SIMPSON DESERT "C" SEISMIC SURVEY

OIL PERMIT 57

NORTHERN TERRITORY

AUSTRALIA

FOR

AMERADA PETROLEUM CORPORATION OF AUSTRALIA LIMITED

BRISBANE, QUEENSLAND, AUSTRALIA

BY

AUSTRAL GEO PROSPECTORS, PTY. LTD.

BRISBANE, QUEENSLAND, AUSTRALIA

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(Scale 1:100,000)

AMERADA PETROLEUM CORPORATION OF AUSTRALIA LIMITED

INCORPORATED IN THE STATE OF DELAWARE U.S.A.

GUARDIAN BUILDING
380 QUEEN STREET
BRISBANE QUEENSLAND AUSTRALIA
G.P.O. BOX 1388R

CABLES AND TELEGRAMS
AMERADA BRISBANE

TELEPHONE: 2 0175

January 26, 1967

The Director
Mines Branch
Darwin

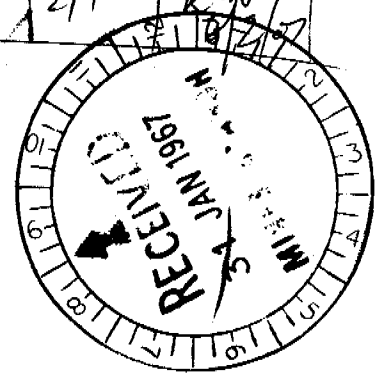
Dear Sir: Oil Permit 57

We enclose for your records two copies of the final report on the Simpson Desert "C" Seismic Survey which was conducted on Oil Permit 57 between May 28, 1966 and August 27, 1966.

Yours very truly,
Amerada Petroleum Corporation
of Australia Limited

Ian McPhee
Administrative Manager

MI	2/1	
Mr	2/1	
Dr Dodson	2/1	



Enc
IM/sa
cc. Beach Petroleum N.L.

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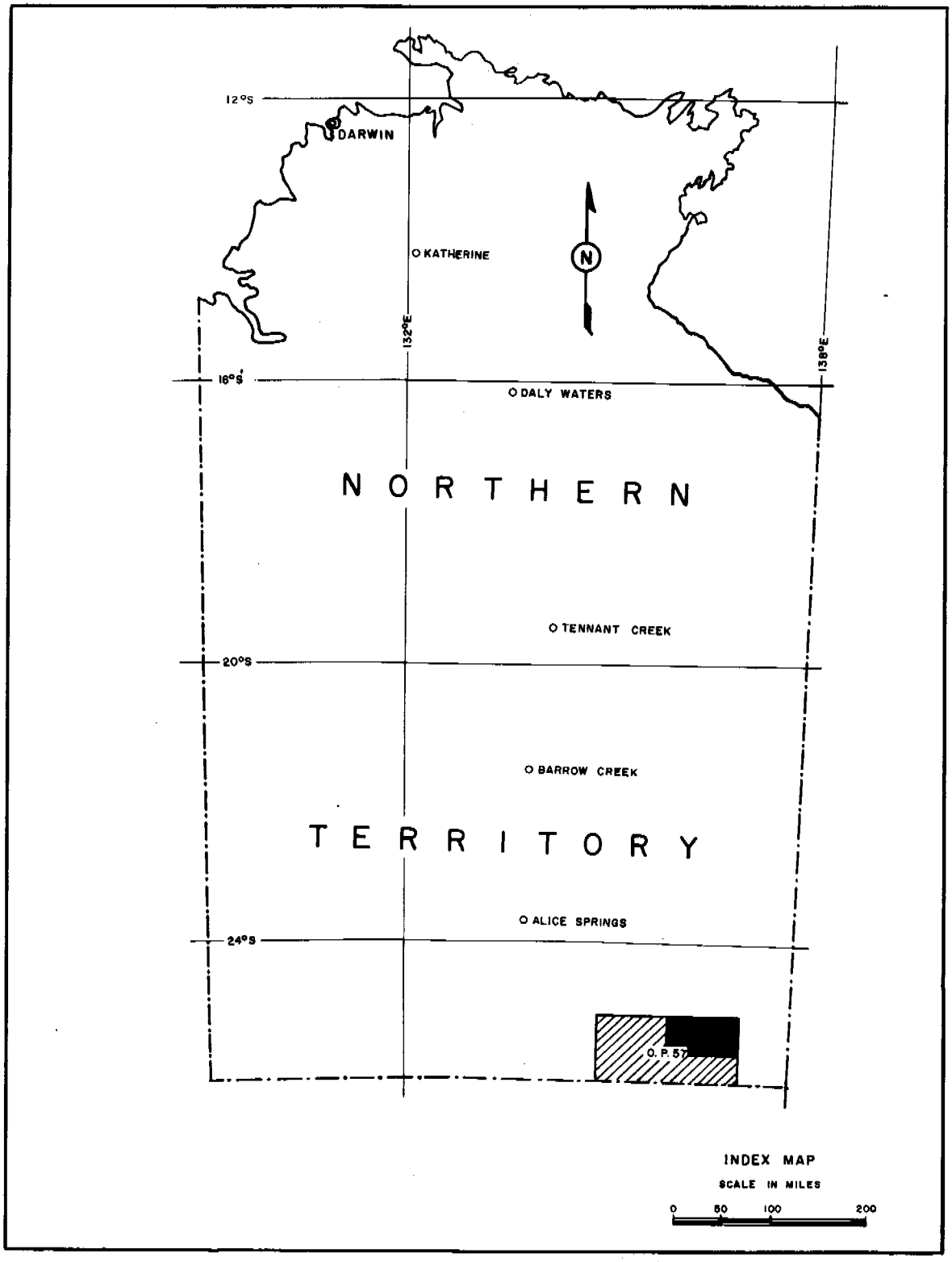

