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Mereenie Vertical Loop Map part II

Interpretation Figures Lines 73 -1 - 4.5
GA1, GA2 and BN

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FINAL REPORT

CENTRAL AMADEUS SEISMIC SURVEY

1973 - 1974

O.P. 175 AND 178

AMADEUS BASIN
NORTHERN TERRITORY

FOR

MAGELLAN PETROLEUM AUSTRALIA LTD.

BY

MANDREL INDUSTRIES INC.

FINAL REPORT

CENTRAL AMADEUS SEISMIC SURVEY

1973 - 74

O.P. 175 and 178

AMADEUS BASIN

NORTHERN TERRITORY

FOR

MAGELLAN PETROLEUM (N.T.) PTY. LTD.

BY

MANDREL INDUSTRIES INC.

AREA MANAGER	R.K. HARRISON
PARTY CHIEF	S.H. WOOD

ABSTRACT

A digital Common Depth Point seismic survey has been conducted for Magellan Petroleum (N.T.) Pty. Ltd. by Mandrel Industries, Inc. in blocks O.P. 175 & 178 of the Amadeus Basin located south and west of Alice Springs, Northern Territory.

The "Geograph" weight dropping technique was used in conjunction with a Sum-It digital field recorder to obtain 895.24 kilometers of 1200% coverage.

All data were processed in Alice Springs by the ComMand on-site digital processing center. Operations were commenced on July 3rd, 1973 and were completed on April 27th, 1974.

Mr. S. Wood of Mandrel Industries, Inc. was in charge of both the field crew and the ComMand processing center while client representation was provided by Mr. L.W. Pfitzner for Magellan Petroleum (N.T.) Pty. Ltd.

TABLE OF CONTENTS

FIGURES

ENCLOSURES

Mereenie

- Horizon A
- Horizon B
- Horizon C-2
- Isopach A-B
- Isopach B-C2
- Horizontal Loop Maps Parts 1, 11 and 111
- Vertical Loop Maps Parts 1 and 11
- Uphole Results
- Interpretation Figures Lines 73 - 1 - 4.5, GA1, GA2 and BN
- Location and Elevation Map

Palm Valley

- Horizon B
- Horizon C-2
- Horizon D-1
- Isopach B-C2
- Isopach C2-D1
- Horizontal Loop Map
- Vertical Loop Map
- Location and Elevation Map

Waterhouse

- Horizon C-1 (Migrated)
- Horizon C-2 (Migrated)
- Horizon D-1 (Migrated)
- Isopach C1-C2
- Isopach C2-D1
- Horizontal Loop Map
- Vertical Loop Map
- Uphole Results
- Location and Elevation Map

Ooraminna

- Horizon C-1
- Horizon C-2
- Horizon D-1
- Isopach C1-C2
- Isopach C2-D1
- Horizontal Loop Map
- Vertical Loop Map
- Location and Elevation Maps.

INTRODUCTION

A digital Common Depth Point reflection survey has been carried out by Mandrel Industries, Inc. for Magellan Petroleum (N.T.) Pty. Ltd. in blocks O.P. 175 & 178 located in the Amadeus Basin, south and west of Alice Springs.

The program was divided into four basic areas entitled Ooraminna, Waterhouse, Palm Valley, and Mereenie (Figure 1).

The objective of the survey was to detail and confirm, if possible, anomalies which had been indicated by previous reconnaissance seismic, gravity, and drilling surveys.

A surface source method, the "Geograph", was employed throughout the survey to provide 1200% coverage. The data were recorded on a Sum-It Floating Point recorder. A total of 895.24 kilometers of coverage were recorded in 2692.85 hours of operation.

Data were processed in Alice Springs at the ComMand digital processing center. Reprocessing of single fold data which had been shot during earlier survey was also carried out in an effort to improve the signal to noise ratio.

Field operations were initiated on July 3rd, 1973 and were concluded April 27th, 1974.

OBJECTIVES

The program is divided into four basic blocks with several prospects contained in each block.

Mereenie

It was desired to investigate both flanks of the Mereenie and Glen Edith anticlines in an attempt to confirm suspected closures.

Along the southwestern flanks of the anticlines the possibility of closure exists along the footwall side of a northeasterly dipping thrust fault. Confirmation was desired of this closure by additional seismic work.

Previous seismic and gravity surveys have indicated an anomalous trend along the northeastern flank with possible faulting. It was desired to further delineate this trend and to confirm, if possible, the existence of faulting.

Further to the north the Gardiner Range anticline is intersected by the Carmichael - Deering structures. Single fold recording methods have previously yielded poor results and it was desired to obtain additional information on the suspected highly complex structural conditions through the use of 1200% C.D.P. recording.

.../3

Palm Valley

Five lines were dropped in the Palm Valley area in an attempt to further delineate the structure. Four of these lines were off the northern flank of the surface anticline while the fifth linked the Palm Valley No. 2 well with Palm Valley No. 3 across the top of the anticline.

PV1 line was dropped along the crest of the surface anticline to provide a seismic tie between the two aforementioned wells and to prove OR disprove stratigraphic continuity.

Lines PV2, PV3 and PV4 were placed parallel to the northern flank of the Palm Valley surface anticline in an effort to determine if nosing exists.

Waterhouse

The southern flank of the Waterhouse Ranges is of interest due to the possibility of entrapments having been created beneath the northward dipping Waterhouse thrust fault.

To the south of the program area lie the James Ranges. A possible anomalous structure just off the northern flank of these ranges had been indicated by earlier single fold surveys but data quality was poor.

Program was designed to cover both the southern flank of the Waterhouse Ranges and the northern flank of the James Ranges.

Ooraminna

This area is considered prospective due to results of two early test wells. Additional program was deemed necessary in order to obtain data in previous "no record" zones.

Previous work had also indicated apparent differences between gravity and seismic profiles and it was desired to resolve these differences if possible.

.../4

LOGISTICS

Bases of Operations

The crew office consisting of the Party Chief, Seismologist, and the Computer plus the ComMand processing center were 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 wellsite 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.

.../5

Dozing

Line 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.

.../6

SURVEYING

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 II lists all permanent markers and locations.

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

.../7

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 is located one refraction takeout and one spare takeout.

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

INSTRUMENTATION

Sum-It Field Recorder

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.

SDA-1 Amplifiers

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

A low cut filter of 12Hz (12db) was utilized in conjunction with an aliasing filter of 62½ Hz (80db).

SDW-300 Camera

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

.../9

FIELD OPERATIONS

Waterhouse

On July 3rd a noise analysis was conducted along the southern end of line 73-3-16(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 Gosses Bluff.

Examination of this noise analysis revealed that the major noise problem associated with the area was not high velocity boundary waves as indicated near Gosses 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 Gosses 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 4).

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 12 Hz (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.

.../10

A split spread field technique consisting of a 2½ station offset to the near trace was chosen. Offsets were 1890-350-0-350-1890 meters (Figure 2).

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 and 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 3).

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

.../11

Palm Valley

After completion of the original Waterhouse program the recording crew moved onto the Palm Valley program. Operations were initiated using the same recording parameters as had been utilized in Waterhouse. Field data did not exhibit any severe noise characteristics and it was decided that no changes were required in the field technique.

One line, 73-3-PV1, was placed along the crest of the surface anticline. Access was difficult to this line and it was necessary to bend this line several times as it followed surface contours between the two wells it linked.

Upholes were also drilled along the lines in case additional weathering control was needed.

Mereenie.

Again the same field technique was employed. Little disturbance was noted from either boundary waves or multiple refractions; but, strong interference was noted in the areas of near surface or surface anticlines. It is thought that this interference may emanate from the surface of these anticlines in the form of near surface diffractions.

Again the up hole rig was employed to obtain near surface information.

Ooraminna

After initiation of operations in the Ooraminna area two problems were incurred. Multiple refractions were destroying shallow data on the longer offsets in some parts of the program area and a deep weathering channel ran through the northern half of the area causing a marked deterioration of data quality.

On two lines, 73-3-2.2 and 73-3-1.9 ext. station interval was reduced to 100 meters with the drop segment being reduced to 150 meters in length Figure (3). This was done in order to permit a higher effective stack without including refraction damaged data.

No upholes were drilled in this area. In the areas of near surface channelling the weathering appeared to be several hundred meters deep making uphole drilling impractical.

.../13

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 récord".

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 thereby preventing 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 lenght 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.

.../14

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 in 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 73-3-1.9 ext. and 73-3-2.2.

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.

.../15

PROCESSING

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 turnaround with maximum effort is a feature of the ComMand with co-operation and supervision by the interpretation team encouraged at all stages of the operations.

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.

.../16

Processing Parameters

Processing parameters employed were subject to extensive pre-use scrutiny and testing, both before and after stacking. A generalised processing flow chart is enclosed (Figure 6).

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 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 computed 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.

...17/

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 utilisation 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.

Experimentation

Apart from analytical experimentation during normal production processing, certain items of 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.

.../18

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 mutiplicity (by progressively discarding long distance traces) to investigate the effect of depth point dispersion in regions of strong dip (Figure 7).

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 III).

.../19

Reprocessing

A number of previously recorded and processed analog lines were reprocessed concurrently with production processing utilising techniques developed on intersecting lines of the present survey.

Format conversion from the original analog tapes to digital format was already completed with the data in an otherwise raw state. The processing sequence was generally similar to that described for the present survey with the exceptions that static corrections as originally computed were used; and, since each line was recorded in single-fold configuration, a residual static correction pass was unnecessary.

In order to retain similar character between these older lines and the present survey, post-stack parameters were chosen to aid correlation of reflected events throughout the area.

.../20

REGIONAL GEOLOGY

The Amadeus Basin is a westerly trending intracratonic depression within the Central Australian Shield (Southern Northern Territory). Present day margins narrow toward eastern and western extremities. The basin is approximately 800 Km by 320Km covering an area of 150,000 square Km (Figure 1).

Since its inception in the Early Proterozoic the Amadeus Basin has received in excess of 9,000 M of sediments. The sedimentary section comprises unmetamorphosed marine sediments laid down in the interval between Early Proterozoic and Ordovician times. Subsequent sediments being principally continental deposits; Recent sediments being comparatively thin occur now as outliers. The sedimentary section overlies igneous and metamorphosed basement rocks, which have surface expression as the Arunta Complex along the northern margin of the basin and the Musgrave Complex along the southern margin (Figure 8)

The earliest sediments in the Amadeus Basin probably extended well beyond present margins. These Proterozoic sediments were deposited as a continuous sheet in a shallow stable, marine environment (Heavitree Quartzite). The development of barred basins and lagoonal environments is inferred from the presence of evaporites and carbonate rocks of the Bitter Springs Formation (Figure 9a, 9b).

.../21

Diastrophism of the Areyonga Movement was accompanied by the development of a 'basinal' province in the southern area of the Amadeus Basin separated from a shelf province to the north, by a medial westerly trending hinge line (Wells et al, 1970). This movement and the South Range Movement in the Late Proterozoic uplifted areas to the south which then became the provenances for the subsiding areas.

Sedimentation continued with little tectonic disturbance during the Late Proterozoic, retaining the two distinct environments. The Areyonga and Pertatataka Formations, deposited at this time, have similar lithology, facies distribution and environmental conditions. Two stages of glaciation have been identified in this time, the earlier of the two covering the entire shelf and the later episode being confined to a small subsidiary basin in the northeast. The Petermann Ranges Orogeny re-configured the basin, shifting the axis of deposition to the north. The shelf province appears to have been little disturbed by these intense movements which were localized in the south west of the basin. The 'basinal' sediments were uplifted as isoclinal and recumbent folds developed and Proterozoic sediments were infolded with basement complex, during Late Proterozoic to Early Cambrian times. Overthrusting of the young Proterozoic sediments was accomplished by utilizing the more competent Bitter Springs Formation as a decollement. This movement provided a southern provenance for Cambrian deposition. The Cambrian Pertaoorta Group, unconformably overlying the Proterozoic rocks, comprises marine sands and silts, including an evaporatic member (Chandler Limestone). Carbonate and evaporitic deposition predominated in the northeast and clastics in the remainder of the basin grade coarse to fine from the west to the south east.

.../22

Sedimentation during this time shows evidence of a facies change across a median ridge subdivisions varying from continental to deltaic in the west to marine carbonates and shale in the east.

The Larapinta Group (Figure 9) was laid down from the Late Cambrian to Ordovician, conformably overlying the Pertaoorta Group and the Proterozoic rocks to the south. The depositional pattern indicates a series of transgressions and regressions in an epeiric sea which probably extended beyond the present basin margins.

These shallow marine Ordovician rocks comprise sandstones, siltstones and shales which show true depositional thinning to the south. Ordovician sedimentation was brought to a close by the Rodingan Movement (Silurian?), the ensuing environment being principally continental. Desert erosion provided sediments of the Mereenie Formation which is partly shallow marine, partly fluviatile and aeolian. An apron of coarse conglomerates developed at the foothills of the Central MacDonnell Ranges. The Mereenie Formation unconformably overlies the earlier rocks, the majority of sediments probably being deposited during the Devonian.

This phase of deposition was interrupted by the Pertnjara Movement (Late Devonian) which uplifted sediments on the northern margin. Molasse deposits of the Pertnjara Group followed this movement, the sediments accumulating at the base, on the southern flank of the newly formed mountains. The Finke Group was deposited contemporaneously within the basin.

.../23

The Alice Springs Orogeny (Foreman et al, 1965) is evidenced by folding overthrusting and the formation of nappes, along the northern margin of the basin. This Mid to Late Palaeozoic cycle may have started near the end of the Ordovician and shows increased intensity in the Devonian, activity persisting into the Carboniferous. The two major occurrences of evaporites appear to have provided shearing planes of weakness with detachment of sediments occurring angularly between these planes as sediments were overthrust (Foreman and Milligan, 1965).

Huge blocks of allochthonous sediments provide evidence of gravity sliding in response to uplifting and overthrusting. The sediments of the Late Palaeozoic depression do not show signs of activity as intense, as that evidenced in the basement complexes to the north. Many of the structures of the depression display an origin in the Palaeozoic and some diapirs and thrusts may have been initiated as early as the Petermann Ranges Orogeny. The Amadeus area stabilized after the deposition of the Pertnjara Group to serve as provenance for the Permian to Cretaceous sediments of the Simpson and Gibson deserts.

Middle Tertiary fluvial and lacustrine sediments were deposited in ancestral river valleys as the climate became wetter. Tilting and minor faulting accompanied the downwarping of the Lake Eyre area, establishing the present system of internal drainage.

