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JAMES RANGE SEISMIC SURVEY

OIL PERMIT 43

NORTHERN TERRITORY

OF AUSTRALIA

FOR

EXOIL (N.T.) PTY. LTD.

Perry House, Elizabeth Street, Brisbane, Queensland

GEOPHYSICAL ASSOCIATES PTY. LTD.

113 Eagle Street, Brisbane, Queensland.

April, 1964

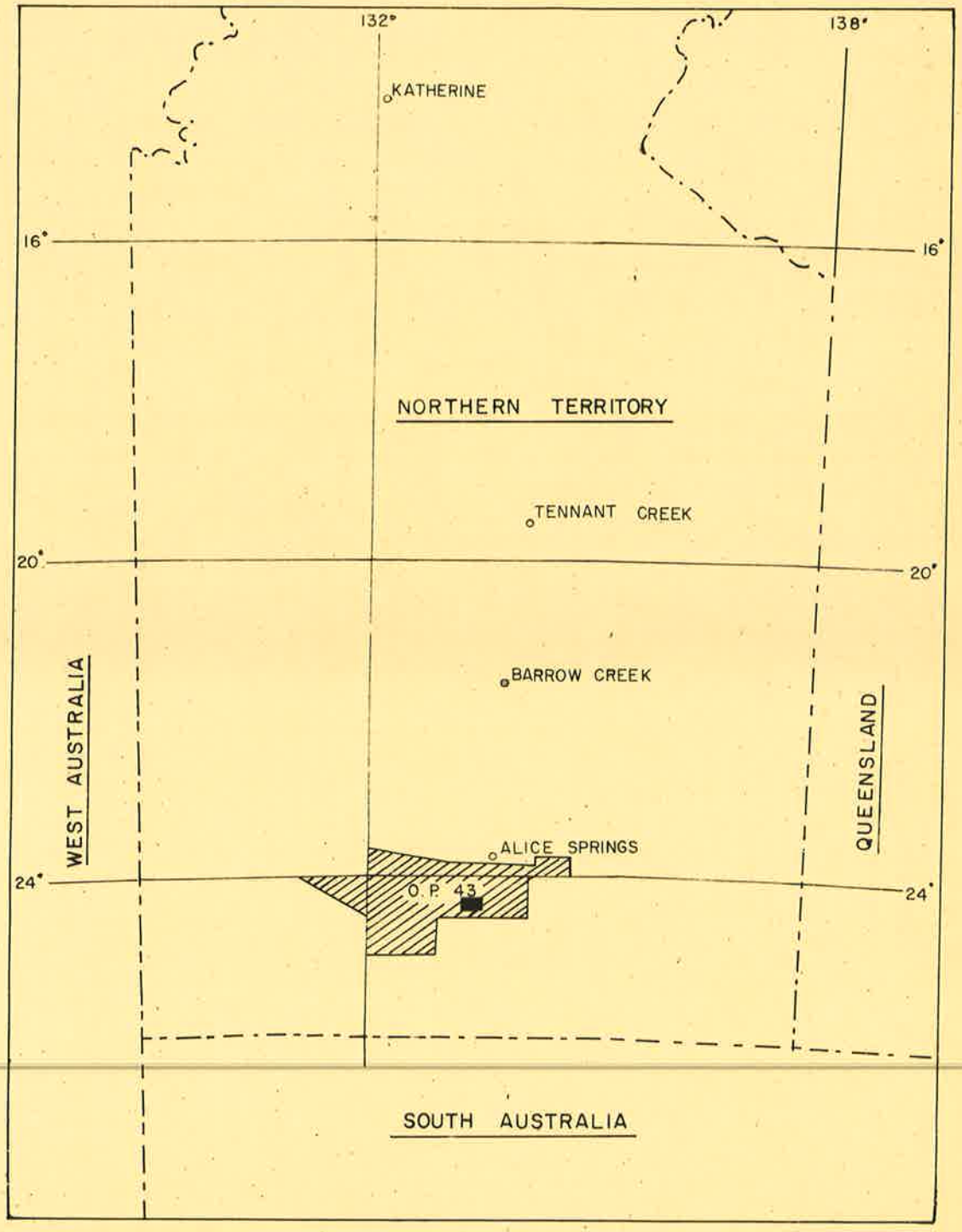
CONTENTS

ABSTRACT

The James Range reflection seismic survey was conducted in order to determine if closure exists on the south flank of the James Range 'C' Anticline.