12°S
DARWIN
KATHERINE
N
132°E
138°E
16°S
DALY WATERS
NORTHERN
TENNANT CREEK
20°S
BARROW CREEK
TERRITORY
ALICE SPRINGS
24°S
O. P. 57
INDEX MAP
SCALE IN MILES
0
50
100
200

Figure 1

ABSTRACT

The Simpson Desert "C" Seismic Survey was conducted between May 28, 1966 and August 27, 1966 by Austral Geo Prospectors, Pty. Ltd. for Amerada Petroleum Corporation of Australia Limited on Northern Territory OP 57, an area subject to a farmout agreement between Amerada Petroleum Corporation of Australia Limited and Beach Petroleum No Liability. The survey utilized continuous coverage reflection seismic methods to provide semi-detail seismic control over a broad anomalous platform area outlined by the reconnaissance coverage of the preceding Simpson Desert "A" Seismic Survey in the general vicinity of Lat. 25°10'S., Long. 136° 45'E. One shallow horizon was mapped throughout the area of the survey and one or two deeper horizons were mapped in much of the area of the survey. The work provided a better appreciation of the geology of the area and some pre-Permian mapping was accomplished.

INTRODUCTION

The Simpson Desert "C" Seismic Survey was conducted by Austral Geo Prospectors, Pty. Ltd. for Amerada Petroleum Corporation of Australia Limited in the northeastern part of Northern Territory OP 57, a 9,313 square mile area bounded by Lats. 25°00' and 26°00'S. and Longs. 135°00' and 137°15'E. that is subject to a farmout agreement between Amerada Petroleum Corporation of Australia Limited and Beach Petroleum No Liability. The field crews utilized continuous coverage reflection seismic methods, with one crew active from May 28, 1966 to July 22, 1966 and a second crew active from June 2, 1966 to August 27, 1966. Field headquarters were at Alice Springs, located about 150 miles northwest of OP 57, and the crews operated from field camps that were moved as the survey progressed. Radio communications were maintained between Alice Springs and the field camps and the crews were supplied by road from Alice Springs.

REGIONAL GEOLOGY

Northern Territory Oil Permit 57 lies within the Simpson Desert, an area in the western part of the Great Artesian Basin that is covered by northwest-trending stabilized longitudinal type sand dunes with intervening clay pans. Only a few outcrops of Mesozoic sediments protrude through the sand cover and therefore information concerning the stratigraphy of the area is based on limited outcrop information and sparse available well data.

The Great Artesian Basin sediments consist of a sequence of Cretaceous and Jurassic marine and continental rocks up to several thousand feet in thickness which occupy a broad shallow depression and unconformably overlie local basins of preservation containing older sediments. Permian marine and continental beds and possibly rocks of Triassic age unconformably overlie a variable sequence of Devonian-Carboniferous "molasse" type sediments which fill restricted embayments beneath the Mesozoic of the Great Artesian Basin. These preserved embayments are

separated by tectonic welts composed of folded Upper Proterozoic and Lower Paleozoic shelf-type marine and transitional sediments believed to be similar to those present in the eastern Amadeus Basin. The stratigraphic sequence within these fold belts is complicated by faulting and erosion, which resulted in the beveling of structurally high areas prior to Permian onlap. The basement consists of Archean igneous and metamorphic rocks comparable to those in the adjacent exposed cratons.

The major structural features in the area are the Simpson Sub-basin, the northeast extension of the Peake and Denison fold belt, expressed in part by McDills anticline, and the shallow basement platform which connects the Archean Musgrave and Arunta cratonic blocks and separates the Amadeus Basin from the Pedirka Sub-basin. (Fig. 2).

The shallow basement ridge between the Amadeus Basin and the Pedirka Sub-basin is apparently a broad upwarp in the basement which may have been active during the Proterozoic and Lower Paleozoic and acted as a barrier to normal marine circulation,