.../24

INTERPRETATION

The surveyed areas have been presented as four subregions designated as Mereenie, Palm Valley, Waterhouse and Ooraminna from west to east respectively. All areas encompass a belt of intrabasinal thrusts and folds adjacent to the northern margin of the Amadeus Basin.

Three horizons and two isopachs have been mapped for each subregion. In general seismic data quality is very good. 'No record' areas are consistently related to anticlinal features, usually where outcropping sandstone rocks may be observed. Where possible the survey data were tied into maps prepared by Krieg (1967), and in most cases ties were very good with few of the old lines requiring repicking or adjustment. The bed thickness of most Palaeozoic sediments is remarkably uniform and little related to structural movements, except in the Ooraminna area.

Gross structure may be viewed as two layers above a crystalline basement with anatexis probably merging the lower layer into the basement. These layers are separated by an incompetent 'plane' comprising the Bitter Springs Formation. Two major diastrophic events have been recognised in the area giving complex relationships between thrust faulting and fold development. The earlier, the Petermann Ranges Orogeny (Late Proterozoic), was localised along the southern border, sediments being overthrust from the south. The later, the Alice Springs Orogeny was localised along the northern border and over thrust from the north.

.../25

Mereenie

The Mereenie map covers several distinct prospects, interrelated by thrust and fold trends. Two parallel thrust lineaments oriented northwest to southeast (Glen Edith Hills and Gardiner Range), intersect a third lineament oriented approximately east-west. The resulting faults, folds and intersections of these lineaments provide potential traps for hydrocarbon accumulation.

Horizons were chosen to tie with previous work on old Line BN shotpoint 83. Preliminary mapping revealed some misties in the area, particularly to the northwest. Hence the horizons to be mapped were chosen so that fair ties throughout the area could be attained and also, so that reflection character could be identified in different areas. Three horizons A, B and C-2 have been mapped. For timing, the onset of the reflection below the coloured line has been mapped. Horizon A is the lower leg of the very strong reflection band estimated to be approximately the top of the Mereenie Formation, possibly an unconformity. It has been mapped to assist ties to outcrop geology. Horizon B does not possess a strong reflection character but has been mapped because of its proximity to the prospective Pacoota Sandstone. A good character correlated tie to Line 73-1-M2 places Horizon B in the Lower Stairway Sandstone and Horizon C-2 has been mapped as the lower leg of a strong reflection band in the vicinity of the C-2 mapped by Krieg (1967).

Correlation throughout the Mereenie area is good. Horizon A is always very strong except when it is high in the section, where the combined effects of deep weathering and muting during processing would alter the character. Horizon B shows an increase in strength to the west. This may indicate an east-west stratigraphic variation. Horizon C-2 also shows a slight variation in character in this dimension. Coherent energy content deteriorates in regions of thrusting (anticlines), however relative character of reflections seems constant.

.../26

The Mereenie maps show horizons and isopachs which give fairly reliable view of the area. However, as it combines data from various sources some caution is necessary in the interpretation of anomalies. The 1973 seismic work has been mapped from migrated sections. All previous lines used were not migrated and have differing static corrections at tie points. Hence anomalous areas on the boundaries between old and new data have to be viewed with caution. The reliability of Horizons A and C-2 are considered 'very good'. Horizon B however, because of possible stratigraphic and observed character variation is 'fairly' reliable. The area to the north of the Gardiner Ranges (Lines 73-1-GA3, GA3 EXT and GA4) has been tied to the previous maps of the Palm Valley area. These 1973 lines are not physically tied to the Mereenie area which forms an interconnected network independently. Character correlation is difficult between the two areas and the time difference (1.0 sec.) is very large. However, such a depth (in time) is also observed north of the Glen Edith Hills in a similar structural environment. This situation leaves a break in the correlation of horizons between the two subregions. Subsequently the horizons mapped in each area, although close, cannot uncategorically be designated as the same units.

The isopachs show little variation along all of the 1973 data. A slight thickening along the flanks of synclinal areas may be attributed to the parallel folding of beds which when mapped are represented by a vertical time difference and not one normal to the 'bedding' planes. This phenomen may also be observed in the Waterhouse area.

.../27

Seven wells have been drilled on the Mereenie Anticline consisting of four shut-in gas condensate wells, one shut-in oil well and two non-economic shut-in wells. The gas and oil producer is the Upper Pacoota Sandstone (Cambrian), and abnormal gas pressures have been observed in the Stairway Sandstones (Ordovician). The Pacoota Sandstones have a high residual hydrocarbon content and evidence of euxinic conditions, indicating that they are probably both source and reservoir rocks. The Upper Pacoota Sandstone is capped by the Ordovician Horn Valley Siltstones and shales which exhibit suitable characteristics to be a source rock. Porosity is extremely low in these silts and sands providing a good cap rock. Permeability and porosity are not exceptionally good in the Upper Pacoota Sandstones although some stringers show a slight improvement. This situation has led to the conclusion that fracture porosity and permeability are of major importance in locating suitable traps.

In the region of the Mereenie Anticline seismic results have provided a good tie to well information along Line 73-1-M2. The best record quality crossing the anticline transversely is found on Line 73-1-4.5. This Line indicates an overthrust with a steeply dipping décollement which maintains this attitude from south of Mereenie No. 1 to the termination of the structure. Lines 73-1-4.7 Ext and 73-1-4.8 indicate an apparent syncline on the southern forefront which seems to consist of horizons which dip northwards under the overthrust segment. The décollement becomes shallower in dip to the west which may be noted by comparing Lines 73-1-4.8 and 7.5. This area then is the most likely site of large throw overthrusting (Glen Edith Hills).

.../28

The western half of Mereenie anticline is an arcuate structure, perhaps due to differential overthrusting. A stratigraphic closure to Mereenie Anticline has been postulated between West Mereenie No. 1 and N.W. Mereenie No. 1 (WCR, N.W. Mereenie No. 1).

The Mereenie Anticline is part of a northwest to southeast fold belt which includes Glen Edith Hills and Walker Creek Anticlines. Structurally, this belt consists of a thrust fault. The thrusting is greatest and the thrust plane shallowest in the Glen Edith Hills area. The thrust plane deepens to near normal along the southern flanks of Mereenie Anticline (Lines 73-1-4.6 to 4.8), and then undergoes a transition to a fold - West Walker Creek Anticline. This is in accord with fault to fold transitions as modelled by Gardner and Spang (1973). Line WW-2 of Gardiner Range Gravity Survey, 1973 does not indicate a fault of great magnitude on the northern flank of West Walker Creek Anticline. Hence the fault observed on Mereenie Anticline may be related to thrusting and is presumed, on the model basis, to terminate between the abovementioned anticlines. The Glen Edith Hills intersect an east-west fault zone (thrust?) which may be observed on the western end of Line 73-1-GA1 near stations 410,420. The Glen Edith Hills are interpreted as being further overthrust than Mereenie Anticline and hence more complex geologically, giving poorer seismic records on the anticline (see Lines 73-1-6.5, F, 7.5 and GE) In this area Horizon A shows variance to the relief of underlying horizons as fault zones are approached. This variance is attributed to continental apron deposits, being laid down towards the end of Mereenie Sandstone deposition or early during Pertnjara Group deposition. These apron deposits are thought to be contemporaneous with the overthrusting of the Alice Springs Orogeny (Wells, et al, 1965). These phenomena may be observed on Lines 73-1-GA1 (W) and GE.

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This northwestern area has two intersecting thrusts with the synclinal sediments on the southern forefront of each being deeply buried and thrust under the overlying sediments. This severe overthrusting may be attributed to the nearby intrusion of Arunta Basement Complex resulting in effective constriction of the basin. Near to the intersection of these major thrusts, sediments have a 'triangular' closure:i.e. two intersecting fault planes flanking a syncline, which is truncated by them and plunging away from the intersection. Such a trap may exist at the northwest extremity of the Glen Edith Hills and certainly does exist at the northwestern extremity of Gardiner Range as defined by Lines 73-1-GA4 and GA3X. The northern flank of the Glen Edith Hills provides a prospective area for future exploration. The critical factor for the location of seismic lines in this area is the location of fault and fracture zones. An improved field technique as suggested on page 13 could yield information on prospective arched and faulted sediments on the northern side of Glen Edith Hills and also on possible fault traps under the southern flank.

The interpretation plate of combined gravity and seismic results for Line 73-1-4.5 indicates a fault with a large throw on the northern flank of the Mereenie Anticline (Gardiner Range Gravity Survey, 1973). The extension of this fault at least west to N.W. Mereenie No. 1 may be inferred from gravity data (Adastra, 1962 and Century, 1961). The eastern extension is less tenuous. This fault on the southern flank of Wild Eagle Syncline is a very favourable prospect for a hydrocarbon trap. The upturning sediments of the syncline terminate against the fault and they may be expected to deepen in sympathy with the eastern nose of the Mereenie Anticline.

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Western closure is difficult to discern; however, two possibilities exist. The stratigraphic (?) closure between W. Mereenie No. 1 and N.W. Mereenie No. 1 could credibly be expected to extend into the synclinal area. The Mereenie Anticline does not show a structural growth extending back to the Ordovician, the time of deposition of the productive Pacoota Sandstones as Isopachs covering rocks of this time show little variance in this area. Hence the depositional environment is not expected to differ between the crest and flank for the Pacoota Sandstone. The stratigraphic closure would then be valid for a trap within the syncline. The second closure possibility is the slight down turn observed in reflections on Line 73-1-M1. A third, but as yet unobserved, possibility exists for tear faults crossing the anticline transversely, providing closure.

The proximity of such a large structural trap to the Mereenie Anticline, which has proven reserves of oil and gas, makes this an attractive prospect. The source of hydrocarbons seems to be the reservoir rocks and possibly the overlying Horn Valley Siltstone. As outlined above, the depositional environment is expected to be fairly constant so that a suitable source may be postulated. One of the most important aspects of defining suitable traps is the presence of good fracture porosity. A fracture analysis of the Palm Valley - Gardiner Ranges - James Ranges Anticlines by Thigpen in 1973 concluded that fracture density was high along the crests and lower flanks of anticlines. Only in the case of narrow anticlines with high curvature was the crestal fracture density expected to exceed that on the flanks. The Mereenie Anticline is certainly not as narrow as the Gardiner Range which was cited as an example of a narrow anticline. Hence good fracture porosity may be anticipated on the flank of Mereenie Anticline.

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The trap outlined above needs careful definition by mapping the fault plane trace to determine its longitudinal extent, and then the horizons abutting this major feature need to be mapped. If this feature proves to be productive, a similar structure may be investigated on the southern flank of Middle Range Syncline. Delineation of this feature could be achieved by seismic surveying.

A continuous thrust zone oriented approximately east-west has been mapped joining the northwestern tips of Glen Edith Hills and Gardiner Range in accord with Krieg (1967). The continuity of these thrusts may not extend across the area, but may be a series of en echelon features which is difficult to assess from seismic data. Antithetic faults from this major trend dissect the northwestern nose of Gardiner Range to form potential traps. A gravity high in the Mt. Solitary area reinforces the possible fault mapped crossing Line 73-1-BN. This fault would give a prospective closed structure along Line 73-1-GA2X. Such a feature could be repeated to the west of Mt. Solitary, the decisive factor again being fault closure. The southern flank of Gardiner Range Anticline also provides an interesting prospect. The region lacking seismic and gravity coverage between Line 73-1-4.5 and 4.5 EXT is anomalous topographically, gravimetrically, and acoustically (See Interpretation Figure Line 73-1-4.5). The northern flank of the Gardiner Range Anticline has near surface salt intruded along the fault zone (Wells and Kennewell, 1972). The salt intrusion as suggested by the Gardiner Range Gravity Report, 1973 provides a prospective area for the upturning and closure of sediments. A gravity profile along the southern flank of the topographic high between Lines 73-1-4.5 and 4.5 EXT would assist in locating isolated salt intrusions.

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Two distinct phases of overthrusting have occurred in the Amadeus Basin. The earlier, the Petermann Ranges Orogeny was largely confined to the lower plate (below the Bitter Springs Formation). The second is readily evident in the overlying sediments (Alice Springs Orogeny). A simplified sequence of events for the development of the Mereenie Anticline may be postulated from the seismic results and is shown in Figures 14 a,b,c. The east-west thrusting appears to be related to basement intrusion and overthrusting along the northern margin, whereas the northwest-southeast thrusts and folds appear to have developed along linear fracture planes originating in the lower plate. Apron deposits imply an onset of thrusting from the north during the Carboniferous as the upper Carboniferous sediments or early Pertnjara Group were being laid down.

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Palm Valley

All the Palm Valley lines produced very good data with the exception of 73-3-PV1. This line, connecting Palm Valley Wells Nos 2 and 3 showed little of the crestal configuration.

Horizons were chosen to tie with previous mapping and as such although close to similarly named horizons in adjacent subregions, they are not the same continous horizon. In contrast to the Mereenie area Horizon B shows stronger reflection character whereas Horizon C-2 shows poorer character. Horizon D-1 is approximately two legs below the D-1 mapped in the west of the Waterhouse area. Correlation of reflections away from the crest of the anticline is very good. Continuity of mapped horizons along Line 73-3-PV1 is doubtful and minor faults may be present that cannot be discerned on the seismic section. Coherent energy content of reflections improves away from the anticline so that 73-3-PV5 gives the best correlation to the Waterhouse area.

The Maps show an 'elbow' shape for Palm Valley Anticline in all horizons. This 'elbow' may be observed as a high on Line 73-3-PV3. The isopachs also reflect this feature as a slight thinning (see Isopach C2/D1). A closed nose has been mapped to the eastern end of Palm Valley structure. Closure however could be effected by tear (?) faults cutting the anticline transversely. All horizons in this area are reliable away from the crest of the anticlines.

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The western end of 73-3-Pv3 shows a slight turnover which increases with depth (See Horizon C-2). A northern extension of this feature is not observed on 73-3-PV5. The lines did show a continuous anticline structure in accord with previous mapping of the Palm Valley area. There is the possibility that a fault oriented east-west and located between the Lines 73-3-PV3 and PV1 could give closure for a fault on the northern flank of the anticline. Such a trap could be considered a good prospect as fracture analysis favours the crests and lower flanks of anticlines (Thigpen, 1973_. Ties to the wells are very difficult to make confidently. They appear to be in fairly close agreement with the ties for Mereenie. Horizon B again correlates to the Stairway Sandstone.

