ONSHORE

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REPORT

on a

REFLECTION SEISMOGRAPH AURVEY

of the

STEELE'S GAP AREA

PERMIT 54, N.T.

Hale River

for

FLAMINGO PETROLEUM PROPRIETARY LIMITED

414 BOURKE STREET

MELBOURNE, VICTORIA

OPEN FILE

by

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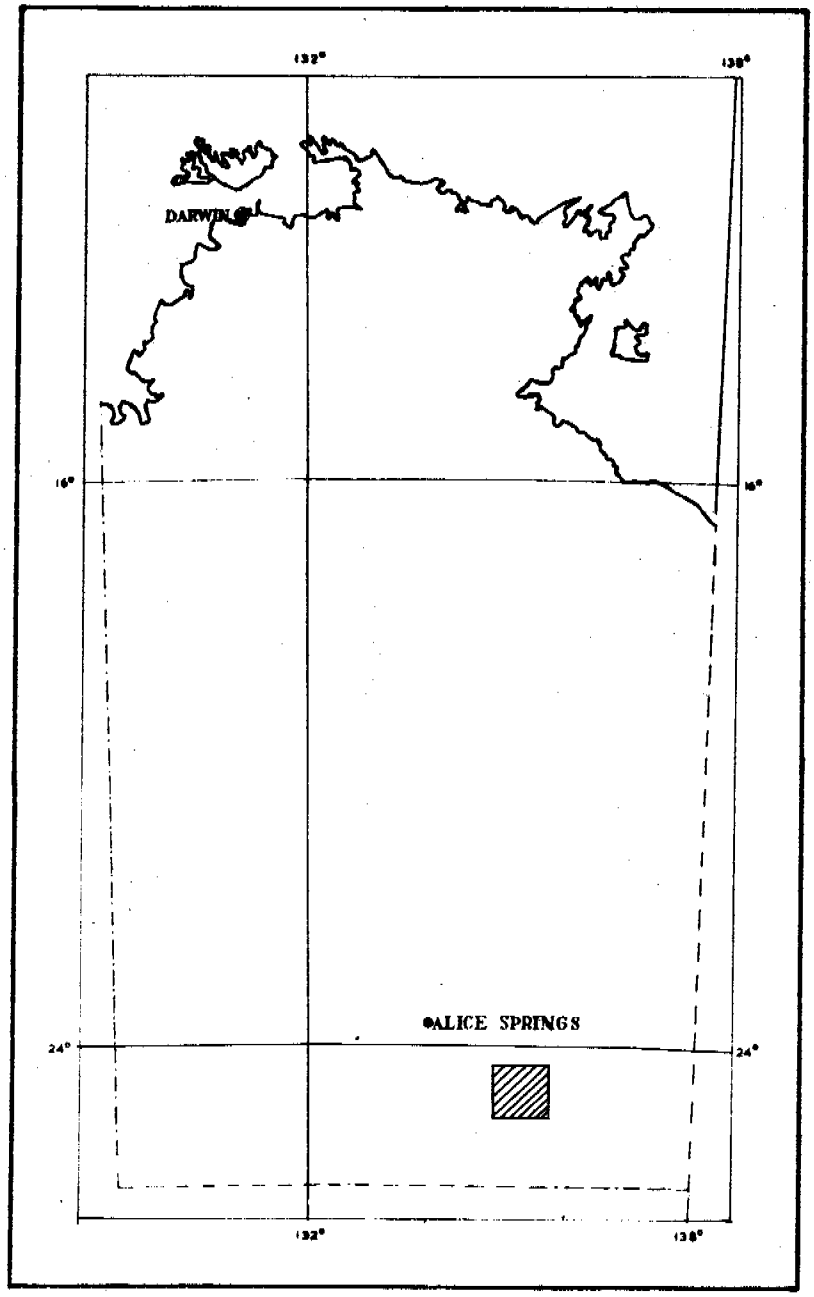

INDEX & LOCATION MAP
NORTHERN TERRITORY
AUSTRALIA

O.P. 54. STEELE'S GAP
FOR
FLAMINGO PETROLEUM PTY. LTD.

