Northern Territory Government

InfoCentre

NT Minerals and Energy

Petroleum Exploration Reports

This file contains scanned images of hardcopy reports/data submitted to the Northern Territory Government under Petroleum Legislation.

Bringing Forward Discovery

This information is made available to assist future petroleum explorers and may be distributed freely.

Scanning information

The quality of the scan reflects the condition of the original hardcopy report/data.

InfoCentre

Call:	+61 8 8999 6443
Click:	geoscience.info@nt.gov.au www.minerals.nt.gov.au
Visit:	3rd floor Centrepoint Building Smith Street Mall Darwin Northern Territory 0800

MEREENIE SEISMIC SURVEY

O.L. 4 - O.L. 5

FINAL REPORT

Prepared By

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

UNITED CANSO OIL & GAS CO. (N.T.) PTY. LTD.

For

MEREENIE JOINT VENTURE

OCTOBER, 1982

C O N T E N T S

FIGURES

PLATES

1. INTRODUCTION

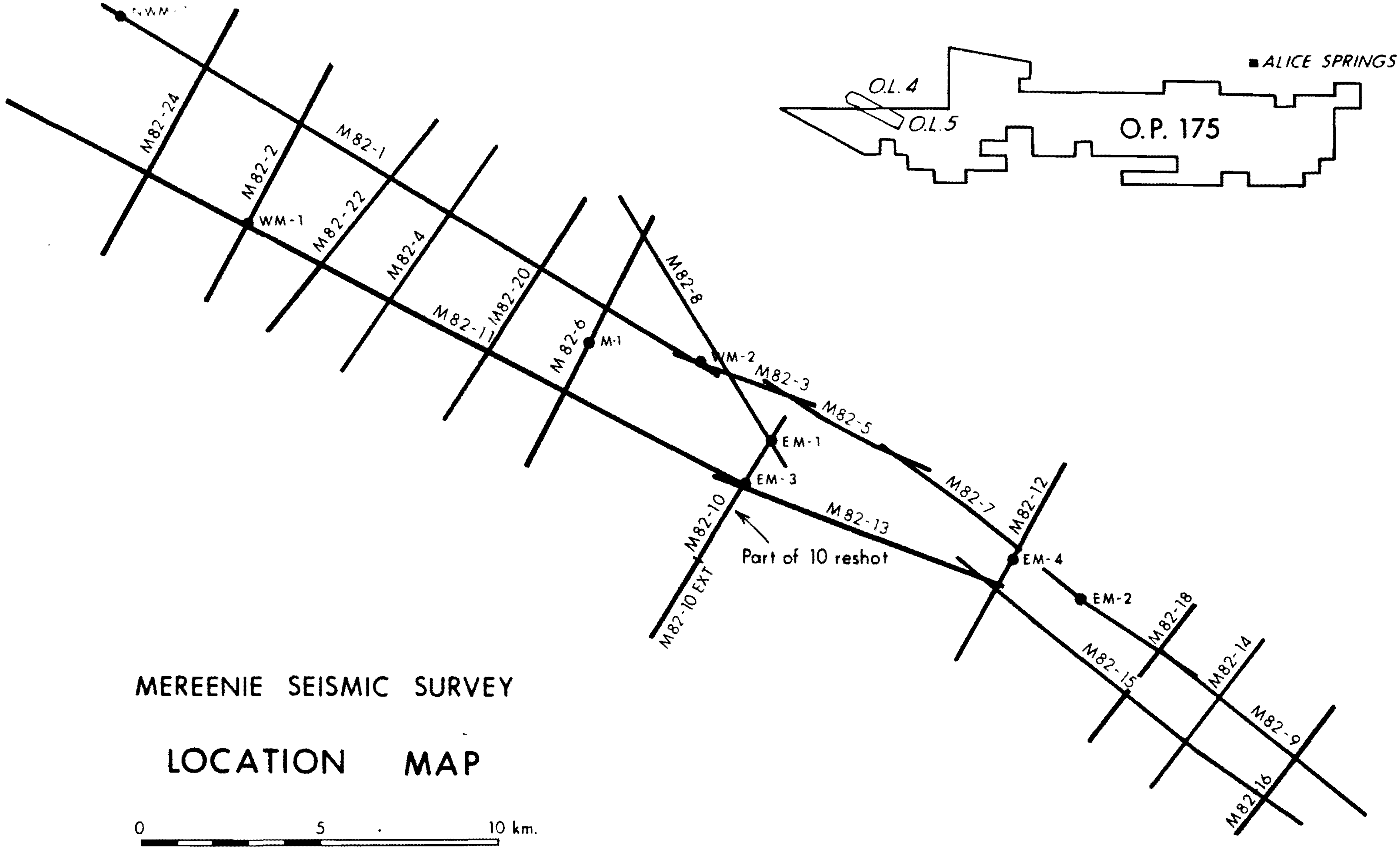
The Mereenie Seismic Survey was carried out by Magellan Petroleum (N.T.) Pty. Ltd. on behalf of the Mereenie Joint Venture during the period December 1981 to February 1982.