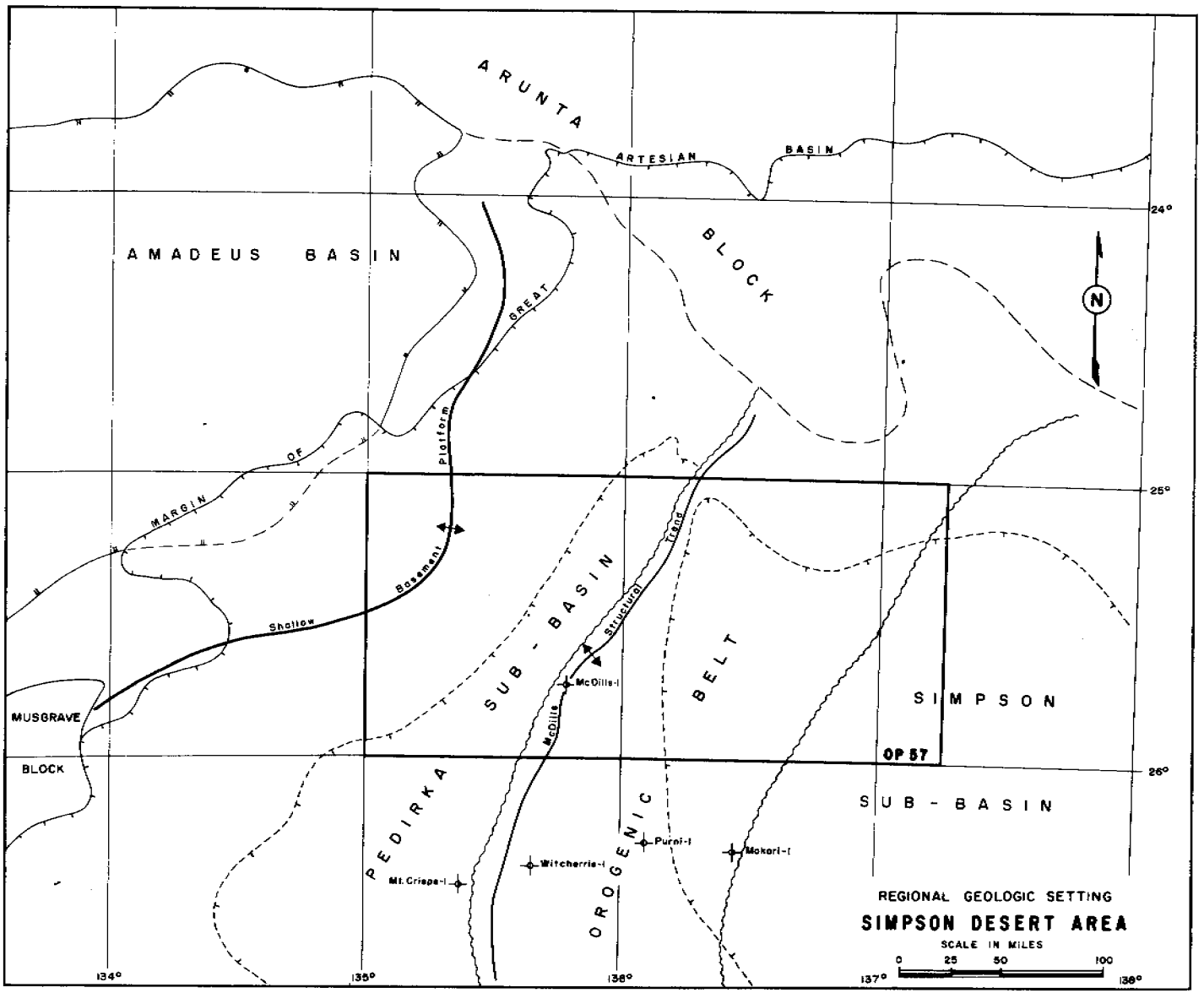

ARUNTA
ARTESIAN
BASIN
AMADEUS BASIN
BLOCK
GREAT
Platform
MARGIN OF
Basement
Shallow
MUSGRAVE
BLOCK
SUB - BASIN
Structural
Trend
McDills-1
McDills
BELT
SIMPSON
OP 57
SUB - BASIN
PEDIRKA
OROGENIC
Witcherrie-1
Mt. Crispe-1
Purni-1
Mokari-1
N
24°
25°
26°
134°
135°
136°
137°
138°
REGIONAL GEOLOGIC SETTING
SIMPSON DESERT AREA
SCALE IN MILES
0 25 50 100

Figure 2

as evidenced by the presence of evaporites within this sequence in the Amadeus Basin. The present configuration of the ridge is most probably due to post-Ordovician uplift, which was renewed in the Permian, but it does not appear to have acted as a complete barrier to Mesozoic incursions.

The Pedirka Sub-basin is a restricted Devonian ? - Permian downwarp controlled in part by bordering positive areas. It is the site of thick locally-derived fill-type deposits that were preserved during successive periods of pre-Permian erosion. The Permian section thickens toward the axis of the sub-basin by addition of section at the top.