The Palm Valley Anticline is an arcuate anticline which terminates towards the Gardiner and James Ranges. The northern flanks of both ranges are fault bounded, being over thrust from the south. In accord with the modelling of fault to fold transitions (Gardiner and Spang, 1973), this lineament maintains continuity as an anticline which is flanked by Palm Valley syncline to the north. The Palm Valley anticline seems to be an independant fold in response to southerly directed basement overthrusting which may postdate the first phase (Figure II). The evolution of the anticline is then due to the differential absorption of movement, along the thrust planes by faulting, and by folding to the north of the Gardiner Range anticline which was transformed from the collinear thrusts. The apparent independence from the Waterhouse thrusts implies that old North-South (?) fault lineaments may segment the basin from east to west and wrench faulting could be expected along these lineament.

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Waterhouse

The Waterhouse area conforms to previous mapping in overall relief. The most prospective area surveyed during 1973 is located in the James Ranges around the Hugh River.

Three horizons (C-1, C-2 and D-1) and two isopachs have been presented. All horizons were initially tied to old work along Lines 73-1-1.5 and 1.6 Horizon C-2 has very strong character and may be readily recognized throughout the area. Horizon C-1 is an enigmatic reflector usually located two or three legs above C-2. Horizon D-1 is also enigmatic but located one leg above a strong reflector. Difficulty was experienced in tying migrated lines to the unmigrated 73-1-AEX. However by utilising ties on the same lines but unmigrated, adjusted values have been plotted on the maps for AEX. Ties throughout the area were good. Misties with the old work may be attributed to different statics corrections which may differ by as much as 40msec. The greatest mistie observed (~60 msec) was in the northwest near Line 73-1-3.6 The old values in the area have been adjusted - the old sections have not been re-picked. Hence the western edge of the Waterhouse map does not match the eastern edge of the Palm Valley map for Horizon D-1. The reliability of all horizons mapped in the Waterhouse area is very good. Isopachs show a slight thickening on the margins of synclines which, as in the Mereenie area, may be attributed to parallel folding.

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Fault traps under the thrusts forming the Waterhouse Ranges are difficult to assess. The difficulty arises in trying to estimate how far the underthrust sediments project beneath the range. The migration of reflections on Lines 73-3-3.3S and 3.3N tends to overlie deep reflections of very steep dip which plunge in opposite directions. Since the migrated reflections have coherency it would seem that the complication may be due to reflected refractions at depth beneath the zone of overthrusting. Although this is a problem in itself, the prerequisite nose necessary for east-west closure on the southern flank of the anticline has not been observed. Such a nose may exist along the northern flank but this is doubted as horizons in the area are very regular in relief.

Line 73-3-3.6 illustrates the tapering out of overthrusting into a conical fold at the western terminus of the anticline. This feature is offset from the main anticline and tear faults between West Waterhouse No. 1 and the main anticline could be postulated for closure. Highs observed on the southern ends of Lines 73-3-1.5 and 1.6 are the western nose of the Orange No. 1 structure. The highs on the northern ends of these lines may have closure against the thrust plane on the southern flank of the anticline and present a drillable prospect. Fracture porosity in the Pacoota Sandstones would be necessary for hydrocarbon accumulation. The Pacoota Sandstones, however do not seem to have as high an organic content in this eastern part of the basin. Hence the Jay Creek Limestone may be an alternative prospect (See Alice No. 1 WCR, 1963). The High River area viewed optimistically in Figure 16 has two potential structures. A southerly dipping thrust fault has been inferred on Line 73-3-3.2 and extended through to Line 73-3-2.2 Horizons on the overthrust block have been positioned by correlation of reflection character and geological outcrop. Reflection character is poor, probably due to fracturing.

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The Waterhouse Ranges appear to be flanked on the north and south by underthrust sediments. Décollement planes within the Bitter Springs Formation are manifested as tight isoclinal folds (See Line 73-3-3.3S), and intrusive thickening on the flanks of the synclines. The Waterhouse Ranges seem to be the cap of a 'mushroom' development of near symmetrical underthrusting (See Figure 15). The western extension of the thrust lineament does not seem to have any of the structures associated with fault to fold transitions as is found in the Mereenie and Palm Valley areas. The eastern extension disappears in the Ooraminna area (See page 39).

Ooraminna

The Ooraminna map covers a structurally complex area where the Waterhouse thrust trend and nearby basement intrusion may be observed. Fair ties to the 1967 work (Krieg) enabled the merging of old and new data.

Mapping around Alice No. 1 well was complicated by poor records to the north, and severe faulting on most lines. The character of reflections in the Ooraminna area is essentially the same as for the Waterhouse area. C-2 is a consistently strong reflector while B and D-1 are not as well defined. Consequently, Horizon C-2 is the most reliable. However reliability diminishes north of Alice No. 1. Correlation by character is good from the west of the Waterhouse area across to Ooraminna. The horizons mapped in the Waterhouse area have been carried throughout Ooraminna. The maps indicate strong relief in all horizons due to intense faulting. The thickness of beds mapped is slightly greater than equivalent beds in the Waterhouse area. This may be largely attributed to the curvature effects of parallel folding as in the Waterhouse and Mereenie areas. Two legs below Horizon D-1, distinct variations in thickness may be observed. A bank of two strong reflections develops into three with an increase in thickness over anticlines (See Line 73-4-1.1). This may also be observed on Lines 73-4-1.5 and 1.6. On line 73-4-2.4 the situation changes and thinning occurs on the extension of Ooraminna Anticline (subsurface). This difference to the other areas is in keeping with the structural disposition of this anticline. It may be noted that Ooraminna Anticline transects faults (outcrop geology), which does not appear to happen for the subsurface structures in the vicinity of Alice No. 1. This difference in thickening suggests that the anticline may have evolved in response to tectonic forces that were different either in time or direction to those responsible for the structures in the north.

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This variable band is approximately located at the top of the Arumbera Sandstone, which suggests that it could be the Chandler Formation -- which has been documented as containing evaporites and related to shearing in response to thrust faulting (Forman et al, 1966). The thinning of this formation may explain its absence in the outcrop sequence of Ooraminna Anticline. In contrast, the thickening over anticlines in the vicinity of Alice No. 1 may explain the presence of salt in formations above the Chandler Formation which was encountered while drilling Alice No. 1 (WCR, 1963). The geological history of the northeastern portion of the basin has shown a variance to the rest of the basin as far back as the Proterozoic (Wells, et al, 1965). Generally, the area has been more mobile with restricted environments ideal palaeoenvironments for the preservation of organic detritus. The Waterhouse overthrust is a prominent structural feature in the west of the area and may be observed on the northern end of Line 73-4-1.5. This pronounced linear trend, however, cannot be observed extending through the vicinity of Alice No. 1. Overthrusting may be observed on Lines 73-4-1.7, 2.1 and 2.2 but correlation with the Waterhouse trend is not apparent. The complexity of fold and faults and their interrelationship to the east of Alice No. 1 is not observed in the Waterhouse area. The Alice area therefore is the confluence of strong fault trends which is evidenced in surface fault and fold orientations. The disposition of these faults and folds suggests folding along sheared fault planes. Such shear faulting could be a concomitant part of variable overthrusting of basement rocks which are much closer to the north of this area than Waterhouse, Palm Valley or Mereenie (Figure 13).

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The north-south fault postulated in Figure 13 has expression in the vicinity of Alice No. 1 and crosses the nose of Ooraminna Anticline to continue south at least as far as Mt. Brunonia. It may however, curve in a manner similar to the trend observed to the east, (See Ooraminna maps). Here in the James Ranges an offset in outcrop due to transcurrent (?) movement may be observed in outcrop geology and the disposition of the ranges. The absence of the Ordovician suite on crossing this fault suggests that a vertical displacement accompanied shearing; the eastern block being slightly uplifted. Stratigraphic inference from the seismic sections (73-4-2.3, 2.4, 1.6) suggests a late Cambrian movement or epeirogeny as confirmed by Brunschweiler's outcrop studies (1959). This shear lineament probably represents a very ancient suture which may extend deep into basement rocks, having undergone rejuvenation with each period of diastrophism. The trend is paralleled to the east and probably has morphological expression as the gaps in the McDonnell Ranges, well known to tourists. This interpretation is speculative but it does account for the observed phenomena.

Alice No. 1 may have been drilled on the flank of westerly plunging anticline and has been mapped as such. This anticline may be an overthrust feature, or alternatively, Alice No. 1 may have been positioned on the crest. Closure for Alice No. 1 is uncertain to the northwest and the southeast directions. A fault closure has been postulated in both directions on the basis of seismic record (Line 3.02 and 73-4-1.9X) and surface geology. No new prospects have been defined in the vicinity of Alice No. 1, however several leads are indicated nearby. Turnover is indicated on Line 73-4-1.7 about stations 210 - 220 a seismic line across this could reveal a closed structure.

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Two anticlinal trends may be postulated flanking the surface syncline to the east, that has expression on Line 73-4-1.7 about station 200. A possible northwest trending nose transverse to this trend is apparent in surface geology. East-west closure may also be augmented by possible north-south faulting either normal, transcurrent, or a combination of the two.

The mapped horizons (C-1, C-2 and D-1) were chosen to tie with the previous work. However Lines 73-4-1.6, 2.3 and 2.4 show a thinning of sediments above Horizon C-1 (Pacoota Sandstone). This thinning is so pronounced that the Pacoota Sandstone could pinchout on approaching Mt. Ooraminna. An isopach is presented in Figure 17 showing the thickness of all sediments between the top (?) of the Pacoota Sandstone and the base of the Mereenie Sandstone (?). All intervening formations are absent in outcrop near Mt. Ooraminna. Seismic record indicates a small basin (e.g. see Horizon C-1) and as Horizon C-1 does not have a strong character the possibility of pinchout cannot be overlooked. Pinchout of the Pacoota Sandstone appears possible anywhere after the 200 msec. isopach line on Figure 17 (based on reflection character continuity). The pinchout of the Horn Valley Siltstone with a combined facies change makes assessment of a caprock a new problem. Several closure possibilities exist: There may be completely closed stratigraphic traps encircling the small basin; although, this is unlikely as the postulated shear fault seems to dissect these small basins. The fault does however appear to have some vertical displacement which could provide closure prospects. The indications are that the Ooraminna Anticline started growing in the Ordovician and as such, probably predates the Alice Springs Orogeny - hence

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its 'continuity' across the postulated shear fault when compared to the smaller drag folds which emanate from faults.

A careful assessment of changes in thickness of the Pacoota Sandstone and adjacent outcropping beds would shed more light on stratigraphic variation in the area. This may enable estimation of sites of increased porosity due to facies changes near pinchouts. A careful evaluation of the organic content of these rocks indicates an alternative source rock to the Pacoota Sandstone is the Jay Creek Limestone. This is the formation which contained high oil saturations when penetrated in Alice No. 1. Outcrop studies have shown that algal bioherms are present in the formation which have a petroliferous smell when hammered. The low porosity of these sediments requires the presence of fracturing at potential trap sites.

The geological history of this northeastern area indicates that stratigraphic traps may be present in Cambrian or later Palaeozoic rocks. Hence more seismic surveying of the areas to the north and south of Ooraminna Anticline could reveal stratigraphic traps.

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Relationship of Seismic Record Quality to Structural Features

In some areas within the Amadeus Basin seismic records are excellent where in 'normal' geological situations a very poor record would be expected. Two notable examples of this occur in the Waterhouse and Mereenie areas (Line 73-3-AEX) and (73-1-GA4).

A geomorphological feature as striking as the Waterhouse Ranges might expectedly be flanked by normal faults. Consequently a seismic line along the flank would yield data obscured by diffractions and refractions. In the case of a fairly shallow thrust plane, as proposed in this interpretation, good reflections may be expected from a line along the forefront of overthrusting (See Figure 18). This situation may be observed on all lines abutting the Waterhouse Ranges on both flanks. In the Mereenie area, good records were obtained on the northern side of the Gardiner Range (Line 73-4-GA4), and the southern forefront to the Mereenie overthrust (Lines 73-4-4.5, 6.5, 7.5 and GE). Poor records have consistently been related to anticlines, on outcropping sandstones with one exception: Line 73-1-E which is located on the southern flank of Gardiner Range Anticline.

The poor data is then attributed to positioning over a near normal fault plane. In accord with the gravity low in this area, salt intruded along the fault plane would contribute to noise and "no record" problems.

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CONCLUSIONS AND RECOMMENDATIONS

All four subregions contain prospects and leads which may be developed. The Mereenie area contains the most favourable prospects owing to the proximity to known hydrocarbon accumulations.

A better understanding of this area should now enable planning of more seismic work to detail further prospects. Although several leads and prospects have been outlined in all areas, closure confirmation rests on the delineation of faults. In some cases gravity data have yielded information on the presence of faults, difficult to validate with seismic information. The cheapest and quickest available method that could yield valuable information on faults and fractures would be remote sensing using a variety of windows. Little information for immediate drilling has been revealed in most areas. The only exception to this is the trap on the south-eastern edge of the Waterhouse Ranges where further exploration would provide little more evidence for closure. The Pacoota Sandstone does not seem to have had as restricted an environment here as in areas to the west, so that target horizons below this need to be considered. The Ooraminna area has potential stratigraphic and structural traps which need definition by seismic surveying. This is an area of variable relief where the mapping of subsurface horizons may yield prospects. All areas surveyed to the west have a relatively uniform subsurface configuration and potential traps require definition of fault traces and their continuity for closure confirmation.

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All areas contain prospects or leads requiring definition by seismic surveying. The potential of the area for hydrocarbon accumulations has been proven, so that further exploration is a favourable proposition.

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BIBLIOGRAPHY

Adastra Hunting Geophysics Pty. Ltd., 1962.
Gravity Meter Survey, Part of O.P. 43, Mereenie Anticline, Northern Territory, (unpub., Magellan Petroleum, Corp.)

Benbow, D., Lawson, W. and Panalp, R.N., 1964.
Well Completion Report East Mereenie No. 1, Northern Territory for Exoil (N.T.) P/L. (unpub)

Brunschweiler, R.O., 1959.
Report to Enterprise Exploration Company P/L on Part I. The geology of Gosses Bluff (N.T.) and Vicinity and Part II/ A geological Reconnaissance in the Area between Hugh River and the Centralian Railway, Deep Well Siding and Maryvale Homestead, N.T. (unpub.)

Century Geophysical Corp. Tulsa, Oklahoma.
Mereenie Gravity Survey, 1961.

Forman, D.J., and Shaw, R.D., 1973.
Deformation of the Crust and Mantle in Central Australia. BMR Bulletin 144.

Forman, D.J., 1965.
The Geology of the Southwestern Margin of the Amadeus Basin, Central Australia. BMR Rep. 87.