SCALE
100 50 0 100 200 300 MILES

FP 1-4

INTRODUCTION

A reflection seismograph survey was conducted in the Steele's Gap Area, Northern Territory, for Flamingo Petroleum Limited, between September 28 and October 22, 1961, by Geoseismic (Australia) Limited.

The area surveyed lies in that assigned under Permit to Prospect for Petroleum No. 54, issued by the Administration of the Northern Territory. The location is shown in the index Map submitted with this report.

The primary purpose of the survey was to determine the probable thickness of the sedimentary section, along two traverses, both running approximately north and south. It was also hoped that the presence of any structural features, suitable for the accumulation of oil or gas, would be indicated.

GEOLOGY AND GENERAL INFORMATION

The Steele's Gap Area lies on the north western edge of the Simpson Desert. Most of its surface is covered by aeolian sand dunes trending in a north-south direction. The climate is extremely arid. Out crops, consisting of Cambrian limestones and sandstones, occur at the northern edge of the desert, as ranges of steep sided hills. A full account of the geology of the area is contained in a Mines Administration Report by T.J. Madden.(1)

(2)

A gravity survey has been conducted by Mines Administration in the area. The results of this survey indicated a southward rise in basement from Steele's Gap. The seismic traverse from Malcom's Bore to Steele's Gap was shot to evaluate this conclusion drawn from the gravity data.

The Camel Flat Syncline was postulated from observed dips of Cambrian rocks in the adjacent ranges. Measurements of the thickness of the Pulya Pulya Sandstone, at many locations in the area, make it appear possible that the lower Palaeozoic section may be preserved under the sand dunes of Camel Flat. The intensity of folding, observed in the northern part of Permit 54, indicates that the Camel Flat Syncline, if present, would probably not be a simple structure, but would most likely be more in the nature of a small synclinorium. Any small anticlinal folds, while being of no great lateral extent, could prove to be drillable prospects, and it was hoped that their presence would be indicated from the Camel Flat seismic traverse.

FIELD PROCEDURE

Continuous profiling was employed in groups of five shot points on each traverse. The spacing between groups was approximately 4 miles on Traverse 1 (Malcom's Bore to Steele's Gap) and 1 mile on Traverse 2 (Camel Flat).

Shot points were located and levelled with the plane table and alidade. All spreads were chained.

Horizontal and vertical control were obtained for Traverse 1 from the Department of National Development (National Mapping Section). The Department's Hale River Sheet shows locations and elevations of concrete survey monuments, spaced at approximately 4 mile intervals along Traverse 1. Shot points were chained and levelled from these monuments, and levels were referred to the Queensland State Datum.

Similar control was not available for the Camel Flat Traverse. A peg marked B.M.R. 1472 was found at Desert Bore and the survey was based on this peg by assuming for it an elevation of 900 feet, and a location of 24°31'20" South Latitude, 134°44'00" East Longitude. The horizontal survey was carried between each group of shot points by stadia measurements.

Shot holes were drilled with a Mayhew Model 1000 rig using air as a circulating fluid. No water was available on Traverse 1, as Malcom's Bore is dry, and Bindi Bore is fitted with only a hand pump. Traverse 1 was suspended about 14 miles south of Steele's Gap when shot holes could not be drilled due to the presence of a fine sand which caused holes to cave whilst being drilled. Two drilling days were lost attempting to drill holes in this area, and it was often extremely difficult to retrieve the drill stem. A rig with a modified rotary table and swivel, enabling casing to be drilled down with air, may solve the problem of drilling holes near Steele's Gap.

Difficulty was often experienced when moving the rig between holes. A tractor and sand mats were of considerable assistance but S.P. 39 was unable to be reached, due to heavy sand, and was therefore not drilled. The drill truck broke two axles and one differential assembly when in heavy sand. Time was also lost moving camp between Malcom's Bore and Camel Flat due to trucks breaking down whilst attempting to negotiate heavy sand.

