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FINAL REPORT

CENTRAL AMADEUS SEISMIC SURVEY

by

E.A. KREIG

REPORT II

November 1974

CONTENTS

SECTION	TITLE	PAGE
I.	ABSTRACT	1
II.	INTRODUCTION	2
III.	PREVIOUS GEOPHYSICAL WORK	4
IV.	REGIONAL SETTING	8
	A. Stratigraphic	
	B. Structural	
V.	OBJECTIVES OF SURVEY	13
VI.*	FIELD OPERATIONS	14
	A. Field Parameters	14
	B. Instrumentation	15
	C. Surveying	15
	D. Equipment	16
	E. Logistics	16
	F. Processing	17
	G. Field Operation Summary and Recommendations	21
VII.	INTERPRETATION	24
	A. General	24
	B. Velocities	25
	C. Maps	27
VIII.	RESULTS OF SURVEY	28
	A. Waterhouse - Ooraminna Area	28
	B. Palm Valley Area	35
	C. Mereenie Area	36
IX.	CONCLUSIONS AND RECOMMENDATIONS	44

(CONTENTS CONT'D)

APPENDICES

A.*	PERMANENT MARKERS
B.*	STATISTICS
C.*	PERSONNEL
D.*	MOHOROVICIC DISCONTINUITY REPORT
E.	SELECTED REFERENCES

* Section prepared by Ray Geophysical Co.

ILLUSTRATIONS

FIGURE

1.	Location Plat (Australia)
2.	Location and Index Map
3.	Amadeus Basin Regional Geology
4a.	Generalized Stratigraphic Diagram
4b.	Summary of Formations
5.	Noise Study
6.	Geophone and Source Arrays
7.	Field Technique - 12 CDP, 140 m.
8.	Field Technique - 12 CDP, 100 m.
9.	Processing Flow Chart

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TABLE I.	Borehole Measurements of Formation Velocities
TABLE II	Formation Well Tops in Feet and Reflection Time below Datum Plane

STRUCTURE MAPS

WATERHOUSE-GORAMINNA AREA--SHEET A

Plate I Top of Pacoota

II Top of Coyder

III Top of Arumbera

PALM VALLEY AREA--SHEET B

Plate IV Top of Pacoota

V Top of Goyder

VI Top of Arumbera

MEREENIE AREA--SHEET D

Plate VII Base of Mereenie

VIII Top of Pacoota

FIELD MAPS *

OORAMINNA AREA

Location and Elevation Map

Horizontal Loop (Closure)

Vertical Loop (Closure)

WATERHOUSE AREA

Location and Elevation Map

Uphole Results

Horizontal Loop (Closure)

Vertical Loop (Closure)

PALM VALLEY

Location and Elevation Map

Uphole Results

Horizontal Loop (Closure)

Vertical Loop (Closure)

MEREENIE AREA

Location and Elevation Map

Uphole Results

Horizontal Loop (Closure)

Vertical Loop (Closure)

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* Prepared by Mandrel Industries

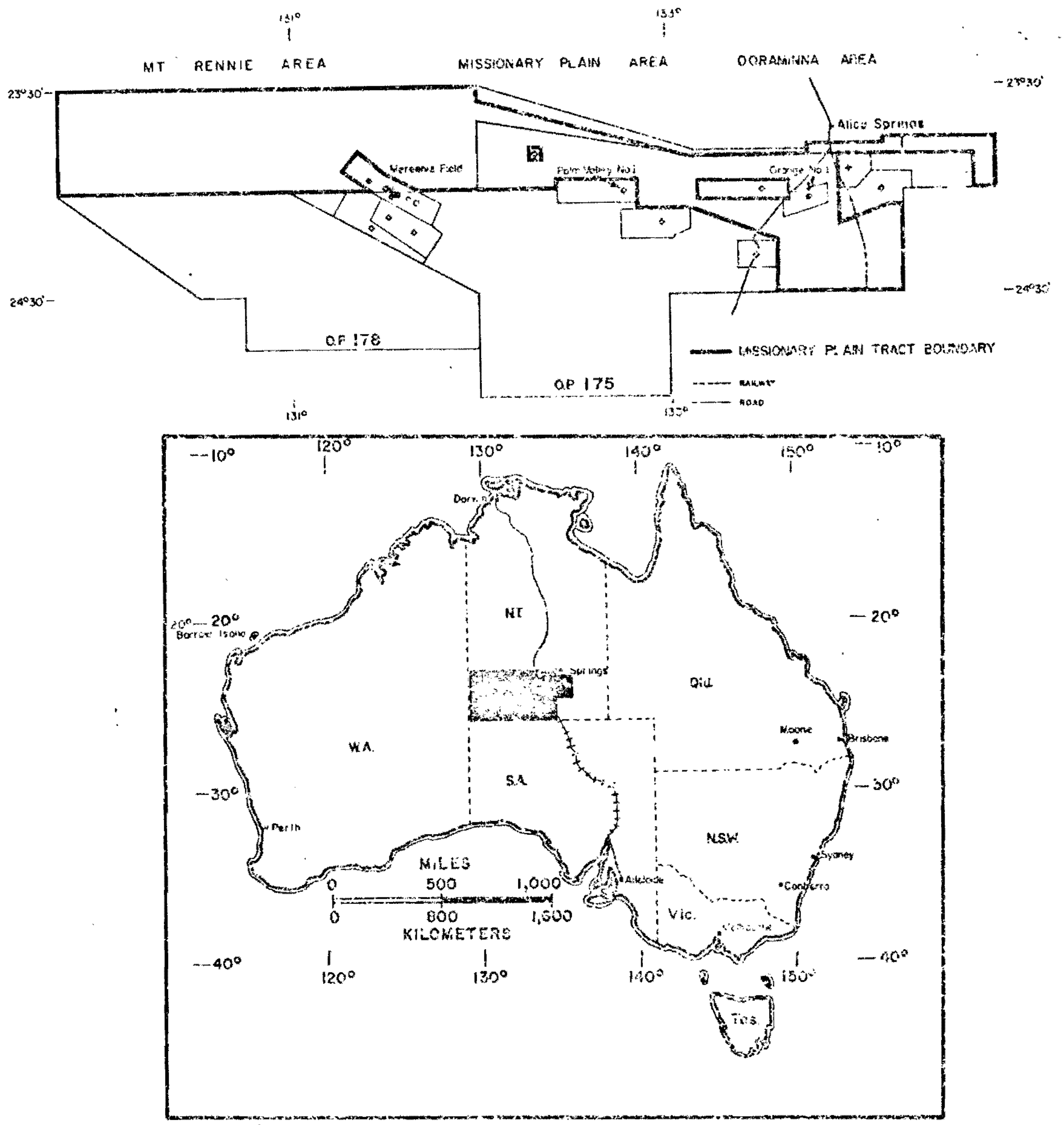

MT RENNIE AREA
MISSIONARY PLAIN AREA
OORAMINNA AREA
Alice Springs
Palm Valley No.1
Mereenie Field
O.P. 178
O.P. 175
MISSIONARY PLAIN TRACT BOUNDARY
RAILWAY
ROAD
23°30'
24°30'
131°
133°
N.T.
W.A.
S.A.
Q'ld.
N.S.W.
Vic.
Tas.
Perth
Brisbane
Sydney
Canberra
Adelaide
Melbourne
Barrow Island
MILES
0
500
1,000
800
1,600
KILOMETERS
10°
20°
30°
40°
120°
130°
140°
150°

FIG. I

A B S T R A C T

In July 1973 a new seismic program was initiated in the Central Amadeus Basin using digital recording of surface input, (weight-drop), and employing a field digital processing unit (ComMand) for early assessment of results. Fill-in and detail work was conducted over parts of Oil Permits 175 and 178, held by Magellan Petroleum (N.T.) Pty. Ltd. Operator, and United Canso (N.T.) Pty. Ltd. to examine structural problems remaining from previous surveys. Field work was concluded on 27 April 1974, after recording and processing 895.24 kilometers of 12-fold common depth point profile.

Results of the survey added to knowledge of structure and faulting in the Alice, Ooraminna, Highway and Waterhouse areas; the Mereenie-Glen Edith fold trend and the NW Gardiner - Mt. Solitary thrust belt. Data in Palm Valley area were useful but contributed little to previous work. Particularly, the economic potential of these several features was enhanced.

As found previously, the quality of data was excellent up to disturbed zones and only in a few cases were reasonably good data obtained either under thrusts or over anticlinal axes.

Progress of the field work suffered from the unusually high rainfall, the dispersed program requiring many camp moves, and more than usual occurrence of mechanical equipment failure.

INTRODUCTION

Early in 1973 plans were made for a seismic program which would augment and add better definition to previous surveys in the Central Amadeus Area.** A number of structural and correlation problems were present which had not been resolved by the single coverage shooting results and several new postulations regarding early (pre-Alice orogeny) warping and deformation had been raised. It was hoped that additional data acquired in 1200% format and digitally processed would assist solutions to these questions.

From tenders by several contractors Ray Geophysical, Mandrel Industries, Inc., (now Petty-Ray Geophysical) was selected for the work. A major factor in this choice was the availability of a Com-Mand field processing system to be installed in Alice Springs which would process data locally within a day or two of acquisition. Thus field parameters and program could be monitored continuously and best use could be made of the seismic party.

The work program was to be over parts of Oil Permits 175 and 178, held respectively by Magellan Petroleum (N.T.) Pty. Ltd. and United Canso Oil and Gas Co. (N.T.) Pty. Ltd. (formerly O.P. 43 and 56). Magellan is Operator.

These permits lie within the northern part of the Amadeus Basin between 23°45' and 25°00' South Latitude and

** See "A Report on the Missionary Plain and Mt. Rennie-Ooraminna Seismic and Gravity Surveys O.P. 43 and O.P. 56 North Amadeus Basin, Northern Territory, Australia, for Magellan Petroleum (N.T.) Pty. Ltd. June 1967."

129°45' and 134°45' East Longitude. In general, the area is south and west of Alice Springs in the southern quarter of the Northern Territory. (Figure 1 and 2). A small amount of work was scheduled within Petroleum Licenses 3 and 4, Mereenie Field Area, which are surrounded by the two permits.

Field work began July 3, 1973 and was concluded April 27, 1974 after completion of 895.24 kilometers of line coverage in 2692.85 hours of operation.

Several additions were made to the program during the course of the survey which were covered by an application for extension submitted to the Bureau of Mineral Resources dated November 16, 1973. Unusually inclement weather was an additional consideration for extension as the progress of the survey was adversely affected by intermittant rains.

Results of the survey have been integrated with those of the previous surveys with a minimum of redundancy. Hence, it is considered desirable to use the previous report, Krieg and Froelich, 1967, in conjunction with this summary. Full use of this report is made herein and portions of it are repeated with any necessary up-dating. Some sections have also made use of the report prepared by the field crew. These are identified herein.

PREVIOUS GEOPHYSICAL WORK

Geophysical work began with the regional gravity surveys by Marshall and Narrain in 1951. In 1957 the BMR extended their north-south line of control from Alice Springs to Giles, Western Australia. Further gravity control was added by the BMR in 1959 and 1960 and an air magnetometer profile was flown from Alice Springs to Giles. A local gravity survey of Gosse's Bluff was run by Frome-Broken Hill Co. Pty. Ltd. in 1958. In 1960 and 1961 further local surveys were carried out at OOraminna structure, Alice prospect and Mereenie anticline. Magellan ran several long traverses in 1961 along various tracks south and west of Alice Springs metering 1,261 stations, and incorporated previous local work by Frome-Broken Hill. A major contribution was made by the BMR helicopter survey in 1961-1962 on a seven mile grid station spacing. (Langron, 1962, and Lonsdale and Flavelle, 1963).

First seismic work was done by the BMR in May to August 1961 (F.J. Moss, Amadeus Basin, Southern Margin, Seismic Survey, N.T. 1961, Record 1962/167), followed in November 1961 by the Palm Valley-Hermannsburg Seismic Survey, Amadeus Basin, N.T. 1962, (Record 1963/5). Namco Geophysical Co. shot over the Alice, Ooraminna and Mereenie prospects for Exoil in 1962. The BMR shot a cross-basin profile from the Gardiner Range through Gosse's Bluff into the Macdonnell Ranges, (Record No. 1964/66). This was followed by the Ooraminna Seismic Survey in July-August 1962, (BMR Record 1966/57).

In 1964 Magellan shot additional seismic control around the northwest half of Mereenie anticline (Patch, J.R. 1964).

In 1965 the BMR made an airborne magnetic and radiometric survey over the greater part of the entire basin.

In 1965 and 1966 Magellan Petroleum (N.T.) Pty. Ltd. conducted an integrated program of seismic, gravity and surface geological work over the Missionary Plain Tract of Oil Permits 43 and 56 (now 175 and 178) in the Amadeus basin, Northern Territory Australia. The survey was carried out in two phases: the Missionary Plain Survey from June 1st to November 27th, 1965; and the Mt. Rennie-Ooraminna Survey from February 18th to December 19th, 1966. The Missionary Plain Survey proceeded on a continuous work basis and resulted in 751½ km of seismic coverage, 2,547 gravity stations and surface geological ties at 21 different sites. The Mt. Rennie-Ooraminna Survey was carried out on a partly continuous work basis and resulted in 1062 km of seismic coverage including 16 km of common depth point shooting, 5,507 gravity stations and surface geologic ties at 15 different sites.