The object of the seismic survey was to provide sub-surface information on structural trends and associated faulting. This survey is the fourth seismic survey conducted on the field, previous surveys having been carried out by Namco International Inc. (1962), United Geophysical Corporation (1964), and Mandrel Industries Inc. (1973).

The survey was carried out by Seismograph Service Limited using vibroesis as an energy source. Processing was carried out by Petty-Ray Geophysical.

The current survey acquired 186.3 kilometres of 12 fold data which in most cases was a considerable improvement over previous data. In general, the survey confirmed the overall shape of the field whilst indicating that two separate culminations are present. Reverse faults associated with the thrusting on the south flank were also identified.

The total cost for the survey to June 30, 1982, was $771,810. Final costs will be advised but are not expected to exceed $850,000.



MEREENIE SEISMIC SURVEY

LOCATION MAP

FIGURE 1

PR 82/76 (ii)

2. REGIONAL GEOLOGY

The regional geology of the Amadeus Basin is contained in the text of the Technical Report Mereenie Field Project (Section 2.1).

The regional geology of the Mereenie structure and a discussion of previous seismic survey results are contained in Sections 2.2 and 2.3.1 of the Mereenie Report. A detailed discussion of the stratigraphy of the Pacoota sandstone is contained in Section 4.2.2 of the Mereenie Report.

Recent drilling results have not altered the stratigraphic succession or changed the regional appraisal of the field.

3. M E R E E N I E S E I S M I C S U R V E Y

3.1 FIELD OPERATIONS

For a complete description of the field operations refer to the enclosed "Field Area Report" provided by Seismograph Service (England) Limited. This also includes a detailed listing of all permanent marker co-ordinates and elevations.

3.2 DATA PROCESSING

Processing was carried out by Petty-Ray Geophysical in Brisbane. A datum of 650 metres above mean sea level was used.

Field tapes were transcribed to Petty-Ray MPX-1 format and the field gain was removed.

The summed data was correlated with the field filtered sweep and put to tape.

Transmission and spherical divergence effects were compensated for. Dynamic trace equalisation was also performed so that all traces in a field record were of equal strength. The field records were then displayed for editing purposes.

The records were reorganised into common depth point gathers with all bad traces edited. Field statics were computed to datum and placed in the trace headers but not applied.

Deconvolution tests were run and a predictive deconvolution operator with a live length of 80 msecs was chosen. It was run over one window which was offset dependant. At 150 metres the window runs from 300-1500 msec and at 1300 metres the window runs from 800-2000 msecs. By applying an offset dependant start time, the operator can be designed on data which is free from front end noise.

The data were then trace equalised using a 500 msec window.

Datum statics were applied.

All of the data were then corrected for normal moveout and muting of the traces was performed.

Automatic residual statics with a maximum shift of ± 10 msecs were then run over one gate prior to stacking the data.

Various filter panels were then displayed but it was found that no digital filtering was required.

The data were balanced using 500 msec windows.

Wave equation migration was then run on all data in an effort to locate the position of Mereenie Thrust zone and reduce noise still present on data.

3.3. INTERPRETATION

3.3.1 QUALITY OF DATA

The data varies from fair to good in the southeastern part of the field to poor in the northwestern end of the field.

3.3.2 HORIZON IDENTIFICATION

The following horizons were identified from time-depth curves which were calculated from the sonic logs of EM #2 and EM #4:

a) Stairway
b) Pacoota
c) Goyder

Tentative identification of