Inadequate results were obtained to reliably determine the exact extent of south dip but a few poor quality discontinuous reflections suggest a relatively small amount of closure exists in this direction.

When an extensive programme of experimental shooting indicated that no appreciable results could be obtained in this area using the normal method of seismic reflection recording the survey was terminated after 70 hours of recording time.



LOCALITY PLAT

JAMES RANGE SEISMIC SURVEY

O.P. 43 N.T.

INTRODUCTION

A reflection seismic survey was conducted between 14 April and 21 April, 1964 for Exoil (N.T.) Pty. Ltd. by Geophysical Associates Pty. Ltd. The survey was carried out in Area 'G' of Oil Permit 43 in the Amadeus Basin in the Northern Territory of Australia. This area is a farmout from Magellan Petroleum Corp. as described in a Primary Agreement between the two companies dated 2 August, 1963.

The work was confined to the south side of the James Range 'C' Anticline located approximately 55 miles south of Alice Springs just north of the Hugh River on the Adelaide Highway. The bulk of the programme was shot between the James Range outcrop and the Hugh River, with two shotpoints extending onto the outcrop and one shotpoint located south of the river.

The surface is mantled with sand, and gravel occurs in the vicinity of the river. A considerable number of trees stand throughout the area but not sufficiently dense to warrant clearing of lines. Large gum trees line the Hugh River and adjoining creeks. Spinifex grass is the primary vegetation.

The terrain rises gently northwards from the river to the range except in the south-central and eastern portions where its evenness is broken by large sand dunes and small isolated sandstone outcrops.

The original programme consisted of four lines. A line close to the Hugh River was abandoned when heavy gravel was encountered near the river on the highway (Line A). The most easterly line was also cancelled due to high sandhills. An additional line was added perpendicular to the strike of the outcrop and commencing at a shotpoint on Line A where the best results had been obtained.

The camp was located at the crossing of the Alice Springs - Adelaide Highway and the Hugh River. Water was available about one mile south of the river at Renners Rock Homestead.

All trucks were of four and six wheel drive. Sand tyres were available on the crew but were not used for the two short lines off the highway. However, if extensive work was contemplated and trails were to be traversed more than once, it is recommended that sand tyres be utilized. Twenty men, including four expatriates, were employed during the operations.

PURPOSE OF INVESTIGATION

The purpose of the survey was to determine if there is closure on the south flank of the James Range 'C' Anticline.

Previous geophysical work done by Magellan Petroleum Corp. consisted of a gravity line over the anticline. This survey indicated a residual low at the centre of the structure suggesting a salt core and possible south closure.

Previous geological work in the area had indicated limited south dip in a Cambrian outlier south of the main Pacoota outcrop on the south side of the anomaly. It was felt that if sufficient closure could be demonstrated, the prospect would be drillable because the Cambrian limestone and shales are known from Alice No. 1 to be good source beds. The underlying Arumbera sandstone had also revealed good reservoir characteristics in Alice No. 1 and in Ooraminna No. 1.

GEOLOGY

The East-West axis of the James Range 'C' Anticline is sympathetic to the regional outcrop and tectonic trends found at the northern boundary of the Amadeus Basin in the McDonnell Ranges. Its northern closure is well defined by surface geological mapping from outcrops of the Stairway and Horn Valley formations of Ordovician Age. Exposures on the crest include the Ordovician Pacoota sandstone and the Cambrian Goyder member of the Pertaoorrta Group. Since the completion of the seismic programme, geologic mapping on the south flank has indicated an east-west fault through SP 4, interpreted as either a strike-slip or a thrust fault.