Initial programming called for continuous reconnaissance seismic profiles across the sand and alluvium covered plains tied to outcrops by projection, with correlation of seismic events between lines. Gravity stations were established at each shot point, along access trails and extended laterally. The program was altered as work progressed to permit evaluation of reconnaissance leads in an attempt to define closed drillable prospects. The entire concealed area of the Missionary Plain Tract was covered with widely spaced reconnaissance seismic lines across an east-west distance of some 483 km, with sufficient detail control to define seven potential test locations on closed structures and contribute structural and stratigraphic knowledge to 20 other anomalous subsurface features.

Interpretation of data has defined the gross structure and stratigraphy of the largely concealed northern margin of the Amadeus trough where petroleum prospects are considered to be most favorable. Several elongate, flat-bottomed, asymmetrical synclines, arcuate sub-basins and regional troughs are separated by narrow anticlines, anticlinal ridges, uplifts and domes, many of which are complicated by thrust faulting and diapirism. Large and small thrust faults, common in the Upper Precambrian, Cambrian and Ordovician sedimentary rocks are shown by seismic profiles at Tyler, West Waterhouse, Orange, and West Gypsum, and by gravity anomalies at West Waterhouse, Carmichael-Deering Creek.

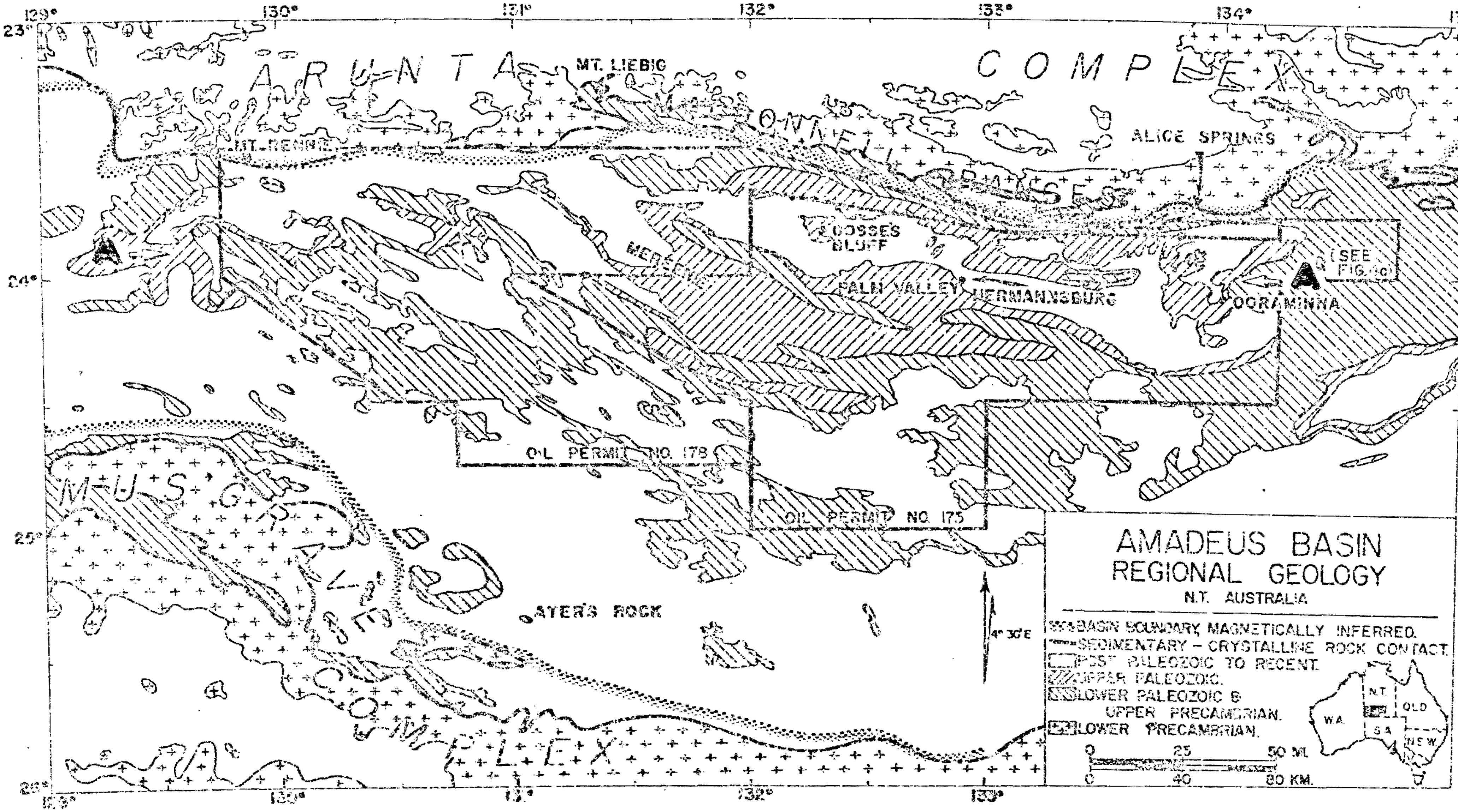
From April to August 1969 the BMR carried out a research seismic and gravity survey of the Gosse's Bluff Area as part of a multidisciplinary investigation which extended over a period of three years in which they were joined by the United States Geological Survey. Brown, 1971, gives a good, detailed account of field proceedures and results (Record 1971/141). The noise spread and the expanded spread shot during this work served as a base for preliminary analyses for determination of field parameters for this survey.

Also during early 1969 a review of velocity data was made by the writer for Magellan Petroleum to incorporate results of a velocity survey at the Tyler hole. Conclusions reached involved a velocity gradient, increasing northward toward the Macdonnell Ranges, which included an increase in near-surface (elevation correction) velocities. As part of the review, a portion of line 2-2, shot points 1 through 22, were transcribed to digital format and reprocessed. A discussion of the results was submitted to Dr. D. A. McNaughton, dated April 10, 1969.

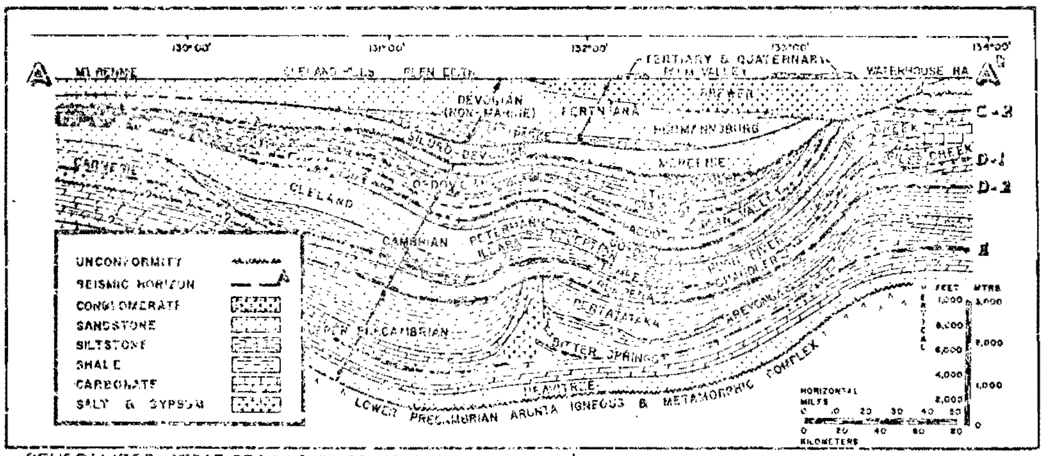
In preparation for the 1973 program certain lines of 100% data obtained by Geophysical Associates Pty. Ltd. in 1965-66, and by Namco for Exoil in 1962, and by United for Magellan in 1964 in the Mereenie area, were digitized and reprocessed in an attempt to improve resolution. This work was done by Seismic and Digital Concepts, Inc., Houston, Texas.

After it was known that a ComMand Processing system would be with the Mandrel crew in Alice Springs, the digital tapes were copied in ComMand format and sent to the crew for re-display. This put all reprocessed data in conformity with the current work and contributed to tying the four periods of surveys together.

FIG. 3



AMADEUS BASIN
REGIONAL GEOLOGY
N.T. AUSTRALIA
BASIN BOUNDARY, MAGNETICALLY INFERRED.
SEDIMENTARY - CRYSTALLINE ROCK CONTACT.
POST PALEOZOIC TO RECENT.
UPPER PALEOZOIC.
LOWER PALEOZOIC & UPPER PRECAMBRIAN.
LOWER PRECAMBRIAN.
0 25 50 MI.
0 40 80 KM.
W.A.
N.T.
QLD
S.A.
N.S.W.
ARUNTA COMPLEX
MUSGRAVE COMPLEX
MT. LIEBIG
MT. RENNIE
ALICE SPRINGS
GOSSES BLUFF
PALM VALLEY
HERMANNSBURG
OORAMINNA
AYERS ROCK
OIL PERMIT NO. 178
OIL PERMIT NO. 175
(SEE FIG. 4c)
4° 30'E
129°
130°
131°
132°
133°
134°
135°
23°
24°
25°
26°



GENERALIZED STRATIGRAPHIC DIAGRAM ALONG LINE A-A' NORTHERN AMADEUS BASIN, N.T., AUSTRALIA

FIG. 4a

AGE	ORIGIN	GROUP	FORMATION AND PREDOMINANT LITHOLOGY (WEST)	(EAST)	THICKNESS	AVERAGE MEASURED DENSITY SURFACE	CORE	Average Velocity of Formation Ft/sec × 10³ *	REMARKS
TERTIARY TO RECENT	CONTINENTAL		Dune Sd, Gvl, Alluv, Ls, Coal, Silcrete, etc.		0-1000'		2.10	5.0±2.0	
DEVONIAN TO PERMIAN?	NON-MARINE; SYNOROGENIC	PERTNJARA	BREWER Cgl, Ss		0-12000'			6.0±2.0 (Est)	
	LACUSTRINE	PERTNJARA	HERMANNSBURG Ss		0-3000'		2.47		
		PERTNJARA	PARKE Siltst, Ss		0-3000'		2.66		
SILURIAN? TO DEVONIAN	AEOLIAN TO DELTAIC		MEREENIE Ss		600'-2500'	2.15	2.40	6.9±1.0	HORIZON 'A'
UPPER ORDOVICIAN	REGRESSIVE MARINE (OSCILLATING)	LARAPINTA	CARMICHAEL Ss, Siltst		0'-500'	2.34	2.34		
		LARAPINTA	STOKES Siltst, Sh, Ls		0'-1600'		2.70	6.6±0.7	
MIDDLE ORDOVICIAN		LARAPINTA	STAIRWAY Ss, Siltst		0'-1830'	2.40	2.53	7.0±2.4	HORIZON 'B'
LOWER ORDOVICIAN	EUXINIC TO TRANSGRESSIVE MARINE	LARAPINTA	HORN VALLEY Siltst, Sh, Dol		0'-800'		2.54	7.2±1.1	HORIZON 'C-1'
		LARAPINTA	PACOOTA Ss, Siltst		300'-3500'	2.47	2.51	7.6±1.2	CAMBRIAN REFLECTION HORIZON 'C-2'
UPPER CAMBRIAN	MAINLY SHALLOW MARINE (SHELF); PARALIC AND DELTAIC IN WEST	PERTAOORRTA; CLELAND Ss	GOYDER Ss, Dol, Sh		0'-1600'	2.60	2.54	8.4±1.1	
MIDDLE CAMBRIAN		PERTAOORRTA; CLELAND Ss	PETERMANN Ss	JAY CREEK (SHANNON) Ls	2500'-6000'	2.66	2.70	8.8±0.4	
		PERTAOORRTA; CLELAND Ss	DECEPTION Siltst	HUGH RIVER Sh			2.69	7.5±1.0	
	MARINE CARBONATE AND EVAPORITIC IN EAST	PERTAOORRTA; CLELAND Ss	ILLARA Ss	GILES CREEK Dol			2.72	8.5±0.8	
		PERTAOORRTA; CLELAND Ss	TEMPE Sh, Siltst, Ls				2.55		HORIZON 'D-1'
LOWER CAMBRIAN		PERTAOORRTA	CHANDLER Salt, Sh, Ls	TODD RIVER Dol	0'-1000'		(1)	7.7±0.7	
	PARALIC-DELTAIC	PERTAOORRTA	ARUMBERA Ss, Siltst		0'-3130'	2.24	2.77 / 2.25	7.5±?	HORIZON 'D-2'
UPPER PRECAMBRIAN (UPPER PROTEROZOIC)	EUXINIC?		PERTATATAKA Cl, Siltst, Sh, Ls		0'-4000'±		2.71		PRECAMBRIAN REFLECTION HORIZON 'E'
	PERIGLACIAL?		AREYONGA Sh, Ss, Dol, Cgl						
	EVAPORITIC		BITTER SPRINGS Ls, Dol, Salt, Sh		7000'±		2.65 (1)	12.0±0.5 (Est)	
	TRANSGRESSIVE		HEAVITREE Qt, Siltst, Dol		2000'±	2.59			
LOWER PRECAMBRIAN	BASEMENT		ARUNTA IGNEOUS AND METAMORPHIC ROCKS			2.6-3.0			

* FROM SONIC LOGS AND WELL VELOCITY SURVEYS

(1) SALT - 2.2, 7.0

SUMMARY OF FORMATIONS, NORTHERN AMADEUS BASIN, AUSTRALIA

FIG. 4b

REGIONAL SETTING

A. STRATIGRAPHIC (Figure 3).

The Amadeus trough is an east-west oriented structural depression comprised of a wedge of sedimentary rocks thickening northward to more than 9,100 meters. It is essentially a basin of preservation containing marine sedimentary rocks of Upper Precambrian to Upper Ordovician age which were derived from deposition on a shallow marine shelf. These are overlain by a sequence of coarse continental clastic rocks of Siluro-Devonian age. The basin is situated between the stable Pre-cambrian crystalline Musgrave Complex on the south and the mobile Arunta Precambrian basement block on the north. East and west margins are less precisely defined as they are overlapped by younger rocks of the Great Artesian and Canning Basins respectively.