Forman, D.J., McCarthy, W.R. and Milligan, E.N., 1966.
Regional Geology and Structure of the Northeastern Margin of the Amadeus Basin Northern Territory. BMR Rep. 103.

.../46

Haites, T.B., 1963.
Stratigraphy of the Ordovician Larapinta Group in the Western Amadeus Basin, Northern Territory for Magellan Petroleum (N.T.) P/L (unpub)

Hopkins, R.M., 1965.
Completion Report Palm Valley No. 1, Northern Territory for Magellan Petroleum Corp.

Institut Francais du Petrole, Bureau des Etudes Geologiques, 1961. Maps prepared for the BMR. Report on Photointerpretation of the Amadeus Basin (N.T.)

Langron, W.J., 1962.
Amadeus Basin Reconnaissance Gravity Survey using Helicopters. BMR Rec 1962/24. (unpub.)

Lonsdale, G.F. and Flavelle, A.V. 1963
Amadeus Basin and South Canning Basin. Results of Reconnaissance Gravity Survey using Helicopters Northern Territory and Western Australia, 1962. BMR Geophysics Prognosis Report No. 1963/24 (unpub.)

McNaughton, D.A., 1962
Petroleum Prospects - Oil Permits 43 and 56, Northern Territory, Australia. (unpub.)

McNaughton, D.A., Quinlan, R., Hopkins, R.M. and Wells, A.T. 1967. The Evolution of Salt Anticlines and Salt Domes in the Amadeus Basin, Central Australia, (Geol. Soc. of America Special Publication, 1967.)

Moss, F.J., 1963.
Ooraminna Seismic Survey, N.T. BMR Rec. 1966/57.

.../47

Patch, J.R., 1964.
West Mereenie Seismic Survey, Amadeus Basin N.T. for Magellan Petroleum (N.T.) P/L by United Geophysical 64/4549.

Quinlan, T., 1959.
An Outline of the Geology of the Alice Springs Area. BMR Record 1959/40.

Ranford, L.C., Cook, P.J. and Wells, A.T., 1965.
The Geology of the Central Part of the Amadeus Basin, Northern Territory. BMR Rep. 86.

Turpie, A. and Moss, F.J., 1963.
Palm Valley - Hermannsburg Seismic Survey, Northern Territory, 1961. BMR Rec 1963/5.

Thigpen, J.B., 1973.
Fracture Analysis, Palm Valley - Gardiner - James Ranges Anticlines by Geophoto Services, Texas Instruments Inc. Dallas, Texas for Magellan Petroleum (N.T.)P/L

Waterhouse, W.J., 1967.
Geological Field Mapping Report, Northwestern End of the Gardiner Range, N.T. Australia (unpub; Magellan Petroleum (N.T.) Pty. Ltd.)

Wells, A.T., Forman, D.J. and Ranford, L.C. 1965.
Geological Reconnaissance of the Northwest Amadeus Basin, Northern Territory. BMR rep. 85.

Wells, A.T., Stewart, A.J. and Skwartko, S.K., 1965.
Geology of the Northeastern Part of the Amadeus Basin N.T., BMR Rep. 108.

Wells, A.T., Ranford, L.C., Cook, P.J., and Forman, D.J. 1970.
The Geology of the Amadeus Basin Central Australia,
Bulletin No. 100.

Wells, A.T., and Kennewell, P.J., 1972.
Evaporite Drilling in the Amadeus Basin: Goyder Pass,
Gardiner Range and Lake Amadeus, Northern Territory.
BMR Rec 1972/36.

Williams, G.K., Hopkins, R.M., and McNaughton, D.A.
Pacoota Reservoir Rocks, Amadeus Basin, N.T. Australia.
APEA Journal p. 159-167.

.../49

APPENDIX I

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

.../50

Waterhouse

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

.../51

Mereenie

First Day	September 15th	February 15th
Last Day	November 28th	April 17th
Days worked	136	
Total Hours (excluding down time)		1167.75
Record Hours		672.25
Travel Hours		145.5
Camp Move hours		70
Weather hours		280
Holiday hours		-
Down hours		262.5
Profiles		3010
Km's coverage		421.82

Ooraminna

First Day	December 2nd	April 18th
Last Day	February 14th	April 27th
Days worked	76	
Total hours (excluding down time)		735.5
Record Hours		360
Travel Hours		61.0
Camp move hours		15.5
Weather hours		259.00
Holiday hours		40.0
Down hours		22
Profiles		1454
Km's coverage		194.26

.../52

APPENDIX II

MEREENIE

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.
73-1-JC	99	745.59	7327915	765573	80 m from creek.
73-1-JC	130	765.75	7330023	761777	I/S with 73-1-4.8.
73-1-4.7	100	713.95	7341002	771183	690 m from creek.
73-1-M2	100	777.90	7340983	765369	4.6 km from E. Mer.~~II~~ 2
73-1-M2	182	699.34	7334449	774803	7.1 km from E. Mer.~~II~~ 1
73-1-F	100	723.13	7364003	745677	160 m from sand hill.
73-1-M1	264	767.62	7353913	756318	7.3 km from Mer.~~II~~ 1
73-1-E	163	740.87	7368919	761655	897 m from I/S with 73-1-BN
73-1-E	100	734.01	7363899	768880	345 m from I/S with 73-1-4.5 Ext.
73-1-4.8	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	724265	58 m from I/S with 73-1-7.5
73-1-GE	100	648.43	7370561	717016	between two sand dunes.
73-1-GE	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	140m from E.O.L.
73-1-GA1	203	755.74	7364140	762746	at 7^{o} bend in line.
73-1-GA1	276	715.54	7370910	755095	at $6\frac{1}{2}^{o}$ bend in line.

MEREENIE (2)

LINE	STATION	ELEVATION	LATITUDE	DEPARTURE	LOCATION OF P.M.
73-1-GA3	100	798.27	7356830	802258	E.O.L.
73-1-GA3	155	777.59	7360814	795696	200 m from extra large gum tr
73-1-GA3	195	758.36	7363850	790983	I/S with GA3 ext.
73-1-GA3	202	764.48	7364380	790158	1 km from I/S with GA3 ext.
73-1-GA3 ext	212	783.21	7369337	777274	near rocky hills
73-1-GA4	100	780.01	7366588	778840	350 from creek bend.
73-1-GA4	114	765.42	7368409	779561	I/S with Ga3 ext.
73-1-F	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	738714	near I/S with 73-1-M1
73-1-6.5	299	694.08	7359846	731686	near I/S with 73-1-GE
73-1-6.5	445	690.90	7374600	745817	762 m from I/S with old line.
73-1-4.6	100	752.05	7347356	760485	at foot of range.
73-1-4.9	133	773.29	7339998	758292	in heavy scrub.
73-1-5.5	100	709.77	7373306	759842	in heavy scrub.
73-1-GA2 ext	67	723.65	7373656	757655	at foot of ranges.
73-1-4.6	182	730.80	7337618	754401	E.O.L.
73-1-4.5	319	759.08	7360679	765843	850 m from range.
73-1-GA1	504	665.89	7387108	728227	600 m from mill & tank.
73-1-GA1	350	691.42	7376859	746682	near 6^o bend in line.
73-1-BN	156	721.13	7369432	763233	near I/S with 73-1-GA2
73-1-GA1	100	813.31	7353443	772360	E.O.L.
73-1-4.9	100	763.69	7343857	760758	near rocky ridge.
73-1-M1	342	825.56	7347254	764988	E.O.L.
73-1-5.5	142	728.70	7368673	756138	E.O.L. near large sand dune

MEREENIE (3)

LINE	STATION	ELEVATION	LATITUDE	DEPARTURE	LOCATION OF P.M.
73-1-4.7 ext	195	778.43	7329192	761105	260 from flat rocky outcrop.
73-1-4.7 ext	141	792.47	7335070	765854	near range.
73-1-4.5	191	782.90	7346192	755259	near Mereenie ~~X~~ 1.
73-1-4.5	107	728.72	7338430	746503	I/S with 73-1-JC
73-1-F	400	750.16	7333127	717487	280 m from rocky outcrop.
73-1-M1	100	705.70	7367871	738071	0.8 km from I/6 with 73-1-6.5
73-1-6.5	100	739.71	7338787	713417	E.O.L.
73-1-7.5	201	665.23	7363784	723308	E.O.L.

PALM VALLEY

LINE	STATION	ELEVATION	LATITUDE	DEPARTURE	LOCATION OF P.M.
73-3-PV5	100	585.37	7352077	279815	2.1 km east of Hermannsberg airport.
73-3-PV5	170	576.86	7351612	270059	5 km from Hermannsberg on north bank Finke River.
73-3-PV4	100	604.83	7336564	291375	1.2 km north of James Range.
73-3-PV4/3	I/S	598.41	7348582	277057	2 km south from 1st grid on Hermannsberg to Alice Spring
73-3-PV 3/2	I/S	611.45	7350275	257673	4 km west of road to Pv ~~X~~ 1 1.5 km north of ranges.
73-3-PV2	195	678.12	7348571	245535	19 km west of road to Pv ~~X~~ 1 in rocky outcrop.
73-3-PV1	100	891.48	7342753	266221	5.2 km east of PV ~~X~~ 2
73-3-PV1	176	935.57	7342140	256833	0.5 km west of PV ~~X~~ 3

WATERHOUSE

LINE	STATION	ELEVATION	LATITUDE	DEPARTURE	LOCATION OF P.M.
73-1-1.7 ext	140	527	7312585	354004	2 km from track
73-3-3.3N	250	582	7343211	340613	at foot of range
73-3-3.3N	1	576.07	7347128	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	339973	E.O.L.
73-3-AEX	100	609.66	7340976	358078	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	7340860	357105	I/S with 73-3-1.6
73-3-AEX	I/S	559.55	7340501	337577	I/S with 73-3-3.3S
73-3-AEX	200	619.06	7340739	323289	I/S with 73-3-3.4
73-3-AEX	155	646.24	7343802	309743	I/S with 73-3-3.6
73-3-AEX	500	668.10	7345015	304434	E.O.L.
73-3-3.6	100	637.77	7336727	306703	E.O.L.
73-3-3.6	240	654.43	7354735	314438	E.O.L. at foot of hills
73-3-1.5	195	605.14	7344807	361510	1120 , from New South Road
73-3-1.5	100	568.07	7334222	369166	12.04 km from Main Road
73-3-1.6	163	630.85	7341523	356883	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	347022	560 m from Main Road
73-3-2.2	153/168	530.80	7319602	343362	140 m from Old South Road
73-3-2.2	93	510.45	7312912	338609	2.94 km from South Road
73-3-2.3	105	569.53	7318328	346207	1.12 km from fence
73-3-2.3	148	558.75	7324351	346155	on South Road 71 km from Alice Springs.

WATERHOUSE (2)

LINE	STATION	ELEVATION	LATITUDE	DEPARTURE	LOCATION OF P.M.
73-3-2.3	265	577.50	7340720	346008	At foot of Waterhouse Range
73-3-3.4	100	562.03	7326882	323209	E.O.L.
73-3-3.2S	153	512.99	7321351	334880	At foot of James Range
73-3-3.2	152	518.18	7322356	335557	At end of a ridge
73-3-3.2	133	514.48	7323925	336635	Near I/S with 3.3S
73-3-3.2S	184	518.03	7318432	333572	E.O.L.
73-3-3.2	100	515.88	7326649	338481	E.O.L.

OORAMINNA

LINE	STATION	ELEVATION	LATITUDE	DEPARTURE	LOCATION OF P.M.
73-4-1.1	100	517.03	7370936	405798	8 miles 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	390843	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	406263	bend (6^{o}) 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	396560	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	7367787	409702	E.O.L.
73-4-2.2	100	533.95	7358764	387750	near railway line

OORAMINNA (2)

LINE	STATION	ELEVATION	LATITUDE	DEPARTURE	LOCATION OF P.M.
73-4-2.1	100	532.96	7356284	391236	E.O.L.
73-4-1.9 ext	208	504.05	7352923	403887	1.6 km from Sante Teresa Rd.
73-4-1.9 ext	100	526.10	7355358	393379	1.6 km for Alice No. 1
73-4-1.9	133	526.38	7356994	391614	Near I/S with 73-4-2.1
73-4-1.9	100	532.93	7359426	387686	E.O.L.
73-4-1.9	115 }	529.16	7355015	394838	I/S with 73-4-1.1
73-4-1.9 ext	160 }				
73-4-2.3 ext	100	530.49	7337704	400481	0.8 km from well
73-4-2.3 ext	134	523.53	7341008	403904	E.O.L.
73-4-2.4	145	569.80	7333183	389022	E.O.L.
73-4-2.4	100	559.69	7327082	390587	1.5 km from 73-4-2.3
73-4-2.3	100	532.90	7334877	396480	E.O.L.
73-4-2.4	111	562.45	7328573	390204	I/S with 73-4-2.3
73-4-2.3	171	557.61	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	199	516.52	7359498	397941	190 m from Santa Teresa Rd,
73-4-1.1	285	551.84	7349567	391077	140 m from Old South Road
73-4-1.1	314	570.52	7346310	388659	I/S with 73-4-1.5
73-4-1.1	399	554.35	7337276	380946	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	268	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
73-4-1.6	257	530.25	7328828	397893	40 m from fence.

APPENDIX III

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, utilising 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.

.../59

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.