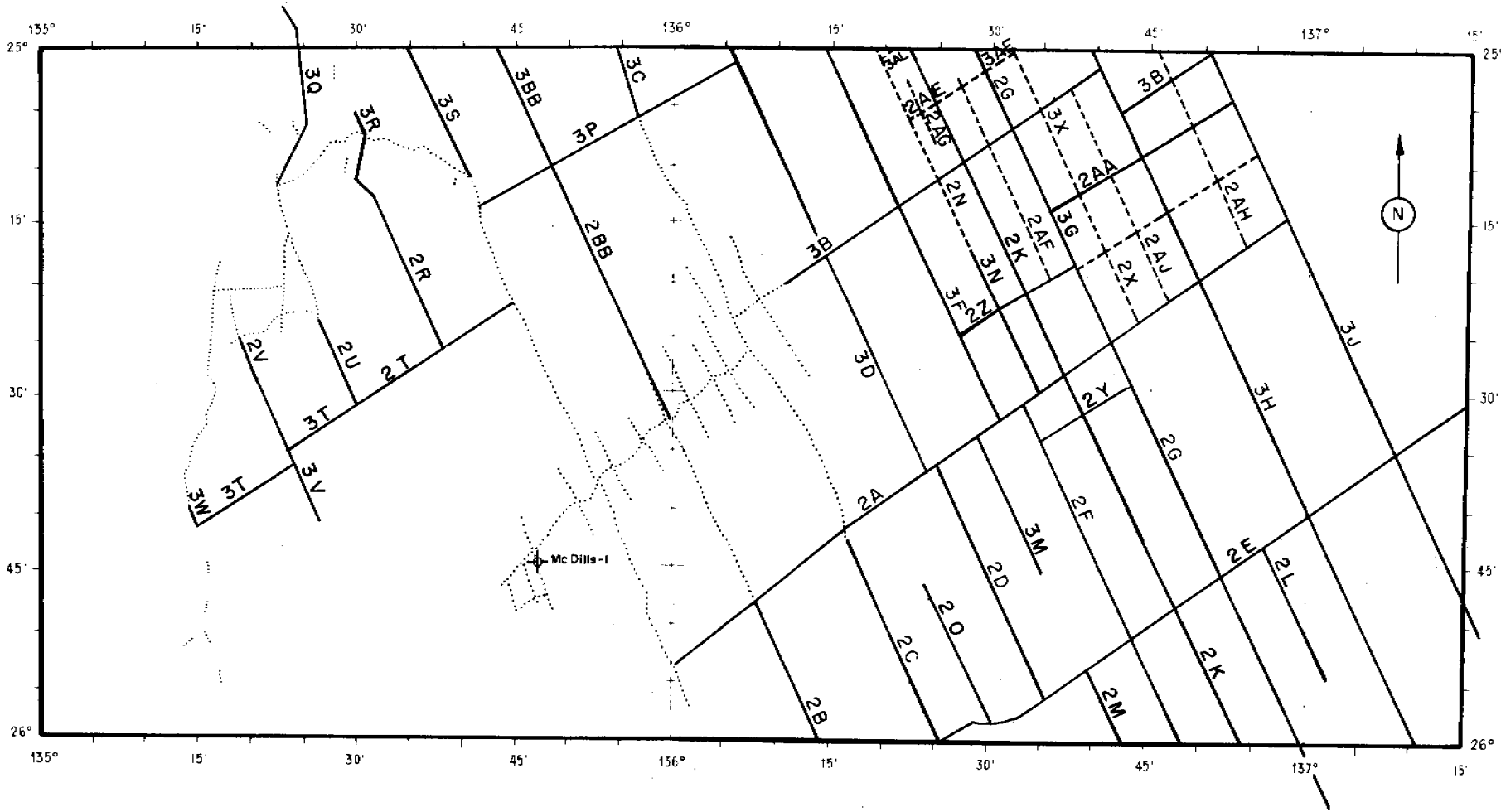
The Peake and Denison fold belt, which is partially represented by McDills anticline, appears to be an extension of a regional tectonic element superimposed along an older hinge line which separated shelf deposition on the west from geosynclinal deposition on the east during the Upper Proterozoic and Lower Paleozoic. Primary orogenic movements along this belt may have begun in the Ordovician but it appears that much of the

"molasse" type detritus found in the adjacent troughs was stripped from the rising orogenic belt during maximum uplift in the Devonian-Carboniferous. Renewed vertical fault movement along the western margin of the fold belt during the Permian and Mesozoic accentuated the relief of this broad feature along a minor new axis, the McDills structural trend. Pronounced thickening of Permian and younger stratigraphic units on the flanks of the McDills structure are evidence of this period of uplift.

The Simpson Sub-basin is a restricted local downwarp similar to the Pedirka Sub-basin. It is limited on the northeast by the Arunta block and on the northwest by the McDills structural trend. A narrow transverse saddle in the McDills structural trend at Permian level may connect the Simpson and Pedirka Sub-basins. Geologically they have probably had similar histories with comparable Devonian?-Carboniferous fill-type accumulations and Permian sections which thicken toward the depositional axes.

PREVIOUS WORK

In 1962 an aeromagnetic survey of the Simpson Desert, including OP 57, was conducted by the Bureau of Mineral Resources and a gravity survey covering most of OP 57, which defined a number of trends, was conducted by Geosurveys. One of these trends was designated McDills anomaly and this was further investigated in 1963 and 1964 by reflection seismic surveys conducted by Geo-seismic for Beach Petroleum No Liability. The seismic program was initiated in the Andado area in October 1963 and was extended into the Anacoora area during the first part of 1964, into the Hale River Floodout area during June and July of 1964 and into the Dakota Bore area during August and September 1964. Reconnaissance seismic coverage was extended into the eastern and northwestern areas of OP 57 between May 28, 1965 and May 15, 1966 when the Simpson Desert "A" Seismic Survey was conducted by Austral Geo Prospectors, Pty. Ltd. for Amerada Petroleum Corporation of Australia Limited (Figure 3). These surveys were all subsidized by the Commonwealth Government under the Petroleum Search Subsidy Act. In neighbouring areas seismic surveys have been conducted by Australian Aquitaine Petroleum Pty. Ltd. in



OP 57

SEISMIC SURVEY INDEX

- – – – – – – Simpson Desert "C" Seismic Survey
- ——————— Simpson Desert "A" Seismic Survey
- ..... Previous shooting by Beach

Figure 3

Northern Territory OP 36, by Mercure International Petroleum, Pty. Ltd. in Op 64, by Flamingo Petroleum and Amerada Petroleum Corporation of Australia Limited in Northern Territory OP 75, by Finke Oil Company Pty. Ltd. in Northern Territory OP 72 and by French Petroleum Company (Australia) Pty. Ltd. in South Australia OEL 21/22.