The BMR established regional stratigraphic aspects which have been modified and simplified and are summarized on Figures 4a and 4b. Useful stratigraphic summaries relevant to petroleum and geophysical assessments are derived from publications and articles by Stelck and Hopkins (1962) McNaughton (1962) and Ranneft (1963).

In general, Lower Precambrian igneous and metamorphic basement rocks are overlain by Upper Precambrian ortho-quartzite, followed by a conformable marine sequence about 1525 meters thick consisting of cherty algal carbonates, evaporites, shales and local sandstones and conglomerates. The Upper Precambrian is conformably or unconformably overlain by Lower Cambrian sandstone, succeeded by a marine sequence of evaporites, fossiliferous carbonates, siltstones and shales, except along the southern and western margins where Cambrian sandstones predominate. The entire Cambrian sequence is present and averages about 2,100 meters thick. It is overlain gradationally by Ordovician sandstone, siltstone, euxinic shale and minor limestone. The Ordovician ranges from a wedge-edge on the south to more than 2,500 meters thick along the present north-central basin margin.

Indicators of the shallow marine shelf environment include: abundant algal growth with local biostromes common in Upper Precambrian and Cambrian carbonates; sandstones of Cambrian and Ordovician age which are glauconitic and contain ripple marks, cross-laminations, and are churned and burrowed with abundant scolithid tubes; and widespread conquinoid "shell hash" limestone beds in Cambrian and Ordovician euxinic shales. Upper Precambrian gypsum is regionally distributed in isolated outcrops, and is common in probably diapiric cores of anticlines. Thick salt series are present in subsurface sections of the Lower Cambrian Chandler formation and Upper Precambrian Bitter Springs formation. Volcanic rocks are very rare, but thin spilitic basalts occur in Upper Precambrian strata along the eastern and southwestern margins.

A widespread sequence of strikingly cross-bedded, non-marine sandstone, sandy siltstone, and a great wedge of synorogenic conglomerate of Siluro-Devonian (?) age unconformably overlies the marine Ordovician sequence. Although average thickness of these continental clastics is 1,500 meters, they are much thicker and markedly coarser in the foothills of the central Macdonnell Ranges. Scattered outliers of Mesozoic and Tertiary non-marine beds are present. Quaternary sand dunes and alluvium blanket most of the plains.

B. STRUCTURAL

The most striking feature of the Amadeus trough is the presence of large anticlinal structures which parallel the basin margins and extend for tens of kilometers. The BMR has established the regional structural setting (Forman et al, 1966) which is summarized by Young and Shelley (1966, p.10-12). Two major orogenic events have deformed the thick section of sedimentary rocks, the older spanning the Precambrian-Paleozoic time boundary and the younger in the mid-Paleozoic.

The "Petermann Ranges Folding" (Forman, D.J. and Hancock, E.N. 1964, p. 40) resulted in tight isoclinal and recumbent folds and some faults involving basement and Upper Precambrian sedimentary rocks in the extreme south. The intensity of deformation diminishes and dies out northwards probably before reaching the Missionary Plain. Upper Precambrian beds along the southern margin are believed to have been forced northward for tens of kilometers over a decollement surface within the Bitter Springs evaporites.

The post-Devonian "Alice Springs Orogeny" (Forman, D.J. and Milligan, E.N. 1965, p. 38) produced most of the obvious surface structures in Paleozoic rocks. The major fold belt describes a great regional arc gently convex to the south, with individual fold axes trending northwesterly in the west, east-west in the center, and northeasterly in the east (Figure 5). Some of the anticlinal axes demonstrate right-hand en echelon offset on the east and left-hand en echelon offset on the west; regional fold axes tend to converge in the central area. The fold structures are characterized by broad, flat-bottomed synclines and sharp, often asymmetrical, anticlines.

Widespread faulting occurs involving Lower Precambrian basement rocks north of the basin margin. Deformation of the sedimentary sequence is also more intense in marginal areas. The entire sedimentary section in the homocline of the Macdonnell Ranges is steeply south-dipping to overturned, and several nappe complexes have been mapped along this northern margin (Forman, D.J. and Milligan, E.N. 1965 p. 35). Their interpretation suggests that strata overlying the Upper Precambrian Bitter Springs evaporites moved southward by gravitational gliding over a regional decollement within it, producing the Amadeus basin folds. The frequency and wave length of the folds decreases gradually from south to north, apparently as a function of thickness of section involved and depth to the inferred detachment plan in the Bitter Springs.

Major thrust faults are present within the basin; cross faults appear to be few in number and locally related to thrust adjustment. Carbonate and gypsum, correlated with the Upper Precambrian Bitter Springs formation, occurs in the cores of many anticlines, but neither the underlying quartzite nor basement rocks occur in the core of any anticline or along faults within the basin proper.

Contorted Cambrian limestones, which correlate with the subsurface Chandler salt series, occur in many anticlinal cores and in the hanging walls of faults in the southern Amadeus. Geologists of the BMR believe that listric thrusting from the lower decollement surface onto an upper decollement surface in the Chandler limestone may have occurred. A number of structures of probable diapiric origin have been mapped and are discussed in some detail by McNaughton et al (1967) and Cook (1966). Diapirs are thought to have originated in the Precambrian evaporite series, and stratigraphic evidence in overlying formations indicates that these structures persistently influenced local sedimentation and were anticlinal growth structures throughout much of the Lower Paleozoic.

The Amadeus area was epeirogenically uplifted and eroded following the later Paleozoic orogeny and many of the anticlinal structures were deeply breached, occasionally exposing their diapiric cores.

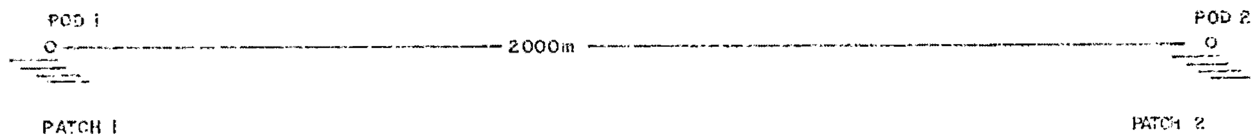
OBJECTIVES OF SURVEY

This survey was planned to investigate further several known structures in an attempt to define possible hydrocarbon traps in fault segments below thrusts, to determine structural trends that may have existed prior to Alice Springs orogeny, and to check the validity of mapped horizons by tying into drilled wells and tying together lines that were previously correlated by reflection character.

Specifically, data were sought on the Waterhouse Range and Mereenie-Glen Edith anticlines, the Alice-Ooraminna complex, the north flank of Palm Valley anticline, the northwest Gardiner Range-Mt. Solitary trend, and the James Range "C" area. Two lines of recording were to determine faulting and stratigraphic unit thicknesses south of James Range "A" but these data were not obtained because of the unusually wet season, which denied access to the area.

Previously recorded single coverage in these areas had yielded very poor to unusable data. It was hoped that multi-coverage digitally recorded and processed data would improve definition of individual drillable structures.

NOISE STUDY
LINE 73-3-1.6
WATERHOUSE



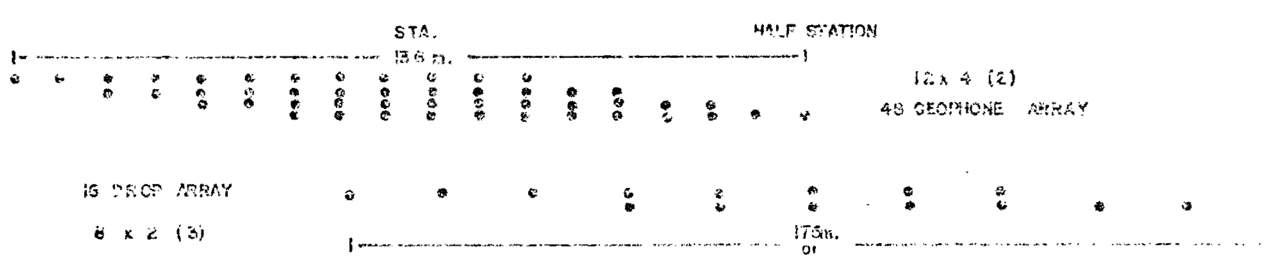
PODS 1 & 2 CONSIST OF 12 GEOPHONES EACH.

PATCHES 1 & 2 ARE 48 GEOPHONE ARRAYS AS SHOWN IN FIGURE 4.

THE WEIGHT TRUCK STARTED AT POD 1 AND MADE ONE DROP PER 10m. INTERVAL UNTIL POD 2 WAS REACHED – A TOTAL OF 201 DROPS.

FIG. 5.

GEOPHONE and SOURCE ARRAYS



GEOPHONE ARRAY IS CENTERED ON STATION
DROP PATTERN IS CENTERED BETWEEN STATIONS

FIG. 6

VI*

FIELD OPERATIONS

A. FIELD PARAMETERS

On July 3rd a noise analysis was conducted along the southern end of line 73-3-1.6 (Figure 5). This was done in order to check the validity of the proposed field technique which had been designed from the analysis of noise parameters taken from data recorded further to the west near Gosse's Bluff. (Brown, 1971).

Examination of this noise analysis revealed that the major noise problem associated with the area was not high velocity boundary waves as indicated near Gosse's Bluff, but multiple refractions of the Meissner type. The velocity of these multiples was approximately 1950 meters per second, which corresponded to the velocity of the boundary waves measured near Gosse's Bluff. Due to this coincidence the proposed field technique was valid even though the type of noise was different.

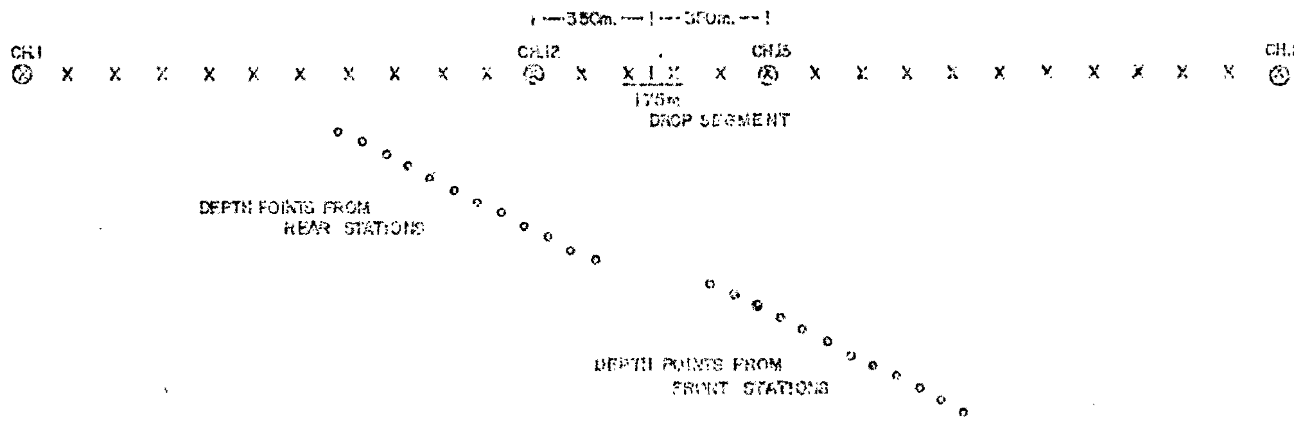
A center weighted 48 geophone array with a total length of 136 meters was employed (Figure 6).

To complement the spatial filter created by the combination of the source and geophone arrays, an electrical filter was used in the recording truck. This filter was a 12Hz (12db) low cut.