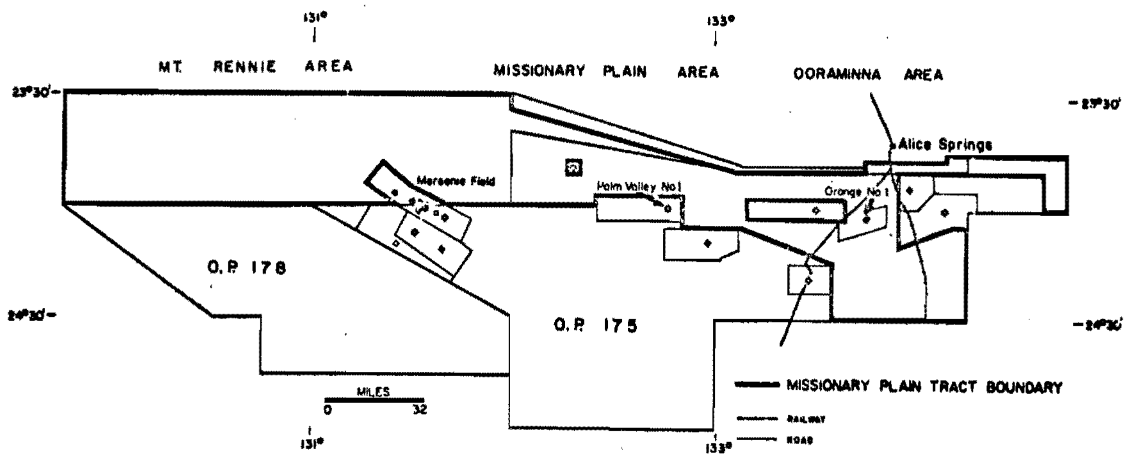
.../60

APPENDIX IV

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 Assistants	(15)

LOCATION MAP



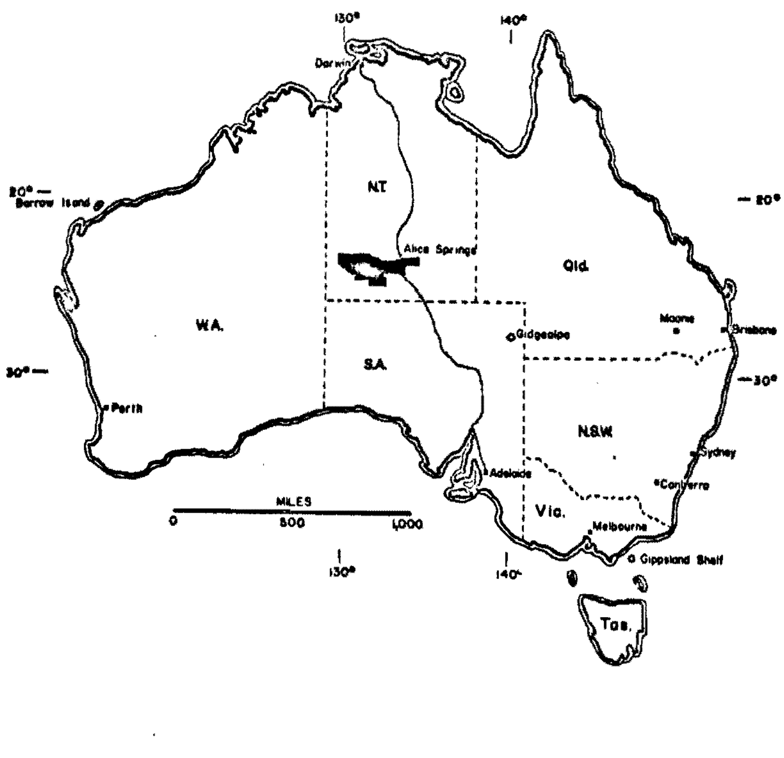
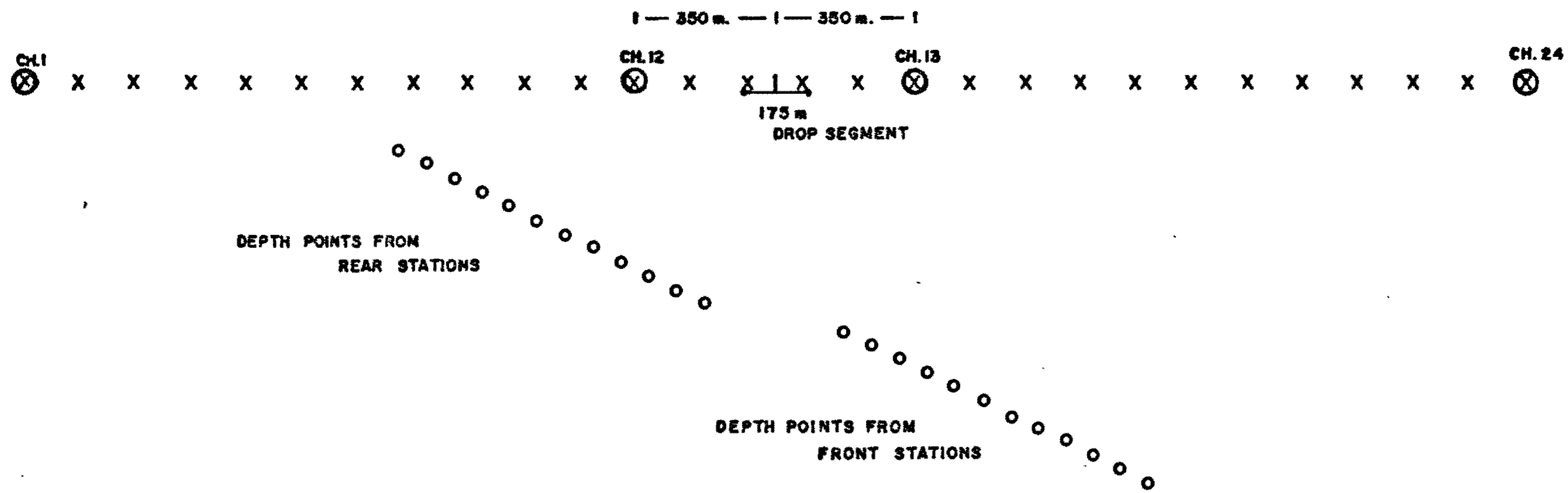


FIGURE 1

FIELD TECHNIQUE — 12 CDP

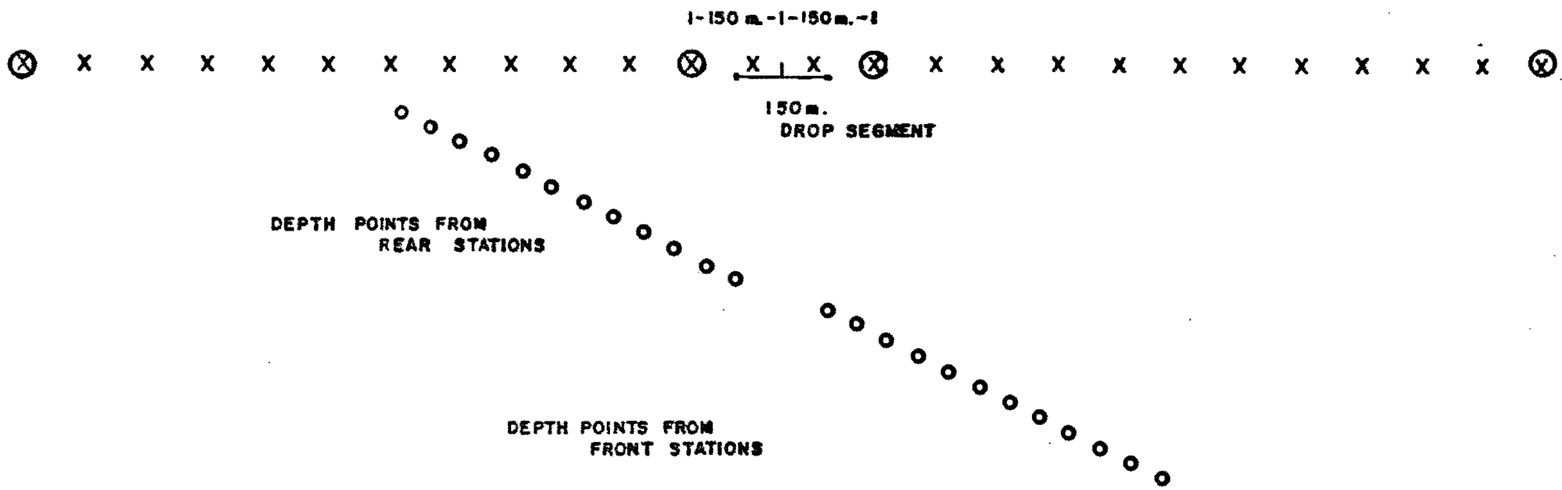


STATION INTERVAL: 140 m.
GEOPHONE ARRAY LENGTH: 136 m.
DROP SEGMENT: 16 drops / 175 m.

INITIAL OFFSET: 350 m.
FAR OFFSET: 1890 m.

FIGURE 2

FIELD TECHNIQUE — 12 CDP

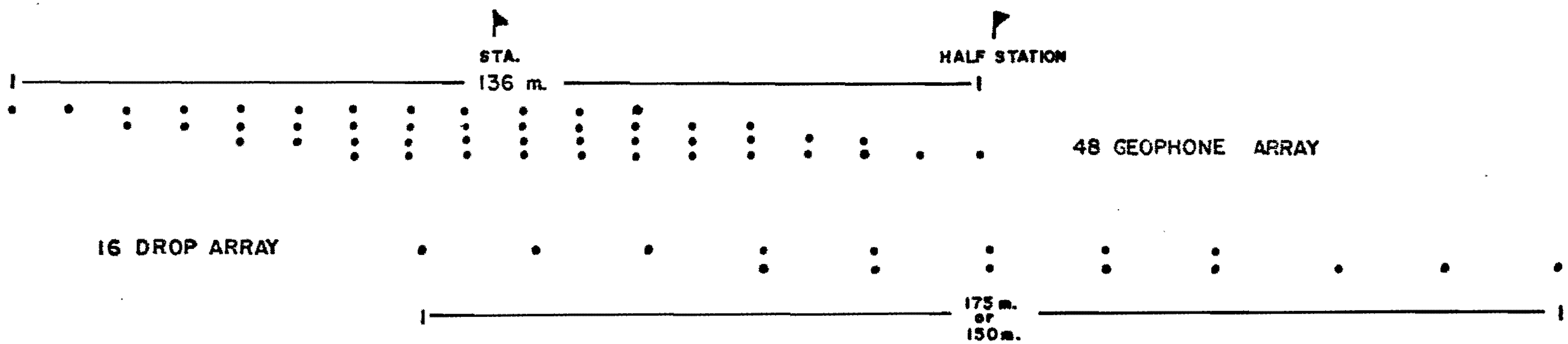


STATION INTERVAL: 100 m.
GEOPHONE ARRAY LENGTH: 136 m.
DROP SEGMENT: 16 drops/ 150 m.

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

FIGURE 3

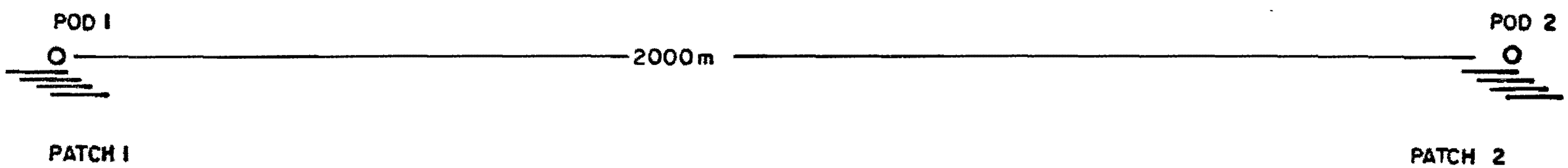
GEOPHONE and SOURCE ARRAYS



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

FIGURE 4

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 10 m. INTERVAL UNTIL POD 2 WAS REACHED—A TOTAL OF 201 DROPS.

FIGURE 5

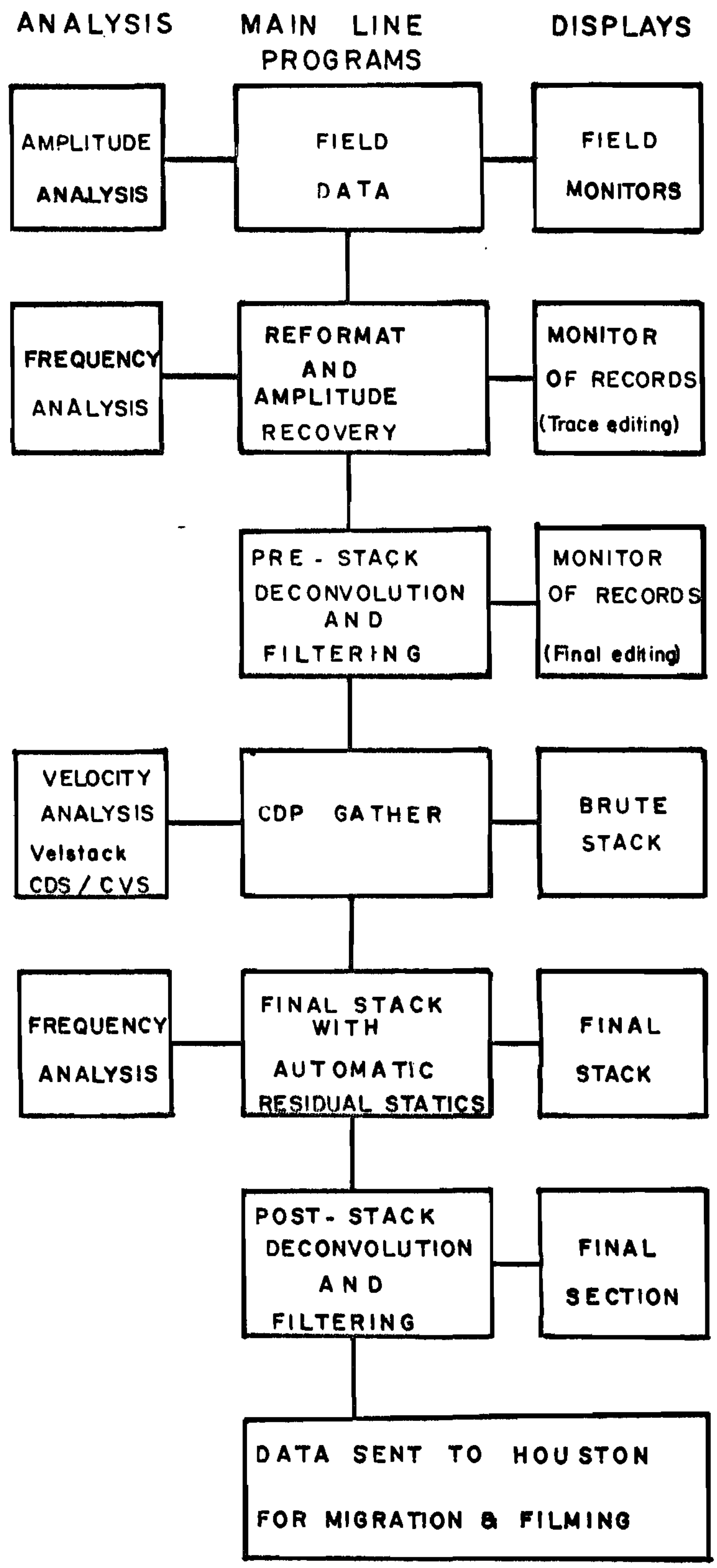
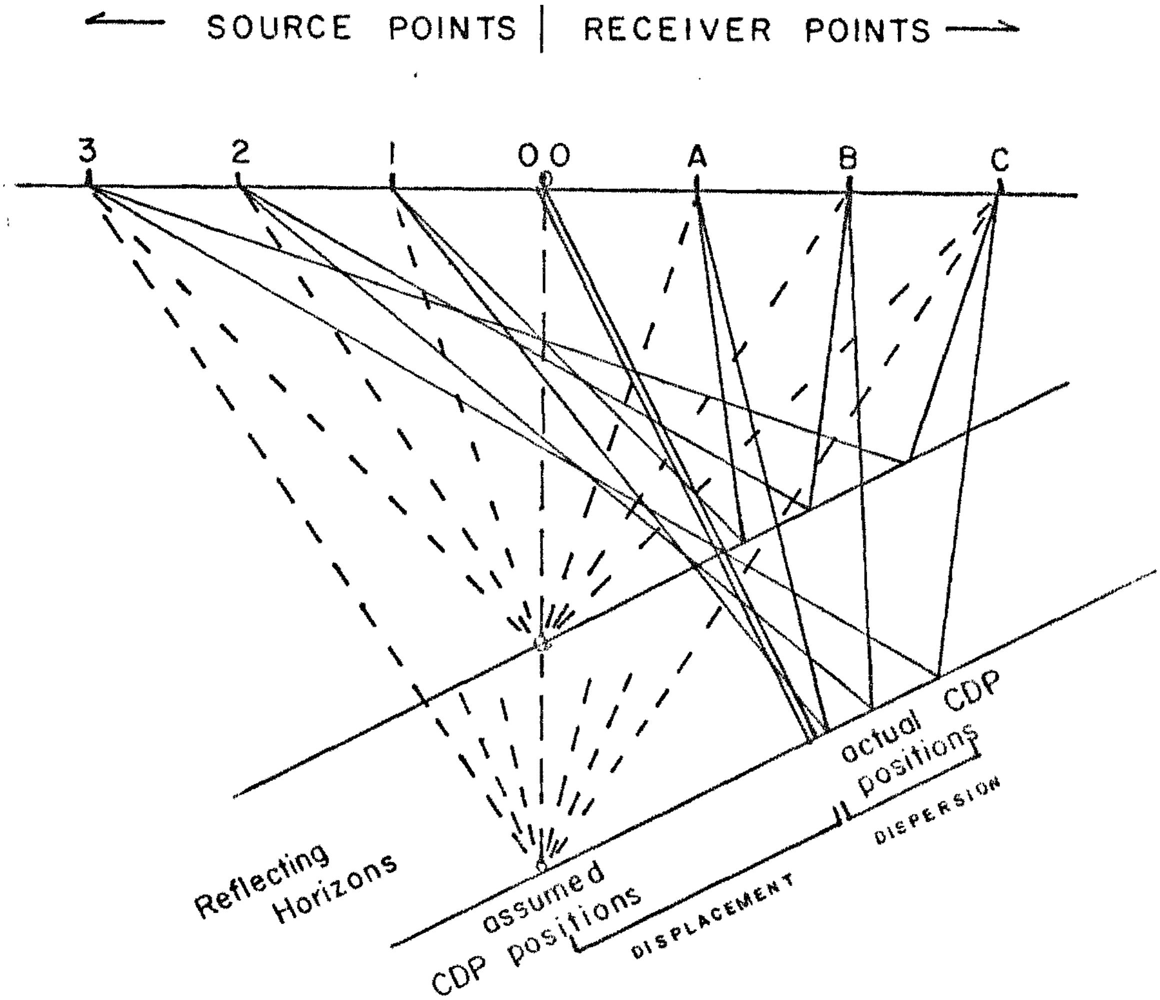