All spread lengths were maintained at 1320 feet. Geophone stations were maintained at 110 feet and six geophones were used per trace. End trace geophones were located at interlocking shot points. Record quality was extremely poor between Malcom's Bore

and Steele's Gap. A three hole pattern shot at SP 15 did not improve results. Fair to good records were obtained along Traverse 2 at Camel Flat, except where spreads were located on loose dune sand. Charge sizes varied between 20 and 50 pounds and hole depths were mostly 100 feet.

INTERPRETATION AND RESULTS.

All records, which showed reflection data, were corrected for elevation and weathering by the normal uphole method. Elevation velocities were computed from refraction plots of first breaks and checked by observation of recorded uphole times.

Reflections were picked, graded for certainity according to principles set out by P. Gaby,(3) and plotted on the cross sections in time. The number and quality of reflections did not permit a reliable computation of average velocities. Correlations, between interlocking spreads, were made by datum to datum time ties. Other correlations were based on consideration of character and interval.

Traverse 1. Malcom's Bore to Steele's Gap.

Record quality was very poor and a cross section was prepared only for the first five shot points at the south end of this traverse. Shallow reflections, probably originating from Cretaceous beds show gentle south dip. Below their base an

unconformity is believed to be present. Beds below the unconformity show steeper dip to the south.

Reflections were observed on records at S.P. 23 and S.P. 24. These events occur out to 2.1 seconds. Near surface refraction velocities are of the order of 10,000 feet per second. Average velocities may be assumed to be at least of the same magnitude, giving a probable depth for these reflections of around 10,000 feet. Near surface beds appear to be almost flat,* whereas the deeper beds show south dip.

Traverse 2. Camel Flat.

Record quality was much better on this traverse. Inspection of the cross section shows at least three conformable horizons, the deepest being at about 5000 feet.

All reflectors are practically flat, except at both ends of the traverse, where gentle dips indicate the presence of Camel Flat Syncline. There is some evidence of a thrust fault at the north end, but unfortunately continuous profiling was interrupted at this part of the traverse.

FOOTNOTE BY MINES ADMINISTRATION PTY. LIMITED *

Some reflected energy is apparent between Shot Points 16 and 24 at corrected times of from .724 to .781 secs. Correlation of these events is questionable however, some character correlation is apparent which indicates gentle south dip at this horizon.

CONCLUSIONS

It is believed that the following conclusions can be drawn from the observed data:-

Traverse 1.

A sedimentary section, possibly 10,000 feet in depth, occurs south of Steele's Gap near S.P. 24. Reflection data indicates less than 4,000 feet of section near Malcom's Bore. Although surface conditions along this traverse are of a type usually considered poor for obtaining seismic reflection records, they are believed to be no poorer than those conditions encountered at Camel Flat, where adequate seismograms were obtained. The reason, for the absence of reflections, is considered to be due to the nature of the subsurface. The change in apparent depth to basement is believed to be controlled by faulting of a complex nature.

Traverse 2.

The prediction of a Lower Palaeozoic section under Camel Flat has been confirmed. A syncline exists but has none of the characteristics predicted from observations of the surface geology. A synclinorium was not observed and the absence of dips on the cross section, in relation to observed dips in outcrops, strongly suggests "Jura-type" folding.

This seismograph survey in no way discounts the area as a petroleum prospect. Both traverses however, indicate that the geology is not simple and further geophysical surveys and re-evaluation of geologic data are recommended, before any drilling sites are selected.

Respectfully submitted,

E. R. Denton B.Sc.
Geophysicist.

Approved by:

R. C. Sprigg M.Sc.
Managing Director,
Geoseismic (Australia) Limited.

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(1) T. J. Madden — "Final Report on the Geology of Oil Permit No. 34, N.T." Mines Administration Report No. N.T./34/92.

(2) J. E. Burbury — "Report on Gravity Surveys in Oil Permits 32 & 34, Northern Territory". Mines Administration Report No. N.T./34.42/94.

(3) P. P. Gaby — "Grading System for Seismic Reflections and Correlations". Geophysics 12 (1947).

APPENDIX I

CALCULATION AND INTERPRETATION METHODS.