A station interval of 140 meters was selected as it not only allowed sufficient offset when used in a split spread configuration, but also permitted efficient usage of the desired geophone and source arrays.

A split spread field technique consisting of a 2½ station

FIELD TECHNIQUE – 12 CDP

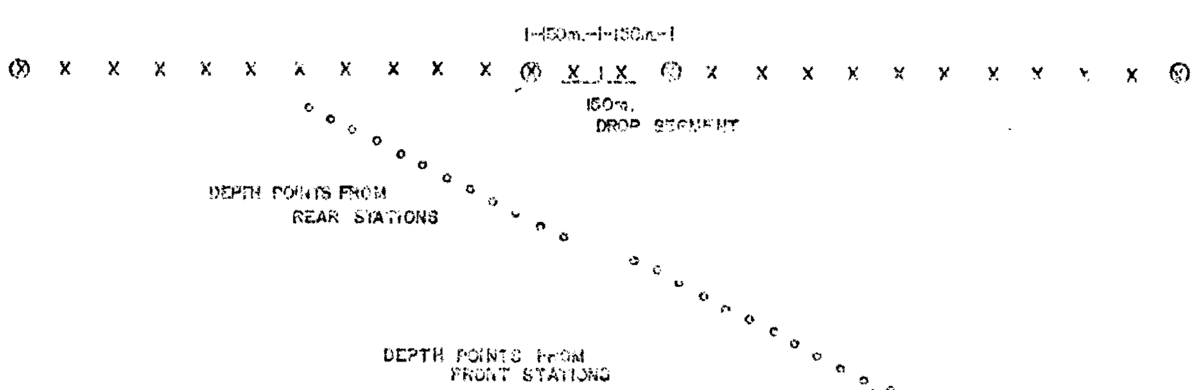


STATION INTERVAL: 140 m.
GEOPHONE ARRAY LENGTH: 136 m.
DROP SEGMENT: 16 drops / 175 m.

INITIAL OFFSET: 350 m.
FAR OFFSET: 1800 m.

FIG. 7

FIELD TECHNIQUE – 12 CDP



STATION INTERVAL: 100 m.
GEOPHONE ARRAY LENGTH: 136 m.
DROP SEGMENT: 16 drops/150 m.

INITIAL OFFSET: 150 m.
FAR OFFSET: 1250 m.

FIG. 8

offset to the near trace was chosen. Offsets were 1890-350-0-350-1890 meters (Figure 7).

The above combination of electrical and spatial filters allowed a theoretical reflection recording band of 12 Hz to 70 Hz with an even attenuation of all coherent noise within this frequency range assuming a horizontal velocity of 2000 meters per second.

Lines 73-3-3.2 ext. were recorded using 100 meter station intervals and a 150 meter drop segment in an effort to improve data quality over a suspected near surface anticline (Figure 8).

Upholes were drilled throughout most of the area as a check on near surface conditions.

B. <u>INSTRUMENTATION</u>

<u>Sum-It Field Recorder</u>

Data were recorded on a 24 channel floating point Sum-It (serial number 24). The output tape consists of a summation of 16 drops in an EPR, mpx 32, format. This tape is 9-track, ½ inch, IBM compatible with a packing density of 800 bpi and is 2400' long. Recording was done for 4 seconds at a 2 millisecond sample rate.

<u>SDA-1 Amplifiers</u>

Minimum fixed gain allowable was 30 db. Over this amount another 90 db of binary gain ranging was permitted in six db steps.

A low cut filter of 12Hz (12 db) was utilized in conjunction with an aliasing filter of 62½ Hz (50 db).

<u>SDW-300 Camera</u>

A SDW-300, dry process, camera was used to display the recorded data.

C. <u>SURVEYING</u>

A K & E transit and a Wild T-2 theodolite were used for the survey. Wherever possible loops were closed and all hanging lines were double run. Elevations and horizontal control were taken from previous surveys, existing triangulation stations, bench marks, and well sites.

Permanent markers were established at intersections and ends of lines. Markers were also established at periodic intervals along the longer lines and at turning points in the line bearing. These markers consist of 5' 6" star pickets with aluminum tags bearing line and station number attached. Appendix A lists all permanent markers and locations.

Vertical and Horizontal Loop Closure maps are included with this report.

D. EQUIPMENT

Vehicular

The crew was equipped with the following vehicles.

One	(1)	Party Manager's Toyota
One	(1)	Observing crew's Toyota
One	(1)	Surveyor's Toyota
Four	(4)	Geophone crew's Toyotas
One	(1)	Bedford-Cable Truck
Two	(2)	Acco Internationals--Water and Supply Trucks
One	(1)	R-190 International with recording hut
Two	(2)	Internationals with Longreach weight dropping units mounted
One	(1)	International with W/shop mounted
One	(1)	D-7 Caterpillar bulldozer
One	(1)	Tractor and float for moving dozer
One	(1)	Caterpillar-12 grader

Cables and Geophones

Twelve (12) CDP cables; 2000' length, medium duty, road type. Four reflection takeouts per cable spaced at 500' intervals. Beside each reflection takeout was located one refraction takeout and one spare takeout.

Geophones: 3360 EV-2A-14 Hz, mounted 12 to a string.

E. LOGISTICS

Bases of Operations

The crew office consisting of the Party Chief. Seismologist, and Computer, plus the ComMand processing center, was established in office space made available by Magellan Petroleum (N.T.) Pty. Ltd.

The field crew's operations were conducted from tent camps located near the center of the program areas.

Access to the prospects was good during dry periods via station and well-site roads.

Terrain

Most of the prospects consisted of relatively open spinifex covered land intersected by occasional bands of scrub timber.

Topography ranged from anticlinal outcroppings such as the James, Gardiner, and Waterhouse Ranges, to gently rolling sand country. Sand dunes were encountered often in the Mereenie prospect.

Dozing

Lines clearance was initially provided by a D-5 dozer. In order to increase the production of line mileage this was replaced by a D-6 dozer and a Cat-12 grader. No problem was incurred in providing sufficient mileage for the recording crew with this combination. The Cat-12 grader was also used to create access roads wherever required.

Weather

Weather was unusually bad, with an abnormal amount of rainfall incurred. A total of 594 hours of time was lost due to inclement weather.

F. PROCESSING

1. Introduction

All data, including the presentation of a provisional final section were processed and displayed on the ComMand on-site digital processing center.

The system is fully integrated and stand-alone in its capabilities. Basically, it is comprised of a RAYTHEON 704 computer, two AMPEX ½ inch nine-track magnetic tape drives, fixed head disc, teletype input, and a GOULD electrostatic printer. A comprehensive software package is provided for use in diagnostic, analytical, bulk processing and display modes.

The ComMand enables rapid inspection of data with preliminary or "brute" stacks available only a few hours after reception of tapes from the field recorder. Minimum turn-around with maximum effort is a feature of the ComMand, with co-operation and supervision by the interpretation team encouraged at all stages of the operation.

2. Data Quality

Processed data were generally good to excellent in the Waterhouse and Palm Valley prospects, with marked deterioration encountered in areas of rugged surface terrain and outcroppings.

In the Mereenie and Alice Springs prospects, record quality ranged from excellent across synclinal troughs and anticlinal flanks to poor over the associated anticlinal crests and inferred structural disturbances.

3. Processing Parameters

Processing parameters employed were subject to extensive pre-use scrutiny and testing, both before and after stacking. A generalized processing flow chart is enclosed (Figure 9).

After reformat of the field tape, a double action amplitude recovery routine was applied consisting of a synthetic amplitude recovery and digital AGC. The output was subjected

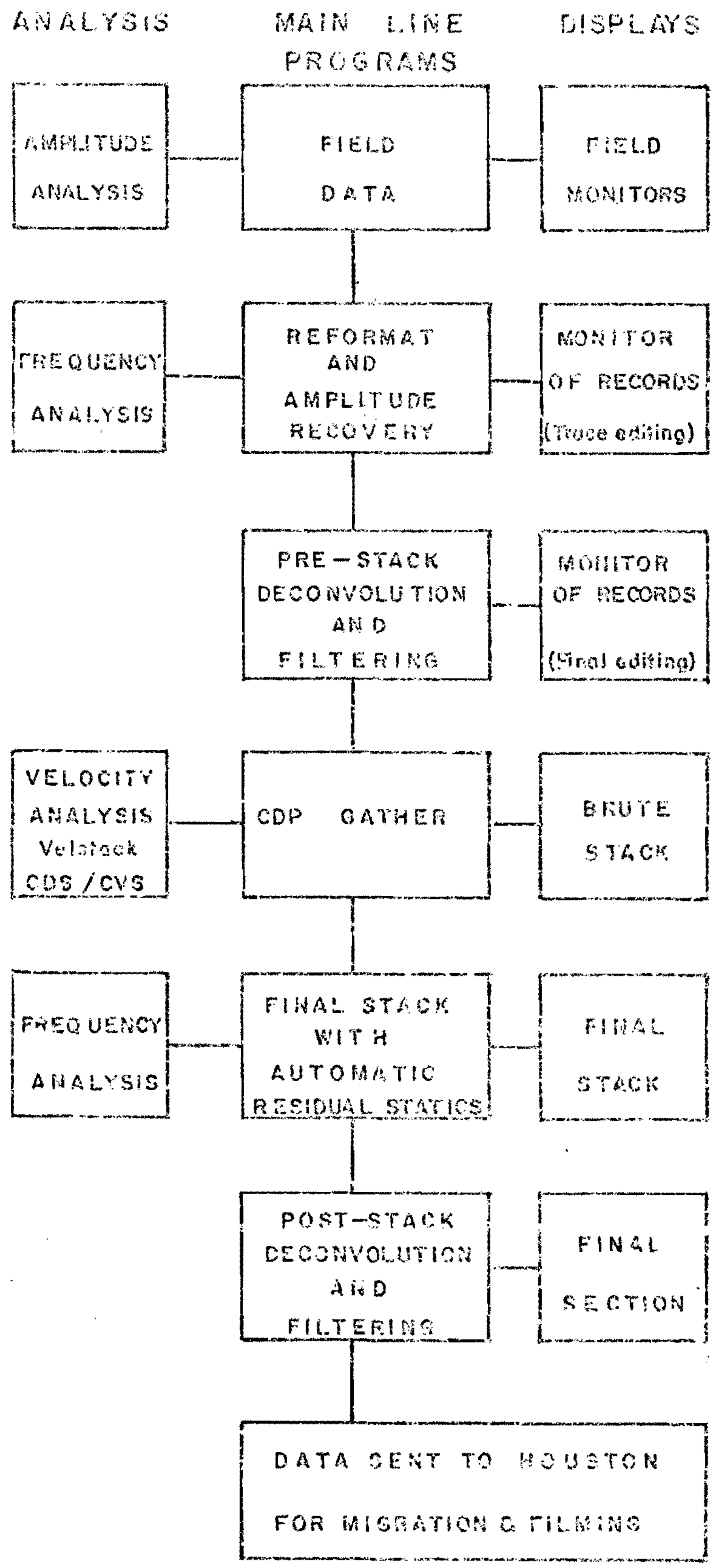

ANALYSIS
MAIN LINE PROGRAMS
DISPLAYS
AMPLITUDE ANALYSIS
FIELD DATA
FIELD MONITORS
FREQUENCY ANALYSIS
REFORMAT AND AMPLITUDE RECOVERY
MONITOR OF RECORDS (Trace editing)
PRE-STACK DECONVOLUTION AND FILTERING
MONITOR OF RECORDS (Final editing)
VELOCITY ANALYSIS Velstack CDS / CVS
CDP GATHER
BRUTE STACK
FREQUENCY ANALYSIS
FINAL STACK WITH AUTOMATIC RESIDUAL STATICS
FINAL STACK
POST-STACK DECONVOLUTION AND FILTERING
FINAL SECTION
DATA SENT TO HOUSTON FOR MIGRATION & FILMING

FIG. 9

to a series of frequency analyses both in the time and frequency domains utilising autocorrelogram plots and power spectra. From these investigations a pre-stack deconvolution pass was determined and applied using a 0.160 sec (later increased to 0.200 sec) operator in the frequency domain. This process was designed both to "whiten" the frequency spectrum over the expected signal range and to attenuate any short period reverberations in the data originating in the low velocity surface layers.

Following deconvolution, a bandpass filter was applied with the purpose of band limiting the frequency spectrum to the desired range determined by examination of computer SIGNAL/NOISE ratios.

Normally the next stage consisted of producing a "brute" stack enabling preliminary interpretation to begin. Following the presentation of a preliminary stack analytical work was carried out in an effort to achieve optimum NMO determination with emphasis placed on velocity control over structural highs. Tools employed consisted largely of VELSTACK (a constant velocity stack program) and CDS/CVS (common distance traces output with a suite of constant velocities). Reliability is considered good with acceptable ties effected to available well logs. Velocities are generally high with near surface velocities ranging from 3000 to 4000 metres/sec.

Following velocity determination, a series of corrected gathers were run in order to design an effective trace suppression or muting function to remove unwanted head waves, refracted energy and first break noise ahead of the true reflected signal.