ANALYSIS
MAIN LINE PROGRAMS
DISPLAYS
AMPLITUDE ANALYSIS
FIELD DATA
FIELD MONITORS
FREQUENCY ANALYSIS
REFORMAT AND AMPLITUDE RECOVERY
MONITOR OF RECORDS (Trace editing)
PRE - STACK DECONVOLUTION AND FILTERING
MONITOR OF RECORDS (Final editing)
VELOCITY ANALYSIS Velstack CDS / CVS
CDP GATHER
BRUTE STACK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

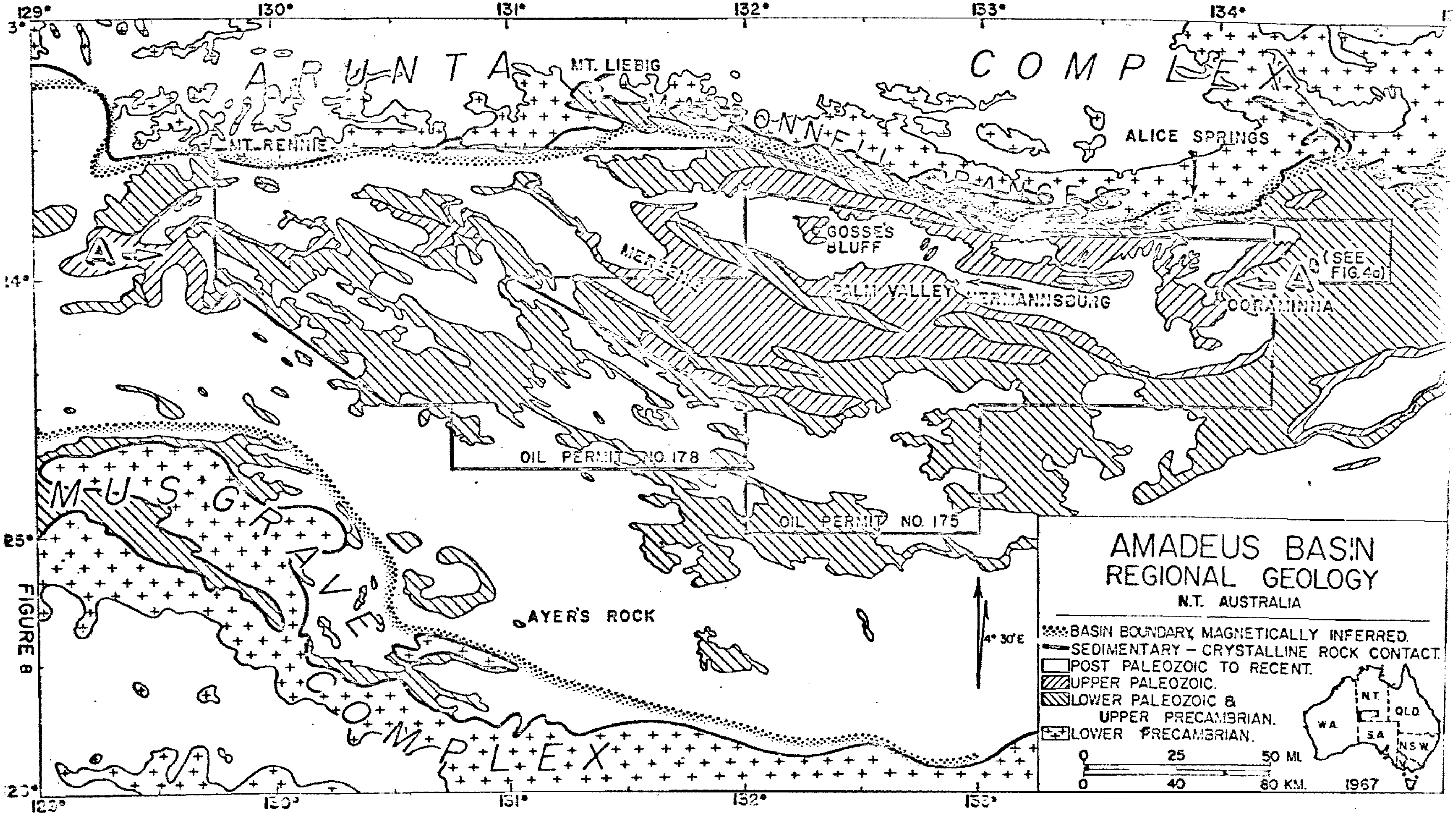
FIGURE 6



The greater the offset, the greater the dispersion & displacement.
The greater the depth, the greater the displacement — the less the dispersion.

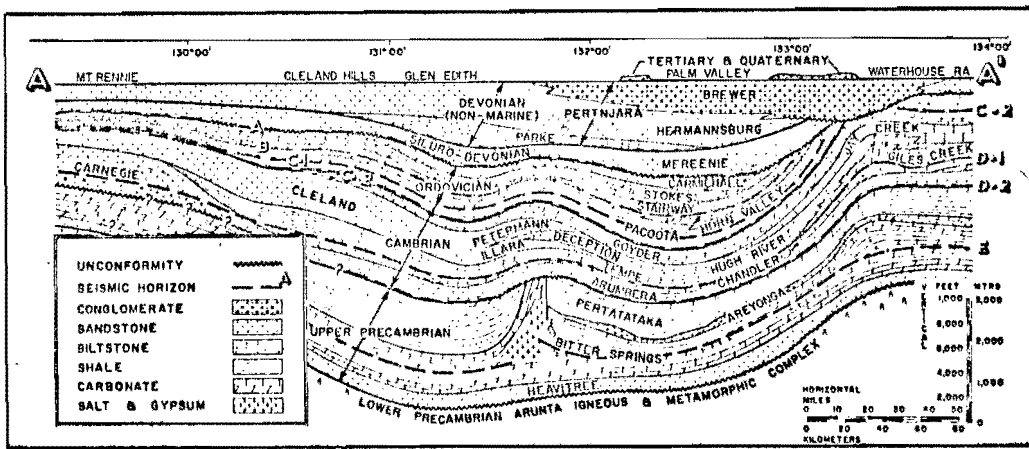
Structural relationships can thus be grossly misrepresented in the time section, and in certain cases trends reversed.
In the case of a high angle normal fault occurring in a section of strong dip, the time section can distort the pattern sufficiently to yield a high angle reverse fault.

FIGURE 7



ARUNTA COMPLEX
MT. LIEBIG
MACDONNELL RANGES
MT. RENNIE
ALICE SPRINGS
GOSSE'S BLUFF
PALM VALLEY
HERMANNSBURG
OORAMINNA
(SEE FIG. 4a)
OIL PERMIT NO. 178
OIL PERMIT NO. 175
MUSGRAVE COMPLEX
AYER'S ROCK
4° 30' E
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.
1967
W.A.
N.T.
QLD.
S.A.
N.S.W.
129°
130°
131°
132°
133°
134°
24°
25°

FIGURE 8



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

FIGURE 9a

AGE	ORIGIN	GROUP	FORMATION AND PREDOMINANT LITHOLOGY (WEST) (EAST)	THICKNESS	AVERAGE MEASURED DENSITY SURFACE	AVERAGE MEASURED DENSITY CORE	Average Velocity of Formation Ft/2/ms*	REMARKS
TERTIARY TO RECENT	CONTINENTAL		Dune Sd, Gvl, Alluv, Ls, Coal, Silcrete, etc.	0-1000'		2.10	9.0±2.0	
DEVONIAN TO PERMIAN?	SYNOROGENIC	PERTNJARA	BREWER Cgl, Ss	0-12000'			8.0±2.0 (Est)	
	LACUSTRINE		HERMANNSBURG Ss	0-3000'		2.47		
			PARKE Sltst, Ss	0-3000'		2.66		
SILURIAN? TO DEVONIAN	AEOLIAN TO DELTAIC		MEREENIE Ss	800'-2600'	2.15	2.40	8.9±1.0	HORIZON 'A'
UPPER ORDOVICIAN	REGRESSIVE MARINE (OSCILLATING)	LARAPINTA	CARMICHAEL Ss, Sltst	0'-500'	2.34	2.54		
			STOKES Sltst, Sh, Ls	0'-1800'		2.70	9.9±0.7	
MIDDLE ORDOVICIAN			STAIRWAY Ss, Sltst	0'-1830'	2.49	2.53	7.6±2.4	HORIZON 'B'
LOWER ORDOVICIAN	EUXINIC TO TRANSGRESSIVE MARINE		HORN VALLEY Sltst, Sh, Dol	0'-800'		2.54	7.2±1.1	HORIZON 'C-1'
			PACOOTA Ss, Sltst	900'-3500'	2.47	2.51	7.9±1.2	CAMBRIAN REFLECTION HORIZON 'C-2'
UPPER CAMBRIAN	PARALIC AND DELTAIC IN WEST	PERTAOORRTA	GOYDER Ss, Dol, Sh	0'-1800'	2.60	2.64	8.4±1.1	
MIDDLE CAMBRIAN		CLELAND Ss	PETERMANN Ss / JAY CREEK (SHANNON) Ls	2500'-6000'	2.66	2.70	8.9±0.4	
	MARINE CARBONATE AND EVAPORITIC IN EAST		DECEPTION Sltst / HUGH RIVER Sltst			2.69	7.9±1.0	
			ILLARA Ss / GILES CREEK Dol			2.72	8.3±0.8	
			TEMPE Sh, Sltst, Ls / GILES CREEK Dol			2.80		HORIZON 'D-1'
LOWER CAMBRIAN			CHANDLER Salt, Sh, Ls / TODD RIVER Dol	0'-1000'		①	7.7±0.7	
	PARALIC-DELTAIC		ARUMBERA Ss, Sltst	0'-3130'	2.44	2.77 / 2.33	7.9±?	HORIZON 'D-2'
UPPER PRECAMBRIAN (UPPER PROTEROZOIC)	EUXINIC ?	CARNEGIE Ss	PERTATATAKA Sh, Sltst, Dol, Ls	0'-4000'±		2.71		PRECAMBRIAN REFLECTION HORIZON 'E'
	PERIGLACIAL ?		AREYONGA Sh, Ss, Dol, Cgl					
	EVAPORITIC		BITTER SPRINGS Ls, Dol, Salt, Sh	3000'±		2.68 ①	10.0±0.8 (Est)	
	TRANSGRESSIVE		HEAVITREE Ss, Sltst, Qtzite	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'