Like other anticlines in the Amadeus Basin, the James Range Anticline appears to have a diapiric origin. It is thought that maximum structural formation occurred during the deposition of the thick Pertnjara sequence during Devonian and Carboniferous times.

Prospective reservoir and source rocks in the Upper Proterozoic include the Bitter Springs limestone and the Aeryonga formation; in the Cambrian the Arumbera sandstone and the Pertaoorrta Group; and in the Ordovician the Larapinta Group.

The Alice No. 1 and Ooraminna No. 1 test wells drilled 17 and 28 miles southeast of Alice Springs respectively - and less than 50 miles from the James Range - yielded significant shows of hydrocarbons.

EXPERIMENTAL SHOOTING

An extensive programme of experimental shooting was carried out in the area when it became immediately evident that normal shooting procedures would not give usable results. After it was decided to leave the drilling of the gravel holes until mud was available the initial reflection spreads were laid at SP 8 using 18 geophones per trace in line at 10 ft intervals. The hole was shot with 20 lbs @ 98 ft and 50 lbs @ 62 ft; the former was an NR record, the latter of poor quality but with good evidence of reflection events from .250 to 1.650 sec.

SP 9 yielded a fair record from 3 deep holes in line using a 30 ft spacing. A single shallow shot of 75 lb was very poor. A comparison between 6 detectors @ 30 ft and 18 @ 10 ft was made on SP 10 with the conclusion that the additional detectors did not improve quality. The single deep hole gave poor results but was superior to a 16 shallow hole box pattern. Both seismograms recorded at SP 11 were very poor with possibly a slight improvement shown by 16 shallow holes over a single deep hole. SP 8 was reshot with 3 deep holes in line but resulted in a NR record. SPs 6 and 7 were both poor, recorded from single holes at 55 and 40 ft respectively with 25 lbs.

In an effort to attain a more comprehensive sampling of the area and also to possibly find better drilling conditions, the crew moved to Line B. Drilling conditions did not improve as gravel was encountered at most locations. All seismograms were recorded from single holes except a third shot on SP 12 (9 holes with 45 lbs @ 20 ft; very poor) and a 16 hole pattern on SP 16 (80 lbs @ 20 ft; poor to fair). Although record quality was poor over the entire line, the better results were obtained with the larger charges at relatively deep depth, i.e. 75 lbs @ 50-80 ft.

Line C was next programmed in an attempt to extend the coverage of the fair reflection energy recorded at SP 9. This line is approximately perpendicular to the strike of the outcrops in the area and it was thought that a different angle of reflected energy in relation to the outcrop might improve data. Deep 5 hole patterns with 12 geophones per trace at 15 ft intervals were employed, but with overall poor results. A sixteen hole shallow pattern on SP 20 and a single hole on SP 22 also failed to produce good usable data. With drilling mud available the remainder of Line A was completed using 5 hole deep or 16 hole shallow patterns, depending on the drilling conditions. The shallow patterns seemed to give, overall, the better results.

At SP 1, the southernmost location on Line A, a 250 foot deep hole was planned. After drilling through sand and gravel to 60 ft, shale was encountered to 195 ft where the hole went blind. Shots were

taken at depths of 173, 88 and 36 ft with no real improvement. The 88 ft shot was superior to the other depths and comparable to a 16 hole shallow pattern at the same location.

Provided of course that reflecting interfaces are present, the experimental shooting did not establish a basis for optimum shooting techniques in this area. However, the following generalizations appear to be valid.

(a) Hole depth must be below near surface sand and gravel layers but depths past 100 ft tend to deteriorate quality and greatly increase high frequency noise return.