Application of an automatic residual statics routine (statcor) followed which served to further refine the stacked output.

Post-stack processing included the extensive utilization of long period time domain predictive deconvolution using operator lengths determined after examination of sectional autocorrelograms (SAC), while a final digital filter was applied after careful examination of Multiple Filter Scans and Signal Power Spectra (AUTOFILT) to achieve optimum resolution and continuity.

Sections were produced at each stage of processing with a provisional final section presented soon after completion of each line.

Periodically copies of final processed data for completed lines were shipped to Houston where migration, if required, and final filming of each line was completed.

4. Experimentation

Apart from analytical experimentation during normal production processing, certain items or interest were selected for special studies. These items included examination of production source and receiver array responses using a range of horizontal velocities encountered throughout the area as well as the effect of field filters on the recorded signal.

Conversion of section stacking velocities to interval velocities, true average velocities and implied depths, particularly on lines adjacent to the Mereenie anticline, gave valuable additional data to aid interpretation of structurally complex crestal lines.

Additional experimentation specifically directed at these complex lines included UP-DIP and DOWN-DIP stack comparisons and in certain cases running a suite of stacks of decreasing CDP multiplicity (by progressively discarding long distance traces) to investigate the effect of depth point dispersion in regions of strong dip.

Another interesting piece of experimentation involved the processing of seismic data recorded to 13 seconds duration in an attempt to record the Mohorovicic Discontinuity. A copy of the report is included (Appendix D).

G. FIELD OPERATION SUMMARY AND RECOMMENDATIONS

Waterhouse, Palm Valley, and Mereenie

Data were of good quality except where program approached or transversed surface anticlines formed by Hermannsburg or Mereenie Sandstones. Data deteriorated drastically in these areas with quality ranging from poor to "no record."

Examination of data recorded in the vicinity of such anticlines revealed a high degree of coherent horizontal energy ranging from 5000 meters per second to 200 meters per second. This noise was of such high velocity that no attenuation was inflicted by the geophone and source arrays over the reflection bandwidth, which thereby prevented the recovery of signal.

One explanation for the proliferation of horizontal noise in the anticlinal areas is to theorize a high degree of minor fracturing in the Hermannsberg and Mereenie Sandstones which would act as point sources for near surface diffractions which are propagated horizontally.

It is suggested that long source and geophone arrays be employed with a split spread technique using a station interval of 50 meters. Offset would be 625-75-0-75-625 meters. Arrays should be of sufficient length to attenuate the high velocity horizontal interference which was prevalent in the anticlinal areas. This would necessitate severe ground mixing of arrays due to the short station increment, but no harm should result.

Ooraminna

This area differs considerably in nature from the others. Two problems, probably interrelated, were encountered which caused a marked reduction in data quality.

A major weathering channel and its associated tributaries crossed the northern half of the program area. Due to this, an abrupt change of statics is required if proper datum corrections are to be made. Using first breaks taken from the field records it was estimated that this channelling could approach 700 meters in depth as compared with a normal thickness of weathering of 50-70 meters.

Within the area of deep weathering multiple refractions of high intensity disrupted data with a resulting deterioration of quality. In an effort to increase the effective stack before having to remove refraction interfered data by muting during processing, it was decided to reduce the station interval to 100 meters in order to decrease the total offset. This produced an offset of 1250-150-0-150-1250 meters. Both shallow and deep reflections were improved with this spread when employed on lines 73-4-1.9 ext. and 73-4-2.2.

This area is interesting both geologically and geophysically and two recommendations are made for any future seismic surveys. A dynamite refraction crew should be utilized to obtain static corrections, particularly for all work done north of the Alice Springs No. 1 well.

Station interval should be reduced to a maximum of 100 meters and preferably to 70 meters. Source and geophone arrays should be increased in length to attenuate the multiple refractions. This would create considerable ground mixing of arrays, but should greatly enhance data quality.

VII

INTERPRETATION

A. GENERAL

Base maps used for the previous survey were modified and adapted for this survey. Essential changes were in scale, from 1:120,000 to 1:100,000, and grid system; the new meter coordinate system replaced the previous 10,000 yard transverse mercator grid. These base maps display much of the surface geology as taken from the 1:250,000 geological series as prepared by the Bureau of Mineral Resources and few changes were made to these data. The old maps were designated Sheets A, B and C, and the new sheets use the same code except that Sheet C is labeled "D" because of its reduced area. The borders have been adjusted to accommodate better the additional shot grid. An index for the sheets as well as an index for the geological series is shown on Fig. 2. (Location and Index Map.)

Almost all of the new work is interior to the previous control so former horizons were carried in the new mapping. Where necessary, adjustments were made and, in some cases, additional or different horizons were run on the old lines. In Ooraminna and Palm Valley Areas, Sheets A and B, better identification of the Arumbera necessitated new picking on the old sections. For other horizons an interval adjustment was made where necessary.

In the Mereenie Area, Sheet D, the Base of Mereenie horizon, as identified on the new sections, was carried to the old work and the latter were revised.

Table I

BOREHOLE MEASUREMENTS OF FORMATION VELOCITIES

Abbreviations: VS=Velocity Survey; AL=Accoustic log; SL=Sonic log.

Fm.	Source	Thickness ft.	m.	Vi (Interval) ft/sec	m/sec	Reliability
MEREENIE						
Alice No.1	AL	950	290	11,600	3536	good
Orange No. 1	VS-AL	1120	341	14,600+	4450	fair
PV No. 1	VS-SL	2192	668	15,600	4755	fair
Tyler No.1	VS	2950	900	17,628	5377	good
E. Mereenie No.2	SL	1825	556	13,500	4115	poor
W. Waterhouse	AL	1005	306	15,700	4785	fair
P.V. No.2	SL	2294	699	15,875	4039	good
STOKES						
P.V. No.1	VS	1037	316	13,900	4237	fair
E. Mereenie No.2	VS-AL	1013	309	13,500	4115	good
W. Waterhouse	AL	129	39	13,094	3991	--
P.V. No.2	SL	1121	342	14,500	4420	good
P.V. No.3	SL	1109	338	14,500	4420	good
STAIRWAY						
P.V. No.1	VS	1087	331	17,600+	5364	poor
E.Mer. No.2	VS-SL	174	53	17,400	5304	--
W. Waterhouse	AL	1140	347	15,600	4755	fair
P.V. No.2	SL	969	295	15,126	4611	good
P.V. No.3	SL	1007	307	15,900	4846	good
HORN VALLEY						
P.V. No.3	SL	330	101	13,636	4156	fair
W.Waterhouse No.1	AL	246	75	14,200	4328	fair
W. Mer. No.2	AL	230	--	--	--	--
PACOOTA						
Alice No.1	AL	887	270	13,700	4176	fair
Orange No.1	VS-AL	1567	478	15,400	4694	--
P.V. No.1	AL	1080+	329+	15,500	4724	--
W.Waterhouse	AL	655+	198+	15,625	4763	fair
P.V. No.3	SL	1183	361	16,150	4923	good
E.Mer. No.1	SL	1036	316	--	--	--
GOYDER						
Alice No.1	AL	856	261	16,000	4877	--
Orange	VS-AL	923	281	17,500	5334	
JAYCREEK						
Alice No.1	AL	1220	372	17,200	5243	fair
Orange	VS-AL	851	259	17,700	5395	fair
Highway No.1	AL	540	165	12,000	3658	poor
HUGH RIVER						
Alice No.1	AL	640	195	16,600	5060	--
Orange	VS-AL	966	294	17,000	5182	poor
Hwy. No.1	AL	2018	615	14,000+	4267	--
James Ra. "A"	AL	1175	358	16,080	4901	--
ARUMBERA						
James Ra. "A"	AL	390	119	14,706	4482	good
AREYONGA						
James Ra. "A"	AL	180	55	17,544	5347	--
GILES CREEK						
Alice No.1	AL	870	265	18,000	5486	fair
Orange	VS-AL	842	257	17,400+	5304	poor

B. VELOCITIES

Velocity surveys are available for only four deep holes in the area: East Mereenie No. 2; Palm Valley No. 1; Orange No. 1; and Tyler No. 1. On most other tests sonic or acoustic logs were run, usually over restricted intervals.

A tabulation of interval velocities derived from velocity surveys and sonic-acoustic logs is given for the various formations in Table I. Many velocity analyses were plotted from the digital data, but discrimination between formations on this basis was not apparent. In areas of less than very good reflection continuity it was desirable to use a constant velocity scan to choose the best stacking velocities.

Although outside the coverage of this recent work it may be well to note that results from the Tyler velocity survey indicated much higher interval velocities in the Mereenie formation than were anticipated. Cores from the well were found to have infilling of pore space by anhydrite (and other (?) secondary minerals) which could account for the abnormally high velocity.

A comparison of the curves for average velocity to top of Pacoota shows: Orange No. 1--14,000 ft/sec; Palm Valley No. 1--14,700 ft/sec. and East Mereenie No. 2--13,650 ft/sec. Below this stratigraphic depth, Mereenie and Palm Valley have only small increases of velocity in the Pacoota section while at Orange the velocity data shows a substantial increase to 14,800 ft/sec. at the base of Pacoota, and continues to increase to 16,100 ft/sec. at total depth in the

Table II

Mereenie No. 1
TD 3983 (1215m)
KB 2583 (788m)

Fm	log d	sub-datum	tr ms
Mereenie	surf		
Stokes	1531	748	107
Stairway	2570	1787	255
Horn Va.	3400	2617	374
Pacoota	3630	2847	407
TD	3983	3200	---

E. Mereenie No. 1
TD 4710 (1737m)
KB 2529 (771m)

Fm	log d	sub-datum	tr ms
Mereenie	surf		
Stokes	1500	771	103
Stairway	2516	1787	247
Horn Va.	3328	2599	370
Pacoota	3550	2821	404
Goyder	4615	3886	527
TD	4710	3981	---

E. Mereenie No. 2
TD 5175 (1578 m)
KB 2357 (993 m)

Fm	log d	sub-datum	tr ms
Mereenie	surf		
Stokes	2078	1521	217
Stairway	3106	2549	364
Horn Va.	3883	3326	475
Pacoota	4060	3527	504
Goyder	5105	4548	650
TD	5175	4612	658

E. Mereenie No.3
TD 5215 (1591 m)
KB 2532 (772 m)

Fm	log d	sub-datum	tr ms
Mereenie	surf		
Stokes	2677	1945	278
Stairway	3834	3102	443
Horn Va.	4668	3936	524
Pacoota	4902	4170	562
TD	5215	4483	652

E. Mereenie No. 4
TD 8750 (2669 m)
KB 2368 (722 m)

Fm	log d	sub-datum	tr ms
Mereenie	surf		
Stokes	1862	1294	214
Stairway	2891	2323	368
Horn Va.	3706	3138	478
Pacoota	3918	3350	506
Goyder	4954	4386	628
Peter'n	5676	5108	--
Decpt'n	6395	5827	--
Illara	6930	6362	--
Tempe	7586	7018	912
Bit. Spgs.	8380	7812	996
TD	8750	8182	1036

W. Mereenie No.1
TD 5504 (1679 m)
KB 2482 (757 m)

Fm	log d	sub-datum	tr ms
Mereenie	surf		
Stokes	1440	758	108
Stairway	2598	1916	273
Horn Va.	3450	2768	395
Pacoota	3708	3026	432
Goyder	4803	4121	589
TD	5504	4822	---

W. Mereenie No. 2
TD 4997 (1524 m)
KB 2535 (773 m)

Fm	log d	sub-datum	tr ms
Mereenie	surf		
Stokes	1840	1105	158
Stairway	2906	2171	310
Horn Va.	3736	3001	429
Pacoota	3966	3231	462
TD	4997	4262	609

NW Mereenie No. 1
TD 5000 (1525m)
KB 2402 (733m)

Fm	log d	sub-datum	tr ms
Mereenie	surf		
Stokes	1750	1148	164
Stairway	2945	2343	335
Horn Va.	3845	3243	463
Pacoota	4220	3618	517

Alice No. 1
TD 7518 (2293m)
KB 1753 (535m)

Fm	log d	sub-datum	tr ms
Mereenie	1165	1212	236
Pacoota	2115	2162	394
Goyder	3004	3051	520
Jay Ck	3858	3897	621
Hugh R	5060	5107	762
Giles	5730	5777	844
Arumbera	7240	7287	1020
TD	7518	7565	1048

Orange No. 1
TD 8886 (2710 m)
KB 1938 (591 m)

Fm	log d	sub-datum	tr ms
Pertn	surf		
Mereenie	940	802	064
Pacoota	2413	2275	344
Goyder	3880	3742	518
Jay Ck	4803	4665	637
Hugh R	5654	5516	738
Giles Ck	6620	6482	852
Chandler	7462	7324	920
Todd R	8210	8072	1005
Arumbera	8294	8156	1012
TD	8886	8748	1080
Pertata			1164?