TABLE 1. SUMMARY OF FORMATIONS, NORTHERN AMADEUS BASIN, AUSTRALIA

FIGURE 9b

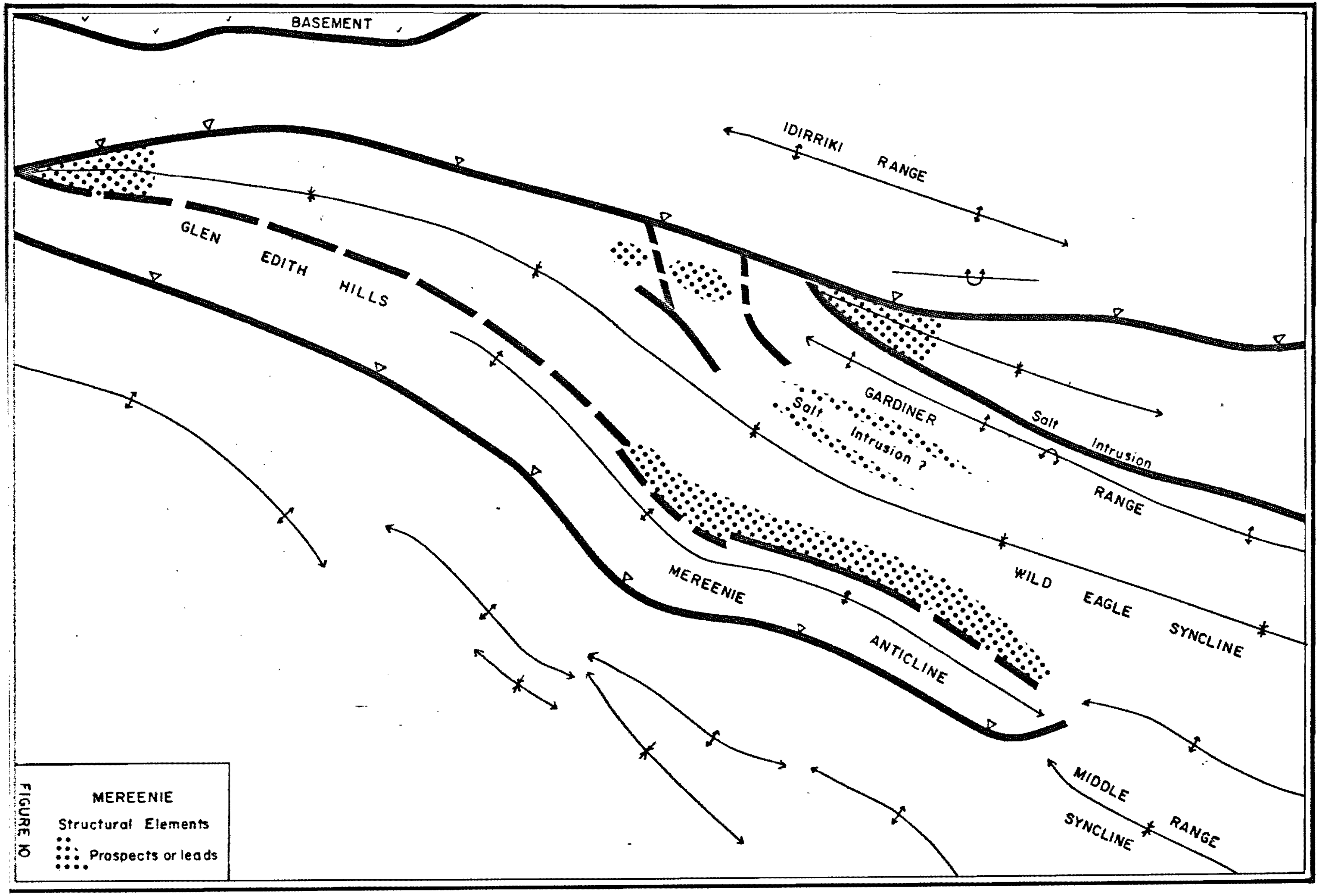

BASEMENT
IDIRRIKI RANGE
GLEN EDITH HILLS
GARDINER RANGE
Salt Intrusion ?
Salt Intrusion
WILD EAGLE SYNCLINE
MEREENIE ANTICLINE
MIDDLE RANGE SYNCLINE
MEREENIE
Structural Elements
Prospects or leads

FIGURE 10

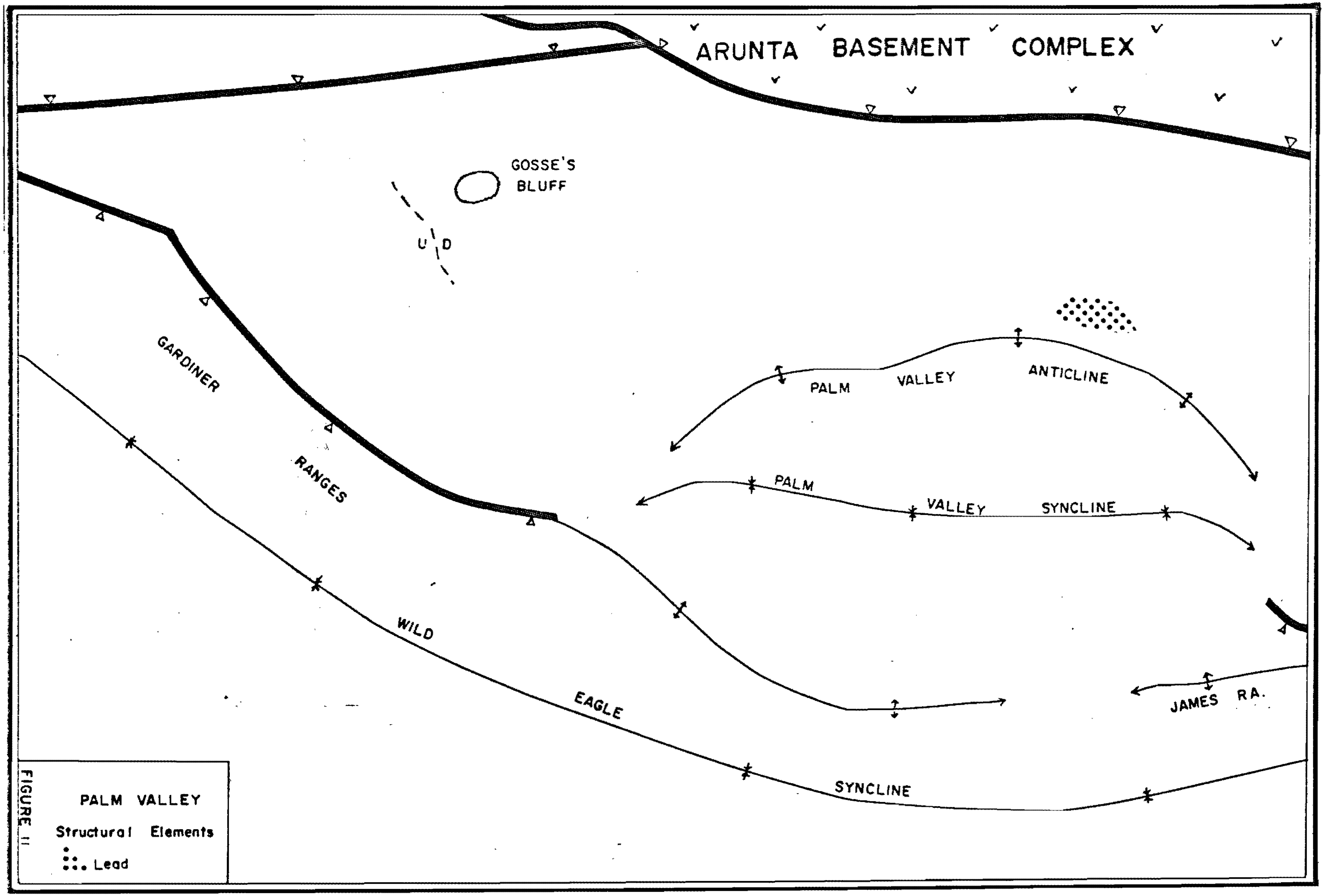


FIGURE 11

PALM VALLEY

Structural Elements

Lead

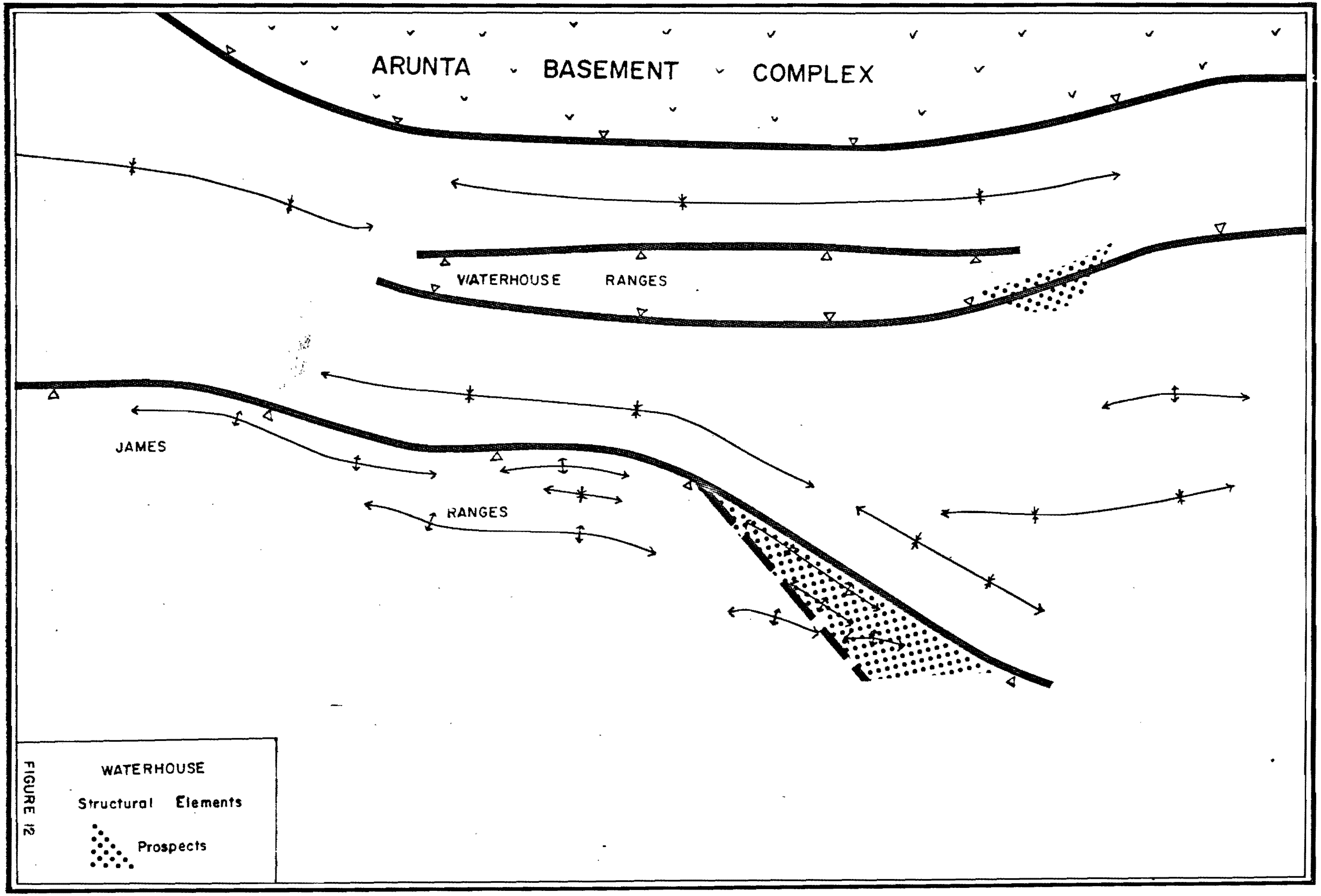
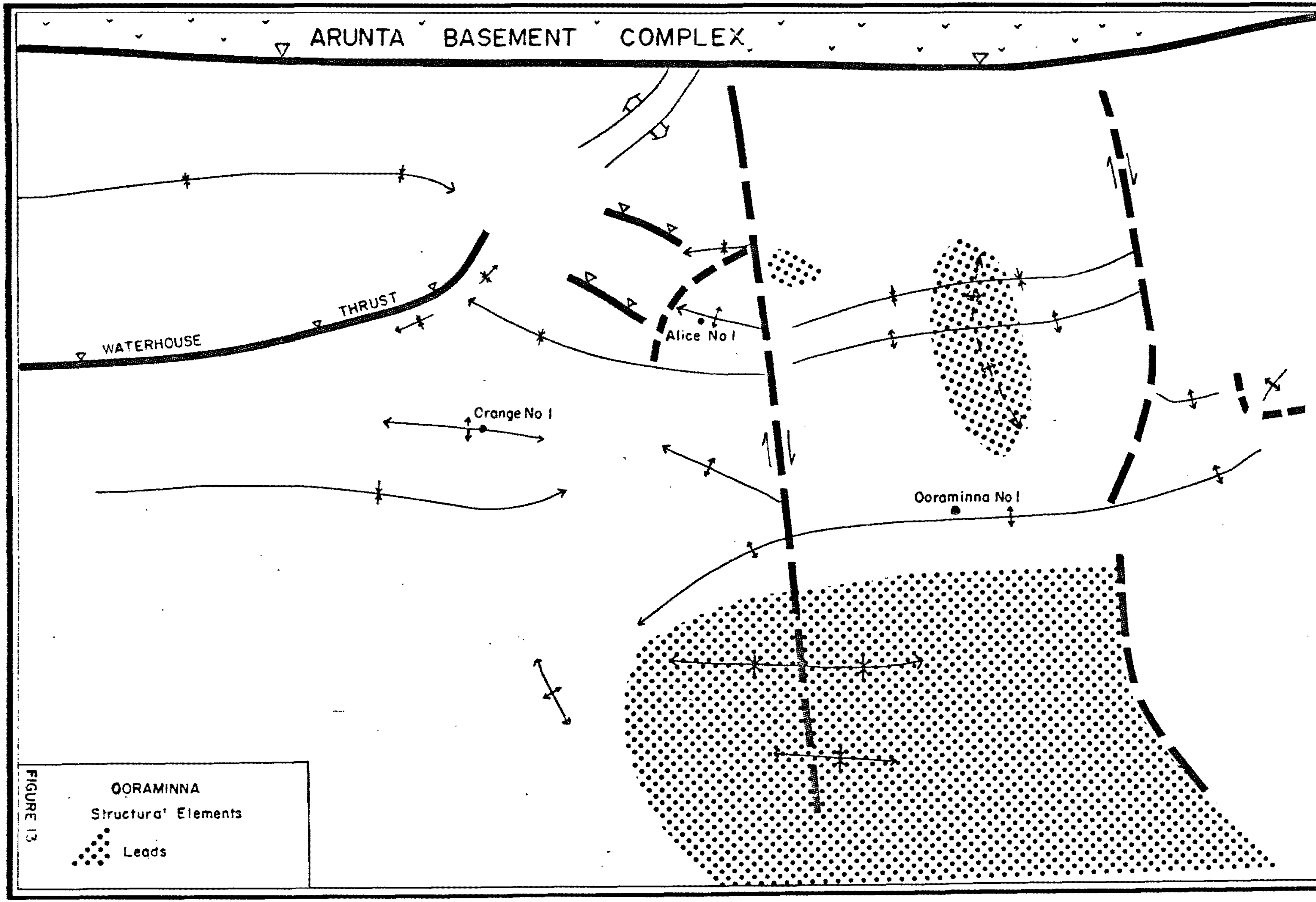