OBJECTIVES OF THE SURVEY

The objectives of the Simpson Desert "C" Seismic Survey were to obtain semi-detail seismic control over the broad anomalous platform area in the vicinity of Lat. 25°10'S., Long. 136°45'E; to integrate all data from this survey with that of the preceding Simpson Desert "A" Seismic Survey; to further investigate previous indications of pre-Permian structure in the area of the survey and prepare a map incorporating all such data; and to map the configuration and magnitude of indicated structural anomalies for the purpose of selecting drilling locations.

DISCUSSION OF RESULTS

The results of the Simpson Desert "C" Seismic Survey are pre-

sented on the following scale 1:100,000 seismic time structure maps which are submitted with this report:

HORIZON "C"
(Approximate Jurassic De Souza Ss.)

HORIZON "P"
(Approximate Permian)

PRE-PERMIAN DATA
(Unidentified)

ISOTIME OF "C" TO "P" INTERVAL
(Approximate Jurassic De Souza Ss. to Approximate Permian)

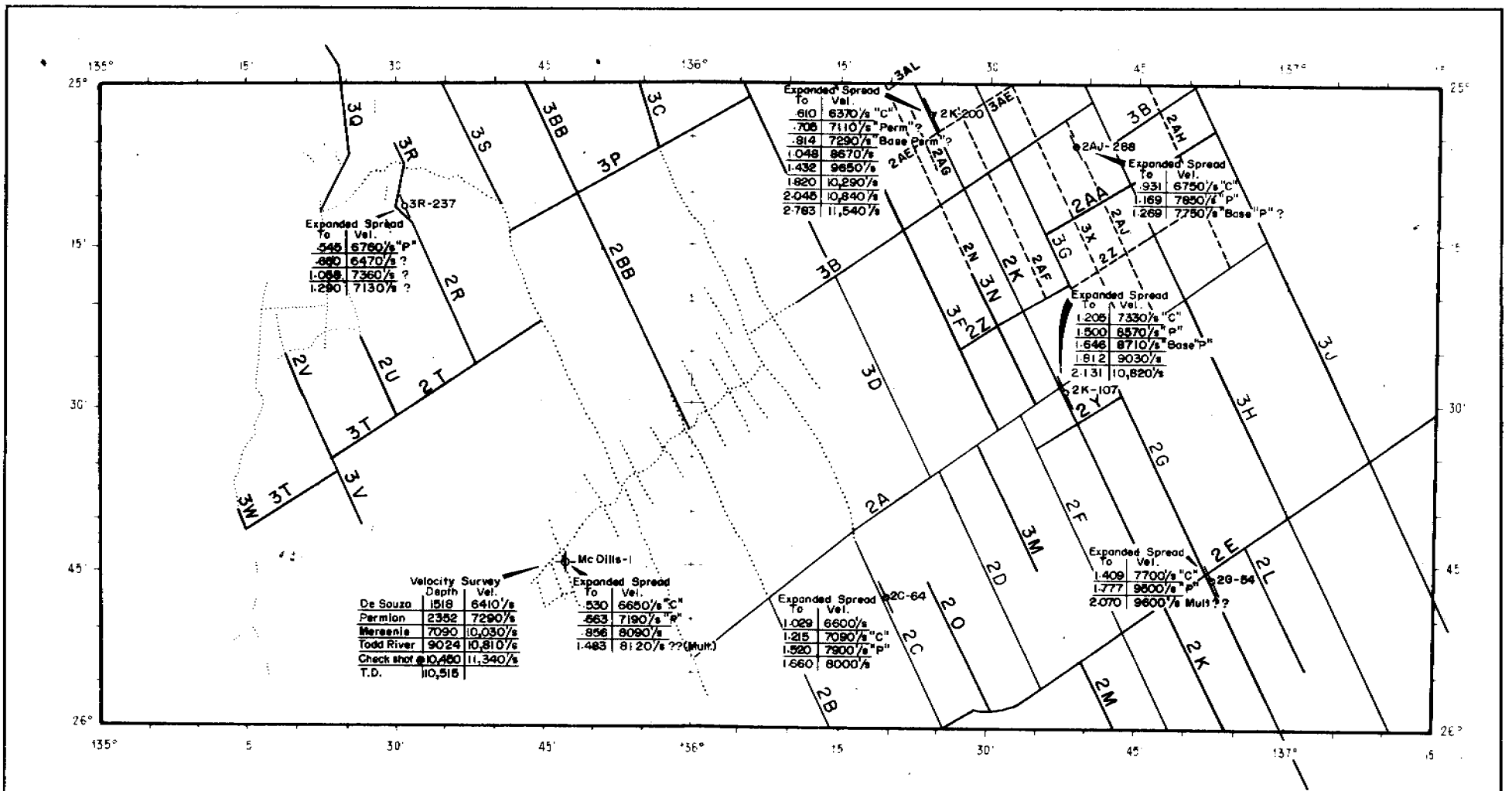
Identification of the stratigraphic units associated with the "C" and "P" horizons is based on ties between this survey and the Dakota Bore Seismic Survey conducted by Geoseismic for Beach Petroleum No Liability and the velocity survey conducted in McDills No. 1 by Amerada Petroleum Corporation of Australia Limited. It is believed, however, that the velocities obtained at McDills are not valid regionally and consequently the maps have been contoured only on the basis of time (Fig. 4).