W. Waterhouse No. 1
TD 6528 (1991m)
KB 2214 (676m)

Fm	log d	sub-datum	tr ms
Brewer	surf		
Hermansbg	2200	1786	310
Mereenie	3353	2939	440
Stokes	4358	3944	568
Stairway	4887	4473	650
Horn Va.	5627	5213	746
Pacoota	5873	5459	774
TD	6528	6106	856

Extrapolated

Fm	log d	sub-datum	tr ms
Goyder	7273	6850	949
Jay Ck	8196	7782	1064
Hugh R	8996	8582	1164
Arumbera	10096	9682	1390

Arumbera formation. A velocity function for Orange has been computed to be 12,590+ 1.26 Z to 4,500 feet, (in Lower Goyder), with constant velocity of 17,800 ft/sec. below this depth.

Near-surface velocities were measured by uphole surveys and first break refraction analyses. The holes were normally drilled to 50 to 70 meters and several shots were fired to the surface geophone. Locations of the uphole surveys and velocities recorded are shown on the uphole maps prepared by Mandrel Industries. (See Section VI.)

C. MAPS

Mapping in reflection time was carried over the several areas and at several horizons. The Top of Pacoota horizon is common to all three sheets. Subsurface ties to several wells support the identification. In the eastern areas, (Sheets A and B), the Top of Goyder and Top of Arumbera are mapped with ties to the well tops at Alice No. 1 and Orange No. 1.

In the western, Mereenie Area, the Base of Mereenie horizon is identified by projection into outcrops and by estimate of interval thickness. The Pacoota horizon is identified by correlation, section thickness estimates, and projection into outcrops as well as rather poor ties to several wells. Very poor data on the flanks of Mereenie structure raise some doubt about horizons carried into adjoining synclines.

Virtually all of the interpretation work was done on the final field sections as received from the crew in Alice Springs. Migrated sections were made in Houston by Mandrel Industries from copies of final field tapes for all dip-lines and these were used for better examination of steep-dip and faulted areas. Other lines, principally strike lines, were re-displayed on film without migration.

Preference for the field sections was based on two factors: First, the time delay of the Houston sections; and, second, the scaling and balance of the field output was preferred to that of the Houston sections.

VIII

RESULTS OF SURVEY

A. WATERHOUSE-OORAMINNA AREA (SHEET A) (PLATES I, II, III)

Seismic program in this area was designed to gain extra information on: i. - The Waterhouse thrust fault which could contain productive reservoirs in the lower plate; ii. - The Alice structure, largely unknown because of very poor data; iii. - The nose of the west side of Ooraminna, toward Orange structure; iv. - The possible reversal of dip, north of the Highway No. 1 hole and on strike with James Range "A" structure. (Poor data on GAI line 3 - 2, provided no satisfactory tie to the Highway hole.)

1. Waterhouse Anticline

Four dip lines were run into the south side of Waterhouse Range, one through the Hugh River gap to the north flank outcrops and one across the west end near the West Waterhouse test well. On line 73-3-1.6 the fault probably cuts the Pacoota formation below surface drop point 152 with very little upturning below the thrust. Deeper formations are unfaulted. On line 73-3-1.5 the Pacoota turns up strongly but is not cut by the fault before the end of the profile at point 193. Deeper horizons, particularly the Arumbera, appear to be broken by imbricate strands and at about the Pertatataka/Bitter Springs level, (1.5/1.6 seconds), a listric thrust crosses the entire section disrupting a reflection between 1.4 and 1.5 seconds below point 150. This thrust then parallels the bedding until it breaks upward again through the base of the Arumbera at point 105/106.

On line 73-3-2.3, all beds turn upward strongly but with only poor evidence of faulting at the Top Pacoota horizon below point 261.

Line 73-3-3.3S turns upward also but data at all horizons deteriorate as the Hugh River Gorge is entered. Projections of surface dips into the seismic section indicate no horizontal displacement on the thrust.

On line 73-3.4, the strong up-turn deteriorates with loss of stack and shows no evidence of the fault.

Line 73-3-3.6, the anticline is crossed outside the outcrop area with excellent continuity of reflections except at the fault crossing, point 137 for the Pacoota and point 142 for the Arumbera. Vertical and horizontal displacement are apparent but die out rapidly in the younger section. The Mereenie formation, about 800 meters shallower than the Pacoota, appears to be unfaulted. The diapiric core of the structure is well displayed on this line, particularly on the migrated section, at a depth of 1.8 to 2.1 seconds.

The strike line 73-3-AEX was placed to try to determine local highs in the lower plate and to tie horizons on the dip lines. No east-west tie existed from the previous work. Over much of the east part of the line above the Pacoota are badly disrupted, and the Top of Pacoota reflection, too, west of point 190. The deeper Cambrian and Pre-Cambrian reflections remain of good character and strength. This is considered to be evidence in support of the Waterhouse fault.

Over the western part of the line the shallow reflections are as good as the deeper. Only a slight disruption at Top of Pacoota level near point 400 indicates a possible fault break.

Previous work by G.A.I., (lines 3-4 and 3-5), indicate the position of the fault to the west where it dies out before reaching line 2-0. A strand of this fault was mapped as trending northwest across line 3-C near its intersection with 3-3.75, thereby separating the subsurface nose from the exposed rocks within the Range.

Data on line 73-3-3.6 do not support this fault or the fault farther north. Both have been removed and the area recontoured.

The West Waterhouse No. 1 test was drilled on the premise that the structural nose was cut off by faulting to form a closure. The fresh water found in the Mereenie sand stone indicates a continuous conduit to the surface, while saltwater in the stairway and Pacoota formations, (plus a minor gas show in the Stairway), furnish some evidence for a barrier to the outcrops. The test hole is located down the nose and it is possible that a structurally higher position, about five to six kilometers eastward, would find gas in the Pacoota formation. The small size of the possible reservoir, however, may dictate against the economics.

Two small closures in the footwall, or lower plate, under the Waterhouse fault are mapped. The first is the previously named Southeast Waterhouse, at the northern ends of lines 73-3-1.5 and -1.6. The second is located south of the west end of Waterhouse Range surface expression and is formed by the arcuate trace of the Waterhouse thrust fault. Both closures are small in areal and vertical dimensions, being eight to ten kilometers in length, up to two kilometers in width and with about 100 ms., (250m.), of vertical closure at Pacoota level. The shape and extent of the closures change slightly at the Goyder and Arumbera horizons. Separation of the Southeast Waterhouse feature from Orange structure is poor on line 73-3-1.6.

2. James Range East

Line 73-3-2.2 was dropped through the outcrops along the road north of the Highway No. 1 hole in an effort to obtain good data to replace the G.A.I. line 3-2 poor data. A better tie to both outcrops and to the Highway well was anticipated. Data improvement was achieved but not great enough to resolve the structural complications. A gross discontinuity is apparent between the surface rocks and the structure at depth, where a good reversal into south dip at Pacoota and deeper levels underlies the north dip of Pertnjara and Mereenie formations on the surface.

This subsurface axis of reversal is interpreted to be a continuation of the surface axis some 24 kilometers to the west-northwest and five kilometers north of the James Range "B" anticline.

Lines 73-3-1.7EX and 73-3-3.2, eastward and westward, respectively, were then dropped to define this axis. The first line yielded good data with north dip thus showing no eastward extension of the structure to this position.

The second line was dropped from the South Waterhouse Plain through the Hugh River Gorge cut in Pertnjara and Mereenie rocks. Unfortunately data deteriorate as soon as the gorge is entered and dip reversal, if present, is obscured except for erratic fragments.

From the evidence on these three lines, however, it is apparent that the surface structure does not conform to that at depth and there is a high probability of the discontinuity being a shallow, flat thrust. On both lines 73-3-2.2 and 73-3-1.7EX is evidence of a deep north dipping thrust. The shallow thrust could be related to this or, alternatively, southward dipping normal faults, unseen on both surface and seismic work would have to be present. Little additional work could be done because of restrictions of topography. A stratigraphic test at drop point 145 on line 73-3-2.2 to a depth of about 1600 meters should reach the top of the Goyder and provide information of possible faulting.

3. Ooraminna Anticline

One significant result from the Ooraminna Area is shown on line 73-4-1.6, a traverse across the southwest plunging nose of the Ooraminna structure. Cambrian-pre-Cambrian intervals are quite constant, showing a very slight regional thinning to the southeast. The Cambro-Ordovician, Pacoota to Jay Creek, however, thins by 36% in a distance of seven kilometers, (point 170 to 220), in coming up the nose from the northwest. The remainder of the overlying Larapinta Group, (Stokes, Stairway and Horn Valley), also thin by 20%, in the same direction and by 50% from the southeast in only four kilometers. These formations must pinch out eastward where the geological map shows Mereenie sandstone lying on Pacoota.

A similar condition is shown on the axial line 73-4-2.3 and extension, and on line 73-4-2.4. On the latter the Larapinta above the Pacoota thins by 63% from point 162 to 98, a distance of nine kilometers, and is not present on the outcrop only five kilometers farther to the northeast.

It is thereby apparent that on at least this part of Ooraminna, structural movement began in late Cambrian time, during Goyder deposition, and continued at least to Mereenie time.

The gap in 73-4-2.3, the axial line plus the deterioration of quality of data as it is approached, makes questionable a projected tie to the outcrops. The Pacoota and Goyder horizons appear to fit well but the Arumbera is definitely displaced.

A surface fault is mapped, crossing the nose at drop-point 112 on the extension which could form a trap in the Arumbera at depth. This fault cannot be seen in the poor seismic data. A wedge of salt is apparent at 1.6 to 1.9 seconds thickening north-eastward from point 125.

4. Alice Structure

Horizon identification at the Alice well is good with excellent seismic data on line 73-4-1.1 from the well southwestward and a nearly complete sonic log from the bore hole. The horizons carry and tie to those at the Orange No. 1 hole.

All data north of Alice No. 1, however, are disrupted and only intermittently useable. This is due partly to structural complexity and largely to an irregular, filled, erosional channel which was calculated to approach 300 meters in depth. (L. W. Pfitzner, personal communication). Another estimate of depth of the channel by the crew was given as 700 meters. (Steve Wood, oral communication).

The net result of these poor data, (and this includes earlier data by Namco and G.A.I.), is that the structural position of the Alice well is quite unknown. As mapped at the Pacoota level the hole lies at the intersection of a south-plunging nose and at the west end of a less pronounced ridge extending westward from the sub-parallel to the north flank of Ooraminna surface anticline. Thrust faulting from both southeast and north is apparent. The Top of Pacoota horizon is probably within 200 meters of the surface only seven kilometers north of the Alice hole and could very well be breached by the erosional channel. A thrust fault farther north is thought to be a continuation of the Waterhouse fault, and, north of this the Pacoota would be absent by erosion. An attempt to determine structure in this area was made by adding lines 73-4-2.1 and 2.2 and the east-west line 73-4-1.8. No reliable data were recorded in spite of very considerable effort by the processing crew to extract coherent energy.

One new aspect developed from the new work involves the evidence of a southward dipping thrust seen at 190 on line 73-4-1.9X and at 230 on line 73-4-1.7. It is possible for this fault to be a detachment which underlies the entire Ooraminna structure indicating that the surface anticline as an allochthon has been moved westward.

With shows of oil in the Alice well in the Goyder and Jay Creek formations it would be reasonable to drill a new test some seven kilometers north, at the intersection of lines 73-4-2.1 and 73-4-1.7. Here, the Arumbera should be found at a depth of about 1100 or 1200 meters. All formations below the Pacoota should be present.

B. <u>PALM VALLEY AREA</u> (SHEET B, PLATES IV, V, VI)

The three segment line, 73-3-PV3 and PV4, was laid out to look for east-west thickness changes which might indicate early, (Cambro/Ordovician), structural trends, and to tie the older dip lines more directly. Line PV1 was attempted in hope of establishing axial control and to tie the No. 2 and No. 3 holes on the crest of the anticline. Line PV5 was programmed later to check an apparent anomalous dip reversal in the Hermannsburg area.

The four strike lines on the flank of Palm Valley give very good data below Pacoota level and good shallower data except from 130 to 230 on PV3 where the surface outcrops are approached too closely. Ties to the previous GAI lines are within accepted limits. At Arumbera level weak evidence for a flat thrust fault dipping southward under the anticline can be seen on PV3.

Line 73-3-PV1, recorded along the rugged crestal axis, yielded very poor data. A westward thickening of upper Cambrian could be interpreted but with considerable question of validity.

C. <u>MEREENIE AREA</u> SHEET D, PLATES VII, VIII

The highly deformed structures in this western area yielded poor seismic results from the 100% coverage surveys by Namco, United Geophysical, and G.A.I. By use of twelve-fold stacking techniques it was hoped to obtain data that would allow better interpretation of faulting and related structural attitudes. Older data were re-processed and played out on the Com-Mand unit but improvement was less than good.

The new program has contributed to structural and stratigraphic knowledge but has not resolved all questions: A difference in both fault interpretation and in correlation between the flanking Mereenie synclines exists. Essentially, little change exists between previous maps and those based on the new work.