FIGURE 12

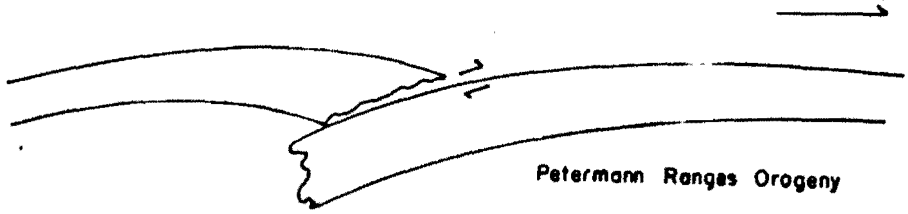
WATERHOUSE

Structural Elements



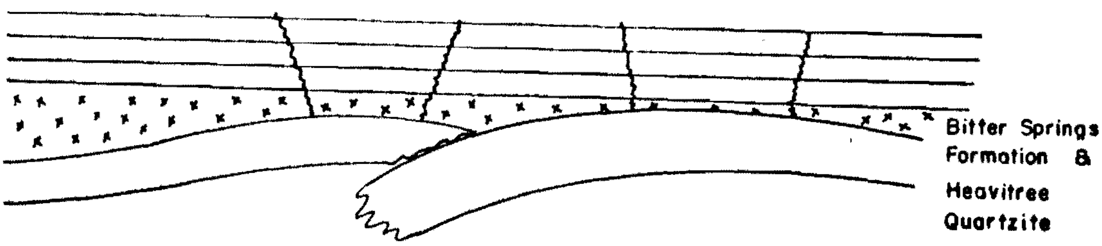
ARUNTA BASEMENT COMPLEX
WATERHOUSE THRUST
Alice No 1
Orange No 1
Ooraminna No 1
OORAMINNA
Structural Elements
Leads
FIGURE 13

1. OVERTHRUSTING FROM THE SOUTH



(a)

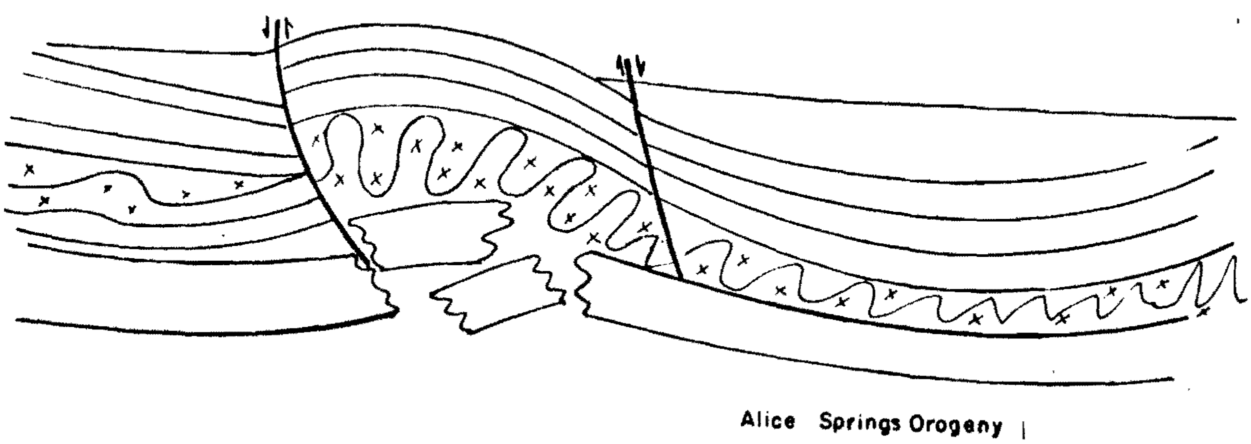
2 DEPOSITION



Stress and fracture development radiate from lower plate.

(b)

3. OVERTHRUSTING FROM THE NORTH



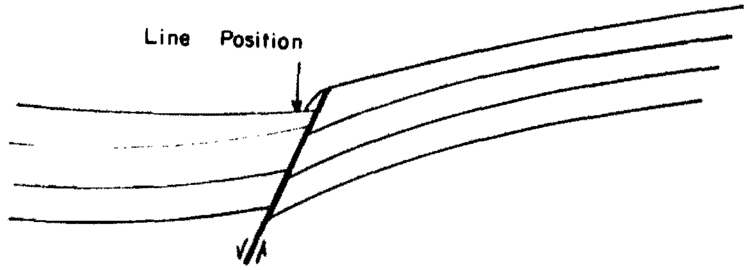
Isoclinal folding and intrusion of Bitter Springs Formation.

Assimilation and metamorphism of lower plate(?).

(c)

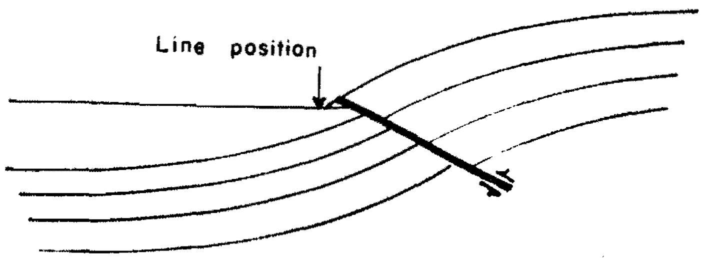
MEREENIE: POSTULATED DEVELOPMENT OF ANTICLINES

FIGURE 14



Poor seismic record.

(a)



Good seismic record.

(b)

FIGURES: 18 a, b

SEISMIC RECORD & STRUCTURE

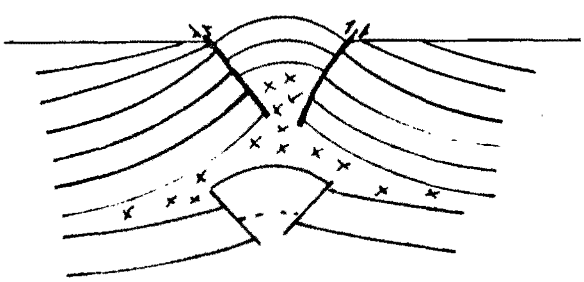


FIGURE 15

WATERHOUSE: 'MUSHROOM' STRUCTURE

FIGURES 15 & 18

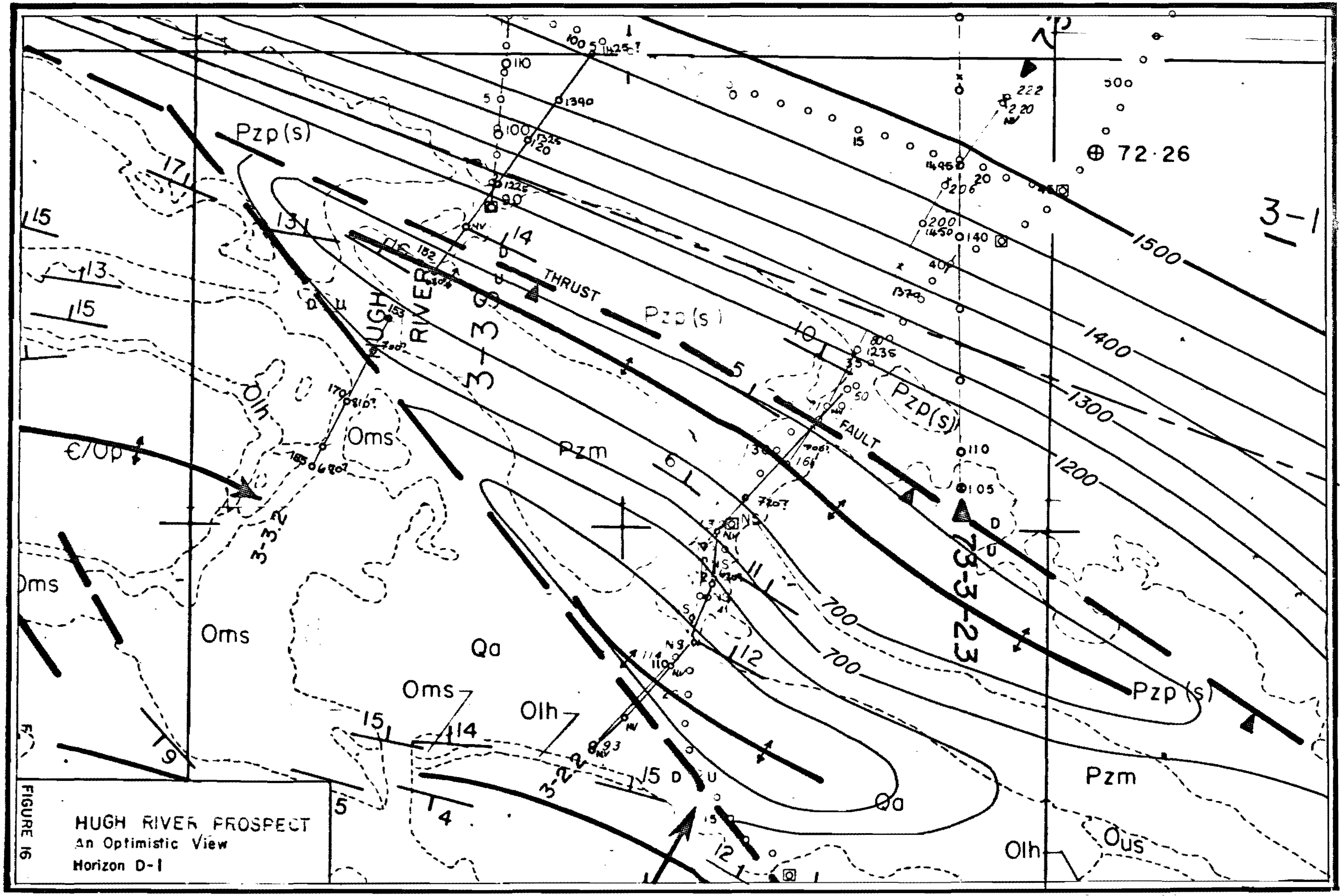


FIGURE 16

HUGH RIVER PROSPECT
An Optimistic View
Horizon D-1

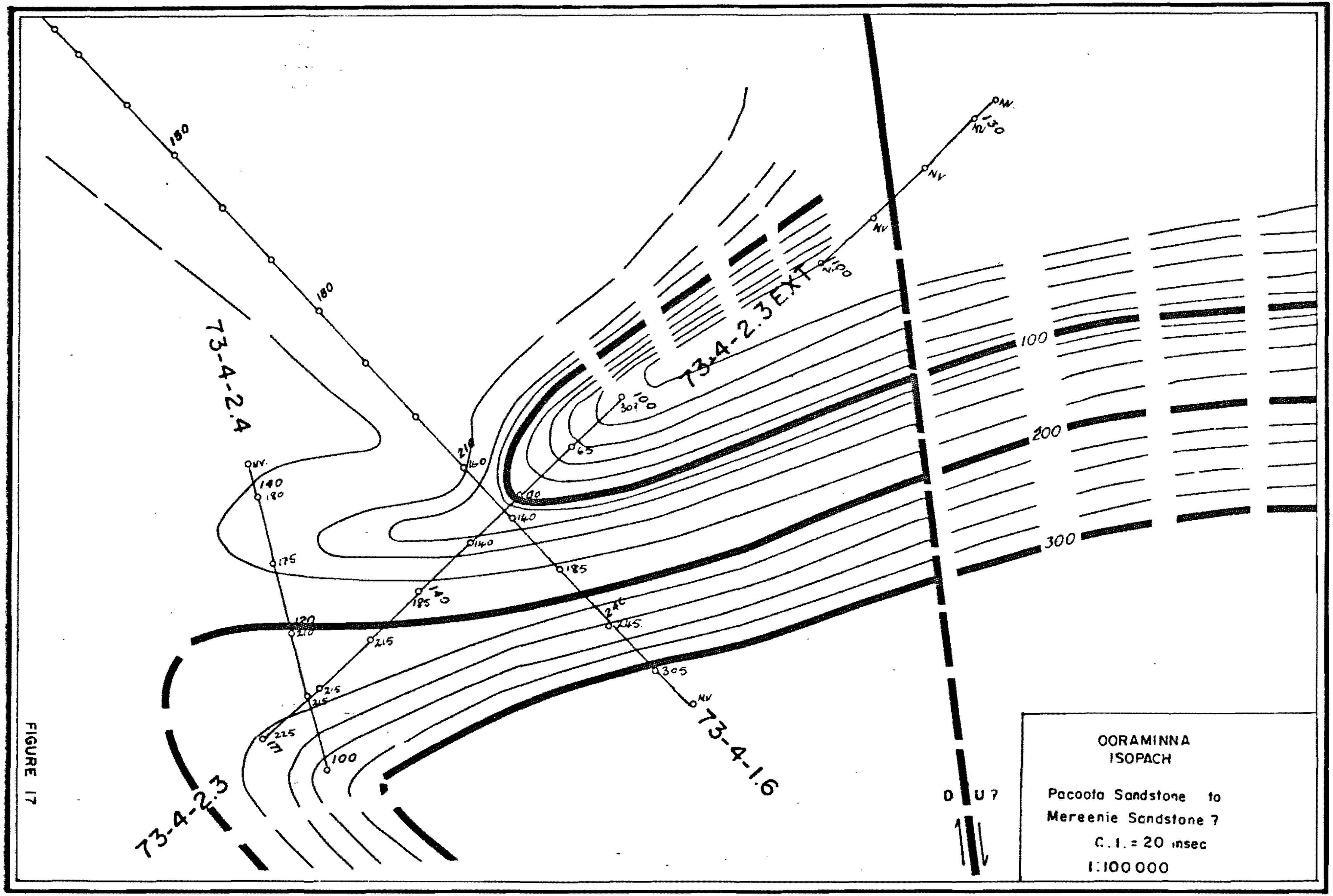

73-4-2.4
73-4-2.3 EXT
73-4-1.6
73-4-2.3
100
200
300
D
U ?
OORAMINNA
ISOPACH
Pacoota Sandstone to
Mereenie Sandstone ?
C. I. = 20 msec
1:100 000

FIGURE 17