Correction Used	Normal Uphole
Elevation Velocities	
Traverse 1	5,000 ft/sec.
Traverse 2	10,000 ft/sec.
Elevation Datum	
Traverse 1	+ 600 feet (Qld. State Datum).
Traverse 2	+ 800 feet (assumed)
Correlation	
Inter-locking Spreads	Datum to Datum end trace time ties.
Other	Character & Interval

OPERATION METHODS AND STATISTICS

Recording.

Type Shooting	Continuous Profiling & Correlation.
Spread Length	1320 feet.
Geophone Interval	110 feet
Shot Point to near geophones	110 feet
End Trace Geophones	At interlocking shot points.

APPENDIX I
Continued.

Type Geophone	S.I.E. S-23
Frequency	18 cps
Geophones per Trace	6
Connection	Series - Parallel
Spacing in Group	10 feet
Type Seismograph	S.I.E. P-11
Number of Channels	24
Type Camera	S.I.E. PRO-11
Type Amplifier	S.I.E. GA-11
Filter Setting	30 - 42
Mixing	None
Number of Shot Holes	58
Subsurface Coverage	14.5 miles
Recording Time	
Drive	27 hours
Field	53 hours
Total	80 hours
Normal Hole Depth	100 feet
Normal Charge	25 pounds
Dynamite used	2,010 pounds
Caps used	83
Leader Length	60 feet

APPENDIX I
Continued.

Drilling

Number of Shot Hole Drills	1
Type Drill	Mayhew 1000
Circulating Fluid	Air
Compressor	Gardner Denver WCQ
Holes Drilled	58
Footage Drilled	5,262 feet
Formations Encountered	Sand Clay Shale Sandstone
Drilling Time	
Drive	36¼ hours
Field	139¾ hours
Total	176 hours
Type Bit	Skidmore-Crook 4¾" 3 Blade Inserts
Number of Sets Used	3

OPERATIONAL DIFFICULTIES

Surface conditions: Heavy sand in many places restricted vehicle movements.

Near Surface Formations: Caving sand prevented the drilling of some holes and also prevented the recording of more than one shot per hole in most cases.

Time Lost: 8 days. Breakdowns and waiting for parts during camp move between traverses.

APPENDIX I
Continued.

Personnel.

Party Chief	E. R. Denton
Computer	D. Oxlade
Observer	J. Kiziak
Surveyor	D. Worral
Driller	I. Mackie
Drillers Assist.	C. Swinton
Shooter	E. Mundy
Assist. Shooter	G. Schmidt
Recording Helper	H. Newman
Recording Helper	C. Degan
Recording Helper	J. Eime
Rodman	C. Torenback
Mechanic	R. Kersten
Cook	G. Rowley
Cook's Assist.	K. Eleftheriadis

The total number outside of the camp crew of three people involved in the survey is 12 men.

Vehicles.

One Toyota (4x4) Landcruiser - Observer's vehicle

One Toyota (4x4) Landcruiser - Reel truck

One Toyota (4x4) Landcruiser - Survey vehicle

One Mayhew 1000 rig mounted on a Bedford (4x4) vehicle.

Two Blitz 1006 gallon (4x4) water tankers.

One 5 ton 1957 International (4x4) Supply Truck.

One Toyota (4x4) Landcruiser - Personnel and office vehicle.

The total number of vehicles on the survey crew - 8

Camp Facilities.

One camp complete with tents, dining, cooking and washing facilities.

One mechanics workshop

One lighting plant.

APPENDIX V.

REGIONAL GEOLOGY

The stratigraphic succession which outcrops in O.P.54 is :-

			FORMATION	THICKNESS
QUATERNARY			Alluvium and sand	
TERTIARY			Freshwater limestone, conglomerates and sandstone	± 200 ft.
			Disconformity	
MESOZOIC	Cretaceous		Rumbalara Shale	50 ft.+
	Jurassic		De Sousa Sandstone	50 ft.+
			Unconformity	
PALAEOZOIC	Upper Palaeozoic Undifferentiated		Pertnajara Formation	± 500 ft.
			Unconformity	
	Cambrian	U	Pulya Pulya Sandstone	2075 ft.
		M	Santa Teresa Limestone	1570 ft.
		L	Hugh River Shale	320 ft.
			? Disconformity ?	
			Arumbera Greywacke	1895 ft.
PRECAMBRIAN	Proterozoic	U	Pertatataka Formation	App. 3000'
			Disconformity	
			Bitter Springs Limestone / Heavitree Quartzite	? 2000 ft.
			Unconformity	
	Archeozoic		Basement Metamorphics	