Seismic events in addition to the mapping horizons were picked and correlated on the record sections but none are as persistent regionally as the "C" and "P" horizons. In general, recognizable pre-Permian events were restricted to the coverage of the Simpson Desert "C" Seismic Survey or immediately adjacent area.

The "C" horizon shows general south dip interrupted by the following relatively large structural anomalies:

(1) A broad anomalous platform area centered at approximately Lat. 25° 10'S., Long. 136° 45'E., the southern and southeastern limits of which are defined by a band of increased dip. A number of small highs are indicated in this area but none exhibit significant northeast dip, the presumed direction of critical closure. Faulting is postulated along the western limits of the platform area.

(2) A large southwest plunging anticlinal feature trending northeast-southwest across the extreme northwestern part of the survey at approximately Lat. 25° 02'S., Long. 136° 17'E. The north-



OP 57
SIMPSON DESERT 'C' SEISMIC SURVEY
EXPANDED SPREADS

- – – – – – – Simpson Desert "C" Seismic Survey
- ——————— Simpson Desert "A" Seismic Survey
- ..... Previous shooting by Beach

Figure 4

west limb is intersected by a normal fault downthrown to the northwest.

(3) A pronounced closed low of considerable areal extent centered at approximately Lat. 25° 23'S., Long. 136°22'E.

(4) A moderately large NE-SW striking anticlinal feature that plunges southwest from about Lat. 25°23'S., Long. 136°30'E. A local flattening is postulated in the crestal area but no significant critical northeast dip was indicated.

The contour configuration at the "P" level is generally conformable with that of the "C" level but usually exhibits greater relief over anomalous areas. It is postulated that an unconformity representing a considerable geologic hiatus occurs between the "C" and "P" mapping horizons and that the "P" horizon is truncated and subcrops up dip near the northern limit of the survey, as designated by the dashed line on the "P" map.

Seismic evidence of pre-Permian sediments is sparse or lacking in much of OP 57 but the Simpson Desert "C" Seismic Survey resulted in a considerable amount of pre-Permian data regarded as

valid, frequently consisting of dip segments of different structural attitude from that of the overlying sediments as mapped on the "C" and "P" horizons. Unfortunately the pre-Permian data were not of sufficient quantity or quality to warrant preparation of conventional structure contour maps on pre-Permian horizons or even a phantom horizon, the major obstacle being indefinite reflection character, segmental reflection continuity, relatively steep dips, probable large faults separating units of discernible data and scarcity or absence of data. Consequently, the most outstanding event of each discernible unit of pre-Permian data was timed, recorded in map form and individually contoured. All inferred pre-Permian structure (fault breaks and anticlinal and synclinal axes) was employed for geologic interpretation of the noncorrelative units to produce the map designated "Pre-Permian Data". In general, the significant structural anomalies indicated on the "C" and "P" maps are also present on the pre-Permian map but locally the geology of the broad platform area is considerably more complex, consisting of numerous small sharply folded anticlinal features separated by probable fault zones.

As noted on the legend of the pre-Permian map, pre-Permian data have not been migrated because of absence of three dimensional control. It is believed that in-line migration of these data would be no more accurate than the accompanying interpretation based upon the unmigrated data, as none of the control can be considered as strike or dip data with respect to the locally-complex pre-Permian structure. Cross spreads on every other shotpoint would be required to make a reliable migration of the pre-Permian data.

In addition to the foregoing structural features, there are a number of smaller anomalies inferred by the contour interpretation of the seismic data that are situated immediately down dip to the south and southwest of the platform area but these features must be considered speculative due to sparse control.

CONCLUSIONS

The semi-detail coverage of the Simpson Desert "C" Seismic

Survey accomplished the objective of delineating areas of interest on the "C" and "P" horizons. The objective of obtaining pre-Permian data was successful to the extent that the general configuration of deep structure was provided.

Respectfully submitted,

AUSTRAL GEO PROSPECTORS, PTY. LTD.