(b) A charge size of at least 75 lb gave best results.

(c) Sixteen shallow hole patterns proved to be the best alternative when drilling conditions prohibited obtaining a single deep hole.

(d) Although evidence is inconclusive, twelve geophones per trace probably enhance energy returns and tend to better cancel random noise than six per trace.

RESULTS

Correlations of the shallowest events over the three survey lines indicate little evidence for closure on the south flank of James Range 'C' Anticline. Although of poor quality, these constitute the most consistent events recorded but probably do not reveal the true dip magnitudes of the deeper beds. This may especially be true between SPs 1 and 5 where surface outcrops do not confirm the south dip measured in the deeper reflections (Cambrian limestone outcrops near the Hugh River). In this area the shallow reflection measures 17 milliseconds of northeast dip. However, the deeper reflections on Lines A and C suggest a south dipping attitude. On line A between SP1 and SP 10, a phantom horizon just below one second measures a southwest dip component of 113 milliseconds. The most reliable indications of south dip occur on Line C between SPs 9 and 20.

In view of the overall poor reflection quality, inaccessibility of some of the area, and difficult drilling conditions generally encountered, the programme was terminated on 21 April.

Time cross sections of Lines A, B, and C and a Shotpoint Location Map are included with this report.

GEOPHYSICAL ASSOCIATES PTY. LTD.

J.H.B. Campbell

J.H.B. Campbell.

APPENDIX I

FIELD PROCEDURE

Surveying

Horizontal and vertical control was based on the gravity station, BM 72/23, located on the Alice Springs-Adelaide Highway. Vertical and horizontal ties were within 2 ft. and 200 ft. respectively.

Surveying was carried out using a plane table and alidade and plotted on a base map at a scale of 1" = 1 mile.

Drilling

Shot holes were drilled using air and water injection methods. Sand, sandstone, and gravel were encountered in most shot holes with limestone encountered in SPs 9 and 10 on Line A. Hole depths varied from 20 to 200 ft. Some difficulty was experienced with loose sand at the top of the shot holes and with gravel deposits, particularly on the south end of Line A, which necessitated the use of drilling additives.

Shooting

Charge sizes varied from 5 to 125 lbs. Average charge size for the area was 50 lbs. There was no apparent optimum charge size and depth for the area. In general, however, for a single shot hole 75 lbs between 50 and 80 ft yielded the best results.

Recording

A continuous recording technique using 1320 ft. spreads was employed throughout with 6, 12, or 18 phones per trace. Monitor seismograms were recorded with no mixing, a double section 20 cps filter on the low side and no filter on the high; playbacks from the magnetic tape were made with a double section 20 cps on the low side and a single section 65 cps on the high side. Unmixed and 25% Bi-directional mixed playbacks were used. Shots were taken using fast AVC and gain set at 70%.

COMPUTATION

The records were computed to a datum of 1500 ft above mean sea level using the standard uphole method and a velocity to datum of 15,000 ft/sec. First arrivals were plotted for each shot point with no indications of weathering apparent on the plots. The following formula was used for the uphole computation:

$$Tc = \frac{2\,(Es - Ds - D)}{Vd} + Tuh$$

where:

Tc = total correction

Es = surface elevation

Ds = shot depth

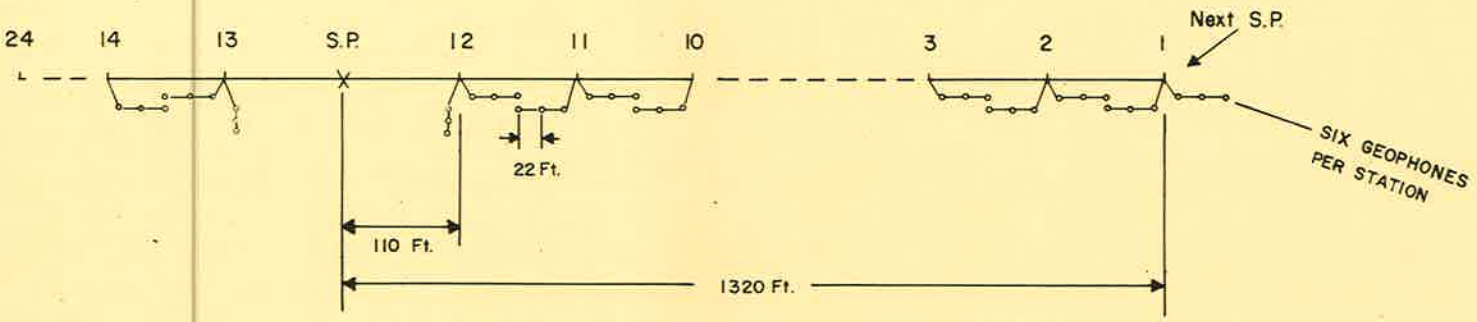
D = datum plane elevation

Tuh = uphole time

Vd = velocity to datum

SPREAD DIAGRAM

TYPICAL REFLECTION LAYOUT



APPENDIX II

Personnel

Party Chief	R. C. Philbrick
Seismologist	R. B. Hudson
Observer	R. Ehrler
Surveyor	D. A. Worrall
Drill Supervisor	G. E. Thompson
Driller	L. Powell
Driller	D. Clark

The basic crew comprised 20 men. In addition to the key personnel listed above, 13 men were employed as:

Rodman	1
Shooter	1
Mechanic	1
Cook	1
Mechanic's Helper	1
Cook's Helper	1
Drill Helpers	2
Recording Helpers	4
Supply Driver	1

Supervisors

Exoil (N.T.) Pty. Ltd.	S. S. Chambers
Geophysical Associates Pty. Ltd.	J.H. B. Campbell

APPENDIX III

Automotive

8 F-750 Fords, 4 or 6 wheel drive, equipped with winch

3 Land Rovers, 4 wheel drive

Recording

1 Recording truck with air-conditioned instrument cab

1 Cable truck with Squirter cable handler and geophone storage

1 Set 24 Channel S.I.E. GA-33 amplifiers

1 50 Channel S.I.E. camera

1 S.I.E. MR-4E (FM) magnetic tape system

450 S.I.E. reflection geophones, S-16, 18 c.p.s.

1 Multicap blaster

1 Portable blaster

3 Road cables 1760 ft.

3 Portable cables 1320 ft.

Shooting

1 Land Rover

Drilling

2 Mayhew 1000 air-water combination drills

2 Water trucks mounted with a stake sided, flat bed 1,000 gallon tank

Surveying

1 Land Rover

1 Transit

1 Alidade and plane table

Supply

1 Stake truck

Office

1 Land Rover

1 Trailer complete with office equipment including dip plotter and printer

Camp

1 Trailer with sleeping accommodation for 4 men, and with washroom facilities

1 Trailer equipped as a kitchen unit with detachable dining and storage tents

3 Tents for sleeping accommodation

1 Semi-Trailer with equipped workshop

2 15 KW generators, trailer mounted

APPENDIX IV

Statistical Data

Starting Date	14 April, 1964
Completion Date	21 April, 1964
Hours Moving	0
Driving Time	6
Field Time	64
Total Crew Hours	70
Time Lost	0
Days Off	0
Total Hours Drilling (2 Drills)	168
Total Hours Recording	64
Holes Shot	24
Number of Shots	35
Profiles Recorded	44
Magnetic Tapes Used	36
Miles Surveyed	6
Holes Drilled	177
Footage Drilled	6397
Average Hole Depth (ft)	36.1
Average Penetration Rate (ft/hr)	38.1
PoundsDynamite used (Geophex)	2095
Caps Used	206
Bits	
Starter	11
Rock	11
Inserts	40
Mud used (100 lb sacks)	6