1. Mereenie Anticline.

The premise of a north-dipping thrust fault under the Mereenie and Glen Edith structures was investigated by six new dip lines and the repetition of one old line (line F, United Geophysical Co., 1964). Principal effort was made on the southeast end of Mereenie with four short lines, 73-1-4.6, -4.7, -4.8, -4.9. Two were placed through wells for good subsurface ties.

Line 73-1-4.7, across the axis at East Mereenie No. 2, provides the best quality data and the well velocity survey by United Geophysical Co., 1964, provides the velocity ties to subsurface horizons as deep as the Goyder, 822 meters, (-2696 feet). At this position near the southeast end of the anticline, the Pacoota and Goyder reflections are particularly good, and are cleanly cut by the north-dipping thrust high on the south limb. The Goyder, in fact, shows no south dip on the hanging wall, (north), side. Strong south dip is present in the footwall, however, and a poor Pacoota correlation indicates only a small throw. The base of Mereenie reflection is very poor but does show south dip into the thrust. Other imbricate slices are apparent at greater depth. No migration of the axis occurs.

The south part of the line is mostly poor data and a projected tie to the Mereenie outcrop indicates a probable south dipping thrust into Johnny's Creek anticline.

Line 73-1-4.8, farthest southeast on the structure, correlates well with -4.7 at Pacoota and Goyder levels. The faulting appears to be breaking up into strands with very little displacement.

Line 73-1-4.6 passes between West Mereenie No. 2 and East Mereenie No. 1. Data are poor on the crest of the fold at all levels but a strong turnover is impled with steep dip into the thrust with about 400 milleseconds, (1000 meters), displacement.

Line 73-1-4.9, through East Mereenie Nos. 1 and 3, is very poor. Some coherent energy on the south extremity indicates strong south dip below the fault.

Axial line 73-1-M2 ties 1-4.7 and 1-4.8, passing through East Mereenie Nos. 4 and 2 and continuing to the Hermannsburg outcrop barrier at the southeast. Data quality are generally good and define the plunge of the axis and the fault imbrication. A diapiric wedge, thickening to the northeast is shown at depth from points 210 to 180 where it becomes poorly defined. The partially continuous energy from 1.8 to 2.1 seconds across the section may represent the basal Bitter Springs formation. Localized diffractions under station 130 may indicate faulting at this deep horizon.

Line 73-1-4.5 crosses the axis at Mereenie No. 1, the discovery well, and extends southwest to the Johnny's Creek outcrops and northeast to Gardiner Range. Crestal data are poor but do show strong reversal with strong south dip below the thrust zone. Probably at least two break faults are present, with a total displacement of about 400 milleseconds, (1000 meters) as on line 1-4.6. A thrust with footwall northdip is shown at the southwest end as Johnny's Creek anticline is approached.

North flank dips are fair with the best data at the base of Mereenie and shallower. An anomalous change of dip occurs at points 233 and 250. The result is an almost flat terrace. Stacked data are excellent north of 250 but deteriorate to the south. Other workers have used this zone as evidence of normal down-to-the-north faulting with an incipient fold developing to the northwest. This writer interprets the evidence as a near-surface velocity anomaly probably caused by a filled erosional channel parallel to the Mereenie north flank. In support of this, the two horizons mapped, Base of Mereenie and Top of Pacoota, tie within reasonable limits between the outcrops on the Gardiner Range nose and the Mereenie No. 1 subsurface points, without faulting.

Line 73-1-F crosses the Mereenie axis some two and one-half kilometers northwest of the NW Mereenie No. 1 hole. Crestal data are poor but do show a sharp turnover. Placement of the thrust fault (s) is not definite but steep south dip is interpreted between and under the thrusts. Evidence for fault displacement is poor, but shows no great amount of horizontal movement.

Steep north dip and a south-dipping normal fault occur between stations 230 to 260. South of 260 a dip reversal indicates the Johnny's Creek axis. The south-dipping thrust is not seen here; either it has terminated or it is lost in the poor data. Farther south the data deteriorate and the Watson Range axis is not even seen.

On Mereenie north flank a normal down-to-the-south fault is shown at station 130. Displacement is a maximum of 100 milleseconds. This fault cannot be confirmed on the United Geophysical data as the quality of reflections deteriorates badly from shot point 82 to 76. Evidence of similar faulting on line CN is also based on poor data.

This portion of the Mereenie northeast flank has been interpreted in several ways by different workers. The possibly anomalous condition is supported by local gravity variations. This writer favors a simple interpretation of only minor faulting and the presence of a filled erosional channel to explain the poor seismic data and the gravity anomaly. Evidence for large faults and/or a subsidiary fold structure is very weak.

Line 73-1-M1 was placed as a strike line to tie together the dip lines on the Mereenie north flank. Data are generally good from the top of Mereenie formation to top of Pacoota. No faulting is apparent and the horizons tie.

Line 73-1-JC, on the north flank of Johnny's Creek Anticline, is apparently too close to the outcropping Mereenie formation and the data are very poor.

2. Glen Edith Anticline

Lines 73-1-6.5 and 1-7.5 were recorded across this apparent continuation of the Mereenie axis and line 73-1-GE placed in the south flanking syncline to afford a tie between the dip lines. Purpose was to obtain better fault information to develop a possible drilling target in the footwall, (south), side of the thrust faulting.

Line 73-1-6.5 shows a beautiful suite of reflections in the northern syncline which carry southward, across a small normal fault at station 383 and terminate at a second normal fault at 377. From, 377 to 300, data are very poor. Good reflections are recorded from 300 to 270 where a less abrupt deterioration to southward begins. The Johnny's Creek and Watson Range axes are crossed farther south but are not seen with any clarity on the section.

The major north-dipping thrust is thought to cut the Base of Mereenie at about station 307 and the Top of Pacoota near 316. Very steep south dips occur in the lower plate below the fault. Imbricate slices are not apparent on the poor data but should be expected.

Line 73-1-7.5 presents the same characteristics as 1-6.5 except that it does not extend far enough northward to obtain good data.

Line 73-1-GE carries excellent data from station 100 to 230. From 230 to the southeast the thrust faults and the proximity to Glen Edith-Mereenie deformation cause distortions. Part of the Mereenie thrust apparently causes some section repetition as seen from station 230 to the northwest; a branch of this fault also cuts upward from near station 275 and trends north to cause overlap in the section below the southeast end of Glen Edith surface structure.

No definite closure in the lower plate of either Glen Edith or Mereenie can be mapped with certainty. It is probable that closures exist, however, and drilling through the thrust zone should be done when possible, especially in conjunction with development drilling in Mereenie field.

3. Gardiner Range Area

This complex structure was investigated by three lines across the plunging nose, three strike lines and two lines positioned for lower plate information on the north side of Gardiner Range itself. Previous mapping had shown the possibility of hydrocarbon traps beneath both the Gardiner fault and the Carmichael fault at Pacoota and deeper horizons.

The new data show even greater complexity than before and suggest a good possibility that traps exist in both upper and lower plates of the Gardiner thrust. The presence of some normal faulting could also form separate closures in the Larapinta and Pertaoerta Groups.

Correlation from upper to lower plate is quite nebulous but one is suggested on line 73-1-BN which would give a vertical displacement of some 1000 milleseconds, 2440 meters, (8000 feet). A similar displacement could occur on line 66-1-6. Data are not good enough to afford much confidence, however.

Line 73-GA1, a strike line, is far enough down the south side of the Gardiner nose to provide excellent information. Best reflections are at top and base of Mereenie and at top of Pacoota. In contrast, line 73-1-GA2, along the crest of the plunging nose, is poor and shows complicated data representing the thrust imbrication present. Line 73-1-E was placed between the above two lines and resulted in no usable data.

Line 73-1-GA1 continues to the west-northwest and from station 350 to station 405 the top of Mereenie reflection is repeated by the Carmichael thrust. From station 410 to 480 data are disrupted by either diapiric intrusion, (L.W. Pfitzner), or by complex imbrication of the fault zone. From 480 to 504 strong southeast dip is recorded on a good suite of reflections. This possible structure was not developed by additional control.

Lines 73-1-GA3, 1-GA3EX, and 1-GA4 were recorded to determine possible stratigraphic thin zones that would indicate favorable trap situations in the lower plate of the Gardiner fault. Good data on GA3 and GA3EX demonstrate a very consistent section to near the Arumbera. At this depth and deeper the early Cambrian section thins to both east and west.

Line 73-1-GA4 reveals quite flat data under the tight surface syncline in Hermannsburg sandstone. No faulting is apparent on the section but it is necessary to have a detachment between the surface rocks and those at depth. This could occur in the muted data above 600 milleseconds on the section. It is possible, perhaps, to use a portion of the Carmichael fault or, more likely, the Gardiner fault to effect this separation.

IX

CONCLUSIONS AND RECOMMENDATIONS

In general, the objectives of the survey were met but with a lesser degree of success than was anticipated. Usable data from below thrust faults is not easy to record with the result that potential hydrocarbon traps in such settings are still ill-defined. The results of one well passing through a thrust and the determination of underlying dips from cores would be most helpful information for correlation to the seismic sections. Concrete findings in one case could be applied to similar conditions at other faults and thus these traps could be evaluated better.

The use of velocity distribution as determined by the CDP velocity analyses for identification of formations is not a reliable indicator. Much more accurate measurements, coupled with use of nearby well surveys, would be necessary for practical use of this parameter.

This survey has contributed to the support of several potential drill-sites. Notably: Southeast Waterhouse, the lower plate trap under southeast Mereenie anticline, the Net Solitary complex, and the southwest Ooraminna nose. A good lead is indicated north of Highway No. 1 hole where a dip reversal shows a separate en-echelon fold or a possible continuation of the James Range "A" axis. The crew was prevented from expansion of data in this area by adverse surface conditions.

The new information north of Alice No. 1 hole indicates an attractive site for an Arumbera test hole, apparently also a "lower plate" structure. Additional subsurface information in this area would be helpful.

The southwest Ooraminna nose stratigraphic trap or fault trap should be investigated, perhaps by shallow core holes to determine the effect of the transverse surface fault at depth.

Most of the unresolved problems are the result of physical limitations of access or of recording and processing limitations. It is apparent that most thrust faults form an acoustic shadow which seldom reflects coherent reflection energy; or, the diffraction noise generated by the bedding terminations is so complex and strong that the coherent signal cannot be extracted from it.

All test wells, particularly those remote from previous tests, should have an integrated sonic log run to total depth and, preferably, with a surface check-shot velocity survey.

The most beneficial information will be from future drilled holes, either stratigraphic, core or structural tests.

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October 30, 1974

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APPENDIX A

PERMANENT MARKERS

MEREENIE AREA

LINE	STATION	ELEVATION	LATITUDE	DEPARTURE	LOCATION OF P.M.
73-1-4,5	100	738.46	7337781	745769	on rocky outcrop.
73-1-JC	193	735.48	7334289	754027	at base of sandhill.
73-1-JC	261	723.86	7338916	745628	840 m along line from I/S with road.
73- [illegible]C	99	745.59	7327915	765573	80 m from creek
73- [illegible]C	130	765.75	7350025	761777	I/S with 73-1-4.8.
73-1-4,7	100	713.95	7341002	771180	690 m from creek.
73-1-M2	100	777.90	7340983	765369	4.6 km from E. Mer. No. 2.
73- [illegible]2	182	699.34	7334449	774803	7.1 km from E. Mer. No. 1.
73- [illegible]	100	723.13	7364003	745677	160 m from sand hill.
73-1-M1	264	767.62	7353913	756318	7.3 km from Mer.1
73-1-E	163	740.67	7368919	761655	897 m from I/S with 73-1-EN.
73- [illegible]	100	734.01	7363899	768889	345 m from I/S with 73-1-4.5 Ext.
73 [illegible].8	139	714.88	7332139	773410	990 m from creek.
73-1-4,8	100	699.94	7336817	776225	1.4 km from creek.
73-1-M2	218	667.58	7331583	778936	410 m from creek.
73-1-GE	164	661.60	7365283	724255	58 m from I/S with 73-1-7.5.
73- [illegible]E	100	648.43	7370561	717016	between two sand dunes.
73- [illegible]E	314	702.78	7352950	741302	150 m from sand dune.
73-1-7,5	100	670.95	7375686	730829	240 m from sand dune.
73-1-GA4	146	757.21	7372576	781209	140 m from E.O.L.
73-1-GA1	203	755.74	7364140	762746	at 7° bend in line.
73- [illegible]A1	276	715.54	7370910	755095	at 6½° bend in line.
73- [illegible]A3	100	798.27	7356830	802258	E.O.L.
73- [illegible]A3	155	777.59	7360814	795696	200 m from extra large gum tree.
73-1-GA3	195	758.36	7363850	790583	I/S with GA3 ext.
73- [illegible]A3ext	212	783.21	7369337	777274	near rocky hills.
73- [illegible]A4	100	780.01	7366588	778840	350 from creek bend.
73- [illegible]A4	114	765.42	7368409	779561	I/S with GA3 ext.
73- [illegible]	300	715.37	7343556	726817	on side of sand dune.
73-1-6,5	200	689.14	7349738	722589	214 m from sand dune.
73-1-6,5	373	705.09	7367459	739714	near I/S with 73-1-M1
73- [illegible].5	299	694.08	7359846	731686	near I/S with 73-1-GE
73- [illegible].5	445	690.90	7374600	745617	762 m from I/S with old line.
73-1-[illegible] 6	100	752.05	7347356	760485	at foot of range.
73-1-4.9	133	773.29	7339998	758297	in heavy scrub.
73-1-5.5	100	709.77	7373306	759842	in heavy scrub.
73- [illegible]A2ext	67	723.65	7373656	757655	at foot of ranges.
73- [illegible].6	182	730.80	7337618	754401	E.O.L.
73- [illegible].5	319	759.08	7360679	755843	850 m from range.
73-1-GA1	504	665.69	736.108	726227	800 m from mill & tank.
73-1-GA1	350	691.42	7376859	746692	near 6° bend in line.
73- [illegible]N	156	721.13	7369432	763233	near I/S with 73-1-CA2.
73- [illegible]	100	813.31	7355443	772360	E.O.L.
73- [illegible].9	100	763.69	7343857	760758	near rocky ridge.
73- [illegible]1	342	825.56	7347254	764988	E.O.L.
73-1-5.5	142	728.70	7368673	756138	E.O.L. near large sand dune.
73- [illegible]7ext	195	778.43	7329192	761105	260 m from flat rocky outcrop.
73- [illegible].7ext	141	792.47	7335070	765654	near range.
73- [illegible].5	191	782.90	7346192	755259	near Mereenie No. 1.
73-1-4,5	107	728.72	7338430	746503	I/S with 73-1-JC
73-1-[illegible]	400	750.16	7333127	717487	280 m from rocky outcrop.
73- [illegible]	150	705.70	7367871	738071	0.8 km from I/S with 73-1-6.
73- [illegible].5	100	739.71	7338783	713417	E.O.L.
73- [illegible].5	201	665.23	7363784	723308	E.O.L.

PALM VALLEY

73-3-PV5	100	585.37	7352077	279815	2.1 km east of Hermannsberg airport.
73- [illegible]V5	170	576.86	7351612	270059	5 km from Hermannsberg on north bank Finke River.
73- [illegible]V4	100	604.83	7336564	291375	1.2 km north of James Range.
73-3-PV4/3	I/S	598.41	7348562	277037	2 km south from 1st grid on Hermannsberg to Alice Springs.
73- [illegible]V 3/2	I/S	611.45	7350275	257673	4 km west of road to PV No. 1, 1.5 north of ranges.
73-3-PV2	195	678.12	7348571	245535	19 km west of road to PV No. 1 in rocky outcrop.
73- [illegible]V1	100	891.48	7342753	266721	5.2 km east of PV No. 2.
73-3-PV1	176.	935.57	7342140	256833	0.5 km west of PV No. 3.

OORAMINNA AREA

LINE	STATION	ELEVATION	LATITUDE	DEPARTURE	LOCATION OF P.M.
73-4-1.1	100	517.03	7370936	405798	12.9 km from Emily Gap near Ross Road.
73-4-1.7	100	535.37	7364420	390012	E.O.L.
73-4-1.7	107	531.45	7363901	390942	I/S with 73-4-1.7.
73-4-1.7	133	522.82	7361957	393918	I/S with 73-4-2.1.
73-4-1.7	237	503.79	7352923	406283	bend (6°) in line.
73-4 1.7	284	505.92	7351318	412177	E.O.L.
73-4-1 8	100	533.61	7367591	393480	E.O.L.
73-4-1.8	122	529.89	7367630	396569	Near I/S with 73-4-2.1.
73-4-1.8	172	514.24	7367707	403546	4.0 km from Ross Road.
73-4-1.8	216	502.54	7367737	409702	E.O.L.
73-4-2.2	100	533.95	7358764	387750	near railway line.
73-4-2.1	100	532.96	7356284	391236	E.O.L.
73-4-1.9ext	208	504.05	7352923	403587	1.6 km from Santa Teresa Road.
73-4-1.9ext	100	520.10	7355558	395379	1.6 km from Alice No.1.
73-4-1.9	133	526.30	7356994	391614	near I/S with 73-4-2.1.
73-4-1.9	100	532.93	7359476	387688	E.O.L.
73-4-1.9	115	529.16	7355015	394838	I/S with 73-4-1.1.
73-4-1.9ext	140				
73-4-2.3ext	100	530.49	7337704	400481	0.8 km from well.
73-4-2.3ext	134	523.53	7341008	403904	E.O.L.
73-4-2.4	145	509.83	7335183	389022	E.O.L.
73-4-2.4	100	559.69	7327082	390087	1.5 km from 73-4-2.3.
73-4-2.3	100	532.90	7334877	396450	E.O.L.
73-4-2.4	111	562.45	7328573	390204	I/S with 73-4-2.3.
73-4-2.3	171	557.64	7327842	389455	E.O.L.
73-4-1.6	219	545.06	7332680	394234	near I/S with 73-4-2.3.
73-4-1.1	190	516.92	7359493	397541	190 m from Santa Teresa Rd.
73-4-1.1	285	551.84	7349567	391077	140 m from Old South Rd.
73-4-1.1	314	576.57	7346310	388650	I/S with 73-4-1.5.
73-4-1.1	399	554.25	7337276	385946	E.O.L. on sand dune.
73-4-1.5	100	573.54	7355071	375136	0.8 km from South Road (E.O.L.)
73-4-1.5	263	575.47	734229-	394869	140 km from fence.
73-4-1.6	100	591.64	7344746	382751	E.O.L.
73-4-1.6	125	571.01	7342209	385157	near I/S with 73-4-1.1.
73-4-1.5	257	530.25	7326828	397693	40 m from fence.

WATERHOUSE AREA

73-1-1.7ext	140	527	7312585	334004	2 km from track.
73-3-3.3N	250	582	7343211	340613	at foot of range.
73-3-3.3N	1	576.07	7347126	340981	350 m from river
73-3-3.3N	I/S	604.11	7355485	340040	I/S with 3-3NXB old line.
73-3-3.3N	342	602.59	7355934	339975	E.O.L.
73-3-AEX	100	609.66	7340273	358378	E.O.L.
73-3-AEX	I/S	564.14	7339880	346011	I/S with 73-3-2.3.
73-3-AEX	I/S	610.97	7340960	337105	I/S with 73-3-1.5.
73-3-AEX	I/S	559.55	7340591	327577	I/S with 73-3-3.25.
73-3-AEX	200	619.06	7340739	323289	I/S with 73-3-3.4.
73-3-AEX	155	646.24	7343302	309743	I/S with 73-3-3.6
73-3-AEX	500	668.10	7345015	304434	E.O.L.
73-3-3.6	100	657.77	7336727	306703	E.O.L.
73-3-3.6	240	654.47	7324733	314438	E.O.L. at foot of hills
73-3-1.5	195	605.16	7314807	361510	1120, from New South Rd.
73-3-1.5	300	565.07	7334222	369165	12.04 km from Main Rd.
73-3-1.6	163	570.85	7341522	356795	2.52 km from Old South Road
73-3-1.6	100	559.81	4333179	358016	5.4 km from New South Road.
73-3-2.2	221	565.27	7326039	347622	560 m from Main Road.
73-3-2.2	155/168	530.90	7319602	343362	160 m from Old South Rd.
73-3-2.2	93	510.45	7312512	338609	2.94 km from South Rd.
73-3-2.3	105	569.52	7318328	345207	1.12 km from fence.
73-3-2.3	148	558.45	7324351	346155	on South Road 71 km from Alice Springs.
73-3-2.3	265	577.50	7340720	346008	at foot of Waterhouse Range.
73-3-3.4	200	562.02	7326882	323209	E.O.L.
73-3-3.25	153	512.99	7321351	334880	at foot of James Range.
73-3-3.2	152	518.13	7322356	335557	at end of a ridge.
73-3-3.2	125	514.48	7323925	336535	near I/S with 3.25.
73-3-3.25	134	518.03	7318432	333572	E.O.L.
73-3-3.2	100	515.85	7326649	338401	E.O.L.

APPENDIX B

STATISTICAL DATA

(All Areas)

Totals for Field Crew:

First Day	3rd July, 1973
Last Day	27th April, 1974
Days in Period	293 days
Total hours (excluding down time)	2692.85
Record Hours	1631.75
Travel Hours	317.60
Camp Move Hours	109.5
Holidays (not worked)	40.0
Weather	594.0
Down	319.75
Profiles	6482
Km's coverage	895.24

Totals for ComMand Processing Center:

Current Seismic Processing (Hours)	1277:20
Reprocessing of older work (Hours)	131:50

Uphole Drill

Total Footage: 5801 (from Nov.)

Total Hours: 273

Number of bits consumed: 82 sets of blades

5 Rock bits

3 Starter blades

Dynamite Used: 425 lbs.

Caps Used: 978

Waterhouse

First Day	July 3rd, 1973; April 24th, 1974
Last Day	August 28, 1973; April 27, 1974

Days worked	61 days
Total hours (excluding down time)	609.60
Recording hours	448.25
Travel hours	85.35
Camp move hours	24.00
Holidays	0.00
Other work	52.00
Down hours	17.00
Profiles	1399 + 84
Km's coverage	204.26

Palm Valley

First Day	August 29th, 1973; Nov. 29th, 1973
Last Day	Sept. 14th, 1973; Dec. 1st, 1973
Days worked	20 days
Total hours (excluding down time)	180.00
Record hours	151.25
Travel hours	25.75
Camp move hours	0.00
Weather hours	3.00
Holiday hours	0.00
Down hours	18.25
Profiles	535
Km's coverage	74.90

Mereenie

First Day	Sept. 15th, 1973; Feb. 15th, 1974
Last Day	Nov. 28th, 1973; April 17th, 1974
Days worked	136 days
Total hours (excluding down time)	1167.75
Record Hours	672.25

Travel hours	145.5
Camp move hours	70.00
Weather hours	280.00
Holiday hours	0.00
Down hours	262.5
Profiles	3010.0
Km's coverage	421.82

98.8 in OP 175
323.0 in OP 178
EN

<u>Ooraminna</u>

First Day	Dec. 2nd, 1973; April 18th, 1974
	Feb. 14th, 1974; April 27th, 1974
Days worked	76 days
Total hours (excluding down time)	735.5
Record hours	360.00
Travel hours	61.00
Camp move hours	15.5
Weather hours	259.00
Holiday hours	40.00
Down hours	22.00
Profiles	1454.00
Km's coverage	194.26

APPENDIX C

PERSONNEL

Party Chief	S. Wood
Seismologist	S. McTaggart
ComMand Operator	R. Lambert
Computer	P. Lock
Electronic Supervisor	B. Easterling
Party Manager	G. Devlin/ E. McLauchlan
Observer	T. Smith
Junior Observer	D. Beeston
Junior Observer	R. Morgan
Mechanic	R. Buckmaster
Mechanic	P. Stark
Shooter	W. Berg
Weight Truck Operator	L. Coombs
Weight Truck Operator	P. Murphy
Surveyor	B. Hedditch
Surveyor	F. Carlson
Rodmen	(2)
Cook	(1)
Field Assistant	(15)

APPENDIX D

INVESTIGATION INTO THE PRESENCE OF THE MOHOROVICIC DISCONTINUITY USING SEISMIC REFLECTION DATA RECORDED TO 13 SECONDS IN LENGTH

An attempt to record, process, and display reflected energy from the Mohorovicic discontinuity was made, utilizing normal procedures carried out for line 73-3-1.7.

Certain limitations, however, both in the recording and processing systems resulted in minor modifications to the original plan.

The field recorder has a maximum recording cycle time of 13 seconds, sampled at 0.002 sec. intervals giving 6500 output digitised samples for processing.

Reformatting of the field tape to ComMand MPX-1 format followed, with resampling to 4 msec. rate, giving 3250 output samples. Because of software restrictions, normal binary gain-recovery was not available, and a digital AGC pass was made with further resampling to 8 msec. rate.

ComMand routine software allows for a total 1500 sample data trace for such programs as CDP stacking and filtering, with the result that the maximum data length allowed was further restricted to 12 seconds, or 1500 samples at 8 msec. rate.

The next stage of processing involved removal of NMO, application of static corrections, and CDP stacking.

Finally the assumption was made that only lower frequency energy would be returned from such extreme depths expected to reveal the "Moho" and that any high frequency energy present was probably ambient in nature, such as random wind, mechanical or electrical interference, or reverberated energy from near-surface events. To discriminate against these "noise" frequencies, an arbitrarily determined highcut filter of 30Hz was applied to the data to pass the expected signal and enhance the appearance of the deep section.

The filtered output was then displayed on the 'GOULD' electrostatic printer.

No prominent reflections were detected below the near surface sedimentary sequences, although certain weak line-ups of energy could be inferred below 9 seconds.

APPENDIX E

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