A. J. Schisler

A. J. Schisler, Geophysicist

December 1966

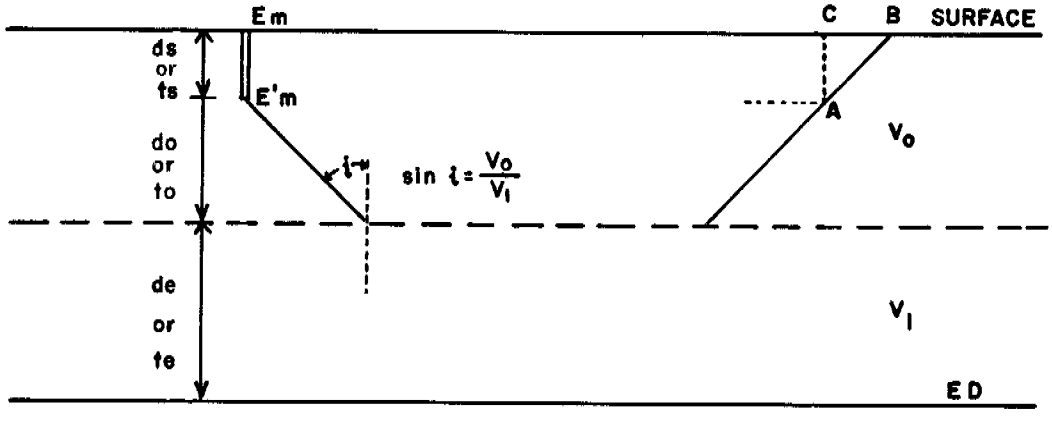
APPENDIX I

CALCULATION AND INTERPRETATION METHODS

Type Corrections Used:

Two layer weathering calculations were employed to determine the average thickness of the unconsolidated sediments present on the surface and to reduce the raw reflection times to a common datum plane. All near surface velocity data were obtained by plotting the refraction breaks recorded from each shotpoint.

Two Layer Weathering Correction



Assumption: Slant ray path AB = vertical ray path AC (uphole time) if ds is small.

APPENDIX I - Continued

CALCULATION AND INTERPRETATION METHODS - Continued

Legend

Em = Average elevation of shotpoint and offset phones

ds = Depth of shot

E'm = Em - ds = Elevation of shot

ts = Uphole time

ED = Elevation datum

Vo = Velocity in first layer

V_1 = Velocity in second layer

Ve = Elevation velocity

T = Intercept time of V_1 plot from refraction breaks

$$do = \frac{(T - ts)\, Vo}{2 \cos\left(\sin^{-1}\frac{Vo}{V_1}\right)}$$

$$de = E'm - do - ED$$

$$To = \frac{do}{Vo}$$

$$te = \frac{de}{Ve}$$

Σt = Total correction for two way travel time from surface to datum

APPENDIX I - Continued

CALCULATION AND INTERPRETATION METHODS - Continued

Corrections

Time Uphole = ts

Estimated weathering below E'm = 2 to

Elevation correction = 2 te

Total correction to datum = Σ t = ts+2to+2te

Magnetic tapes were replayed with both static and dynamic corrections manually applied to produce corrected wiggle trace and variable area presentations of the seismic data.

Interlock Ties:	Datum to Datum
Elevation Datum:	300 feet A. S. L.
Weathering Velocity (Vo):	±3000 feet per second
Elevation Velocity (Ve):	6000 feet per second

Horizons Mapped:

Horizon:	"C"
Time Range:	From .271 to 1.243 seconds
Horizon:	"P"
Time Range:	From .632 to 1.703 seconds
Horizon:	"Pre-Permian Data"
Time Range:	From 1.126 to 2.350 seconds

Interval Mapped:

Interval:	Horizon "C" to "P"
Time Range:	From .203 to .501 seconds

APPENDIX II

PERSONNEL AND STATISTICS

PERSONNEL:

(1) Description of field party.

Crew 2 consisted of a Party Chief, Junior Party Chief, computer observer, junior observer, shooter, two drillers, two assistant drillers, a surveyor, rodman, mechanic, cook, cook's assistant, seven helpers.

Crew 3 consisted of a Party Chief, Party Manager, junior party chief, one computer, an observer, junior observer, shooter, two drillers, two assistant drillers, a surveyor, rodman, mechanic, cook, cook's assistant, six helpers. To this we had a drill supervisor, handling both crews, and a supply truck driver.

(2) List of personnel for each crew including each man's position:

POSITION	CREW 2	CREW 3
P. C.	J. Denham	W. E. Moore
P.M.	-	T. E. Barnard
Jr. Party Chief	C.F. Kous	-
Computers	A.A. Murnieks	B. Carr, A. White
Observer	D. Laing	J. Simpson
Shooter	P. Connors	A. Young
Jr. Observer	R. Sargent	P. Stevens
Drillers	G. White, W. Winters	D. Seabrook, P. Goode
Surveyor	M.P. Van Der Boor	B. Llewelyn

APPENDIX II - Continued

PERSONNEL AND STATISTICS - Continued

(2) List of personnel for each crew including each man's position:

POSITION	CREW 2	CREW 3
Drill Helpers (2)	G. Sadler	I. Tutt
	G. Gregg	J. Trott
Rodman	Graham Smith	R. McGarry
Mechanic	N. Dean	R. Shea
Cook	A. Mayberry	K. Barden
Cook's Assistant	H. Reid	W. Greenwood
Helpers	7	6
Drill Supervisor	W.R. Scheihing	
Supply Truck Driver	J. Clayton	

ALICE SPRINGS OFFICE

Supervisor	E. M. Hoffman
Computer	N. Musk

APPENDIX II - Continued

PERSONNEL AND STATISTICS - Continued

STATISTICS:

RECORDING TIME (Crew 2)

MONTH	TRAVEL	FIELD	RECORD	MOVE	HOLIDAY	LOST	TOTAL
June 1966	40	277	317	-	10	-	327
July 1966	23	130	153	6	-	-	159
Aug. 1966	30	165	195	15	-	-	210
TOTALS	93	572	665	21	10	-	696

RECORDING TIME (Crew 3)

MONTH	TRAVEL	FIELD	RECORD	MOVE	HOLIDAY	LOST	TOTAL
May 1966	8	40	48	5	-	-	53
June 1966	20	100	120	10	10	-	140
July 1966	10	7	17	-	-	-	17
TOTALS	38	147	185	15	10	-	210

TOTAL BOTH CREWS	131	719	850	36	20	-	906

APPENDIX II - Continued

PERSONNEL AND STATISTICS - Continued

STATISTICS: - Continued

		CREW 2	CREW 3	TOTAL
(1)	No. of miles traversed (1320')	121.5	35.75	157.25
	(2000')	12.0	-	12.0
(2)	No. of holes shot	532	145	677
(3)	Average depth and size of shots:	Seven holes, each 20' apart, 10 lbs. in each, i.e. 70 lbs. total at 35 feet (average)		
(4)	Total amount of explosives used:			
	powder	37170	14865	52035
	caps ---	3676	1011	4687
(5)	No. hours spent recording	572	147	719
	hours travelled (recorders)	93	38	131
(6)	No. hours spent drilling	821	200	1021
	hours travelled (drillers)	157	66	223
(7)	No. move hours (Recorders)	21	15	36
	No. Holiday hours (Recorders)	10	10	20
(8)	No. move hours (drillers)	21	15	36
	No. Holiday hours (drillers)	10	10	20
(9)	Total footage drilled	137,041	30,896	167,937
(10)	No. of blade (inserts) bits used	21	11	32
(11)	No. rock bits used	1	-	1
(12)	Starting date	June 2, 1966	May 28, 1966	
(13)	Completion date	Aug. 27, 1966	July 22, 1966	

APPENDIX III

FIELD PROCEDURE AND EQUIPMENT

EQUIPMENT:

(1) Type of Geophones used	EVS Electrotech 30 cps.
(2) Number and type of amplifiers	24 SIE PT 100 (per crew)
(3) Type and number of tape units	1 Fortune unit (per crew)
(4) Description of the recording and shooting units	International 160 trucks, conventional two wheel drive, on both units on each crew.
(5) Description of the shot-hole drilling rigs, types and number of units.	Crew 2 (1) Mayhew 1000, mounted on a 192 IHC 6 x 6 truck, with a Gardner-Denver mud pump, 586 cu. in. air compressor. (2) Mayhew 200, mounted on a 160 IHC truck, with a Gardner-Denver mud pump and an Atlas Copce VG6 air compressor unit. Crew 3 (1) Mayhew 1000, mounted on a 192 IHC truck, with a Gardner-Denver mud pump, 586 cu. in. air compressor. (2) Failing CFD-2, mounted on a 160 IHC 4 x 4 truck, with a Failing mud pump and Atlas copce VG6 air compressor

APPENDIX III - Continued

FIELD PROCEDURE AND EQUIPMENT - Continued

EQUIPMENT: - Continued

(6) A description of other operating equipment

Crew 2
(1) One 6 x 6 IHC water truck
(2) One IHC 180, conventional two wheel drive water truck
(3) Two Toyota Flatbeds, driller and W.R. Scheihing 4 wheel drive.
(4) One Toyota Utility for cables and geophones - 4 - wheel drive.
(5) One Toyota Utility for Surveyor 4 - wheel drive.
(6) One Toyota Land Cruiser Station Wagon, P.C. Car.-4-wheel drive.

Crew 3
(1) One Zeligson, 6 x 6 water truck.
(2) One IHC 180, conventional two wheel drive water truck.
(3) Two Toyota Flatbeds, driller and Tom Barnard. 4-wheel drive.
(4) One Toyota Utility for geophones and cables. 4-wheel drive.
(5) One Toyota Land Cruiser Station Wagon, P.C. Car - 4 wheel drive.
(6) One Land Rover for Surveyor (rented).

APPENDIX III - Continued

FIELD PROCEDURE AND EQUIPMENT - Continued

FIELD PROCEDURE:

(1)	Number of geophones per trace:	16-SP - 15' apart; 7 hole pattern in line with spread, holes 20' apart.
(2)	Geophone connection:	Series Parallel
(3)	Geophone spacing in groups:	16 - SP - 15' apart
(4)	No. of recording channels:	24
(5)	Filter settings for monitor record and tape:	Out - Out
(6)	Filter settings for field playback	31-78 C.P.S. (one section)
(7)	Unmixed on both crews	
(8)	Spreads used:	1320' & 2000', both crews
(9)	Recording method used:	Split spread continuous profiling
(10)	Distance from shot point to close geophone stations:	110' for 1320' spreads 150' for 2000' spreads
(11)	Number of geophone stations adjacent to shot points:	Two

(12) All time lost to various causes made up at end of each work period, except as shown on recording time break down.