The Permit area forms part of the Amadeus Basin, a relatively long, narrow, latitudinal trough which extends from the Simpson Desert in the east westward at least to the West Australian border. The basin is bounded on the north and south by metamorphics and granites which outcrop approximately on the latitude of Alice Springs in the north and the South Australia/Northern

Territory border in the south. In this basin are preserved sediments which range in age from Upper Proterozoic to Devonian; these in turn are unconformably overlain, and in places masked, by Upper Palaeozoic, Mesozoic and Cainozoic beds.

The Upper Proterozoic and Lower Palaeozoic sediments comprise a conformable sequence of sandstones, carbonates and shales which approaches 11,000 feet in thickness. In O.P.54 the succession in the lower part of the Upper Proterozoic is difficult to establish due to faulting but it is thought that the Heavitree Quartzite and the Bitter Springs Limestone would together approach 2,000 feet in thickness.

Above these formations the Pertatataka Formation of approximately 3,000 feet thickness consists of interbedded sandstone, carbonates and shale with a disconformity, and some evidence of glacial detritus, low in the formation.

Following conformably the Upper Proterozoic beds is the Cambrian section of total thickness 5,860 feet consisting of Arumbera Greywacke, Hugh River Shale, Santa Teresa Limestone, and Pulya Pulya Sandstone.

The Arumbera Greywacke is 1895 feet thick and consists essentially of red-brown ferruginous sandstone, and white felspathic sandstone. The sandstone are massive, current bedded and ripple marked and contain clay galls intermittently throughout the section. No fossils have been found in the Arumbera Greywacke in the Permit area.

The Hugh River Shale and Santa Teresa Limestone comprise a single environmental unit of 1,890 feet thickness which consists of a lower shale and minor carbonate formation 320 feet thick, followed conformably by the carbonates and shale of the Santa Teresa Limestone. The presence of the brachiopods Kutorgina and Nisusia at the base of the Hugh River Shale indicate a Lower Cambrian age for the base of this unit.

Overlying these beds is the 2,075 feet of the Pulya Pulya Sandstone. This is a white, quartzose sandstone with abundant white clay matrix. Porosity is present only in the basal 50 feet of the formation, the rest of the section is remarkably uniform in lithology and uniformly dense. Fragments of brachiopods and trilobite trails reported from the Steeles Gap area, indicate the age of this sandstone to be Upper Cambrian or Lower Ordovician.

No Lower Palaeozoic beds higher than the Pulya Pulya Sandstone are found outcropping in the Permit area.

The Upper Palaeozoic section in the Permit consists only of small outliers of quartzite conglomerate and limestone conglomerate of the Pertnajara Formation. This formation has no great lateral extent and the thickness is not thought to exceed 500 feet.

The Mesozoic beds are represented by the Jurassic, De Sousa Sandstone and the Lower Cretaceous, Rumbalara Shale. The outcrop of the De Sousa Sandstone is almost completely covered by the sand of the Simpson Desert, and only two outcrops each of approximately 30 feet of white, argillaceous sandstone occur in the Permit area. The Rumbalara Shale outcrops only along the southern boundary of the Permit and its thickness is thought not to exceed 300 feet.

In the northern part of the Permit, the Upper Proterozoic and Lower Palaeozoic rocks are severely disturbed and the structure is dominated by low and high angle thrust faults with steep to vertical dips common throughout the area. At Steeles Gap, the Bindi Anticline has vertical to overturned dips on its south flank and dips up to 60 degrees on its north flank. Other structures in the Steeles Gap area show similar strong folding.

Two structural features, the Phillipson Pound and the Camel Flat Syncline, provide a striking contrast to the general disturbance apparent in the rest of the area. Dips in these two structures are relatively gentle and it seems likely that they have both been displaced as blocks along low angle thrust faults and have thus been preserved from the severe compression which has deformed the remainder of the area.