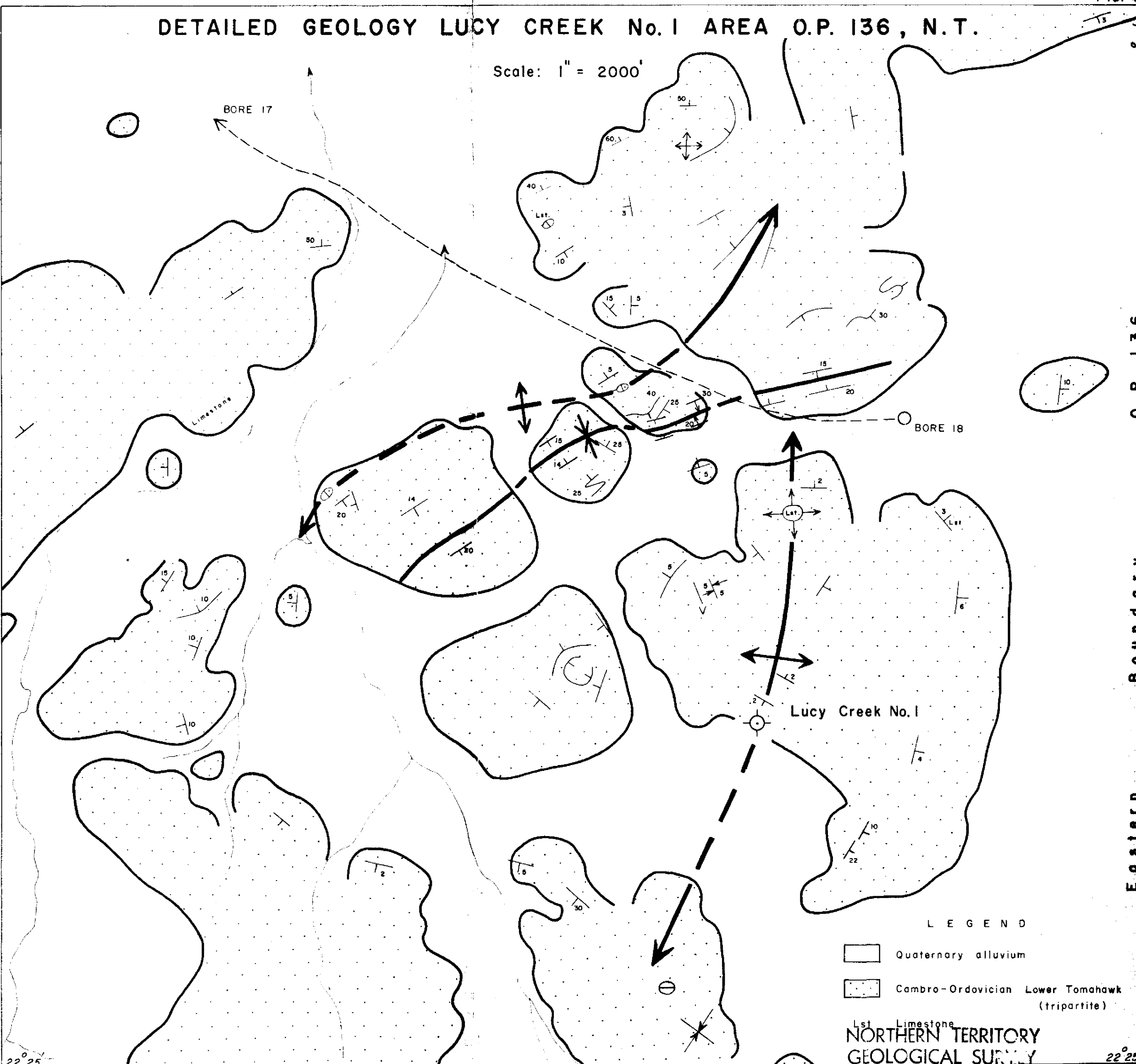
Geology after Bureau of Mineral Resources



PR 67/7A

DETAILED GEOLOGY LUCY CREEK No. 1 AREA O.P. 136, N.T.

Scale: 1" = 2000'



LEGEND

- Quaternary alluvium
- Cambro-Ordovician Lower Tomahawk (tripartite)

Lst Limestone
**NORTHERN TERRITORY
 GEOLOGICAL SURVEY**

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Eastern Boundary O.P. 136

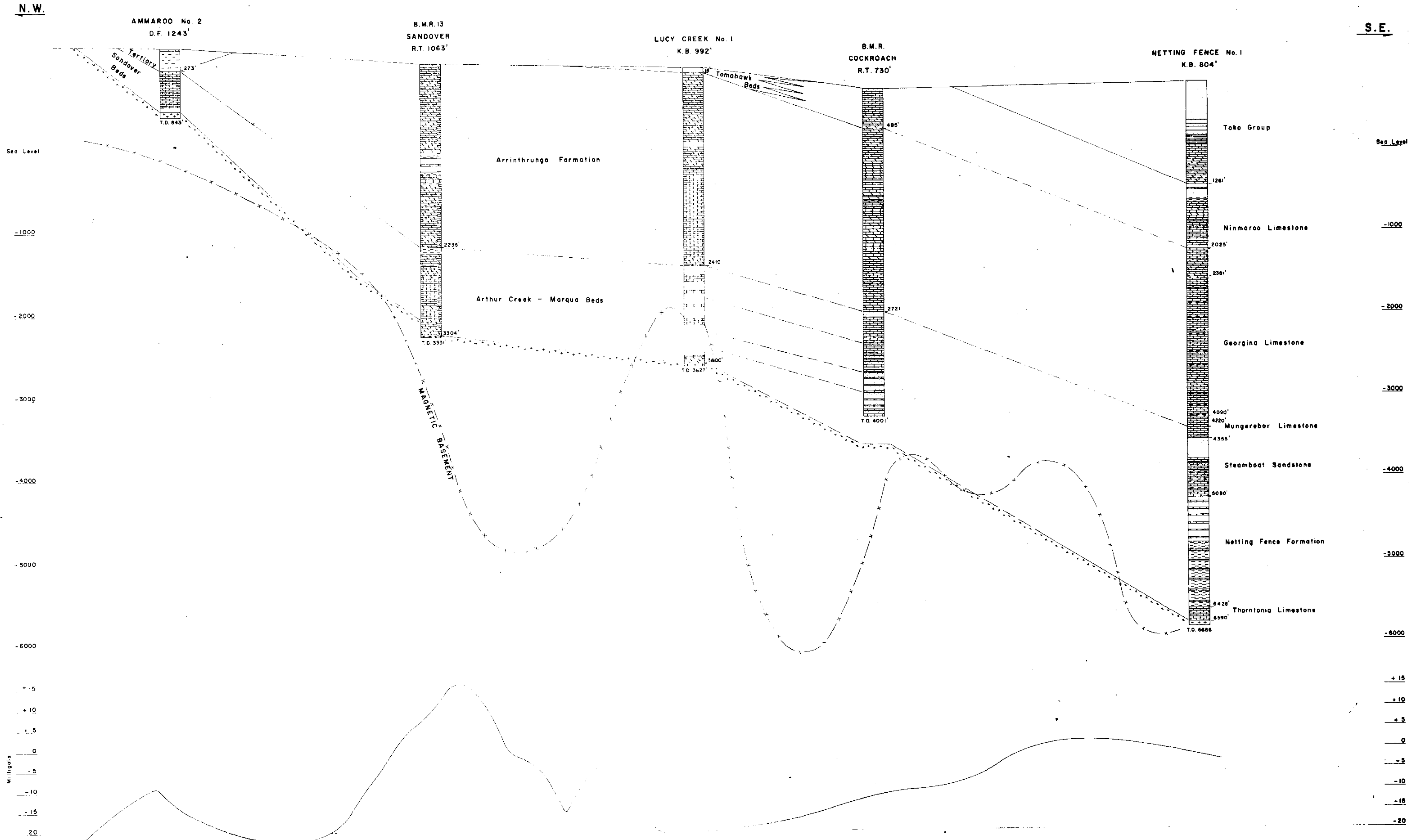
GEORGINA BASIN SUBSURFACE CORRELATION

AND GEOPHYSICAL OBSERVATIONS

SECTION I

Horizontal Scale 0 5 10 15 20 miles

Vertical Scale 0 200 400 600 800 1000 feet



BOUGUER ANOMALY PROFILE

NORTHERN TERRITORY
GEOLOGICAL SURVEY

MAGNETIC AND GRAVITY DATA AFTER
BUREAU OF MINERAL RESOURCES

--- Electrical, Sonic or Gamma-Ray Correlation

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GEORGINA BASIN SUBSURFACE CORRELATION

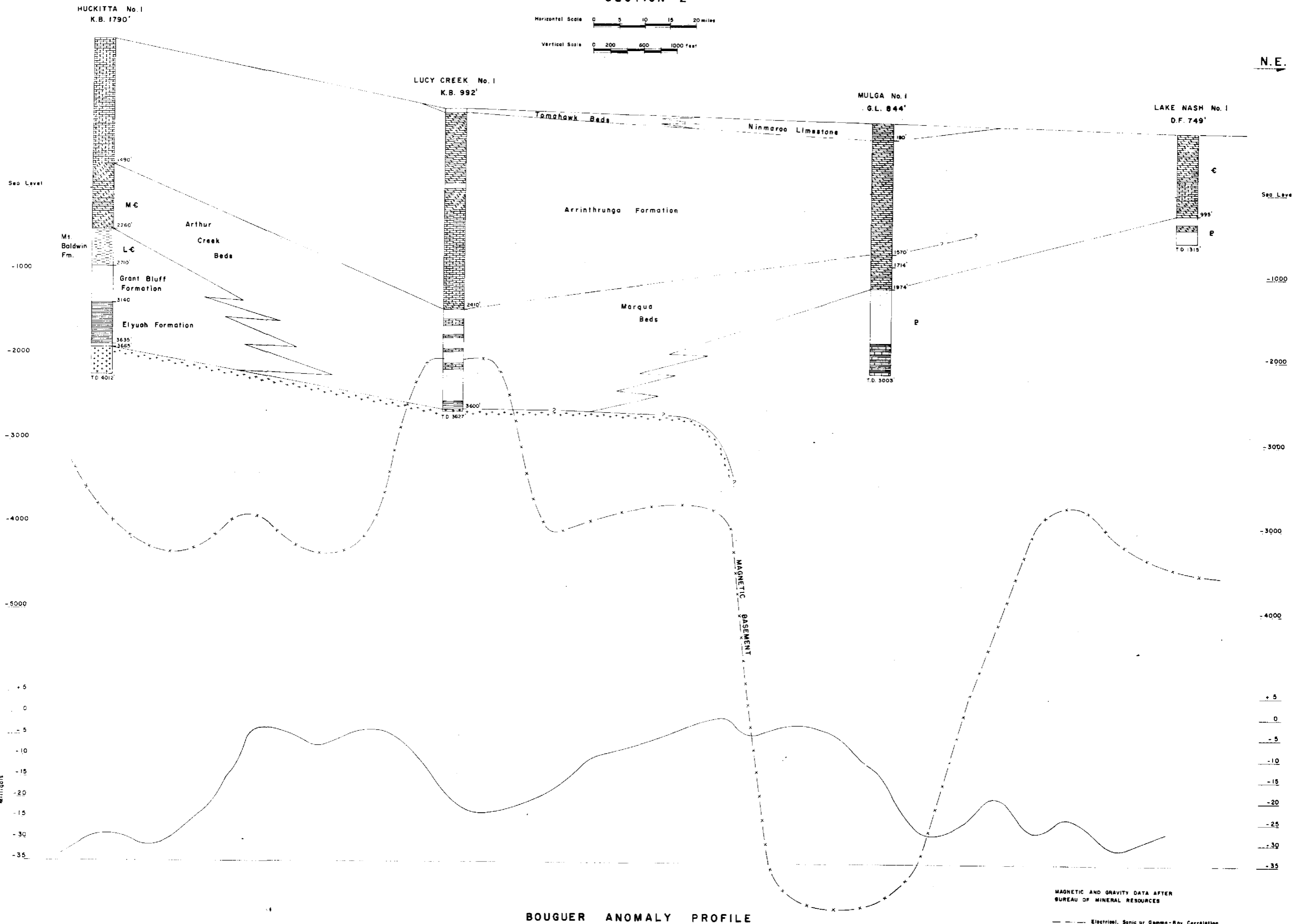
FIG. 7

AND GEOPHYSICAL OBSERVATIONS

SECTION 2

S.W.

N.E.



BOUGUER ANOMALY PROFILE

MAGNETIC AND GRAVITY DATA AFTER BUREAU OF MINERAL RESOURCES

Electrical, Sonic or Gamma-Ray Correlation

PK67/78

NORTHERN TERRITORY
GEOLOGICAL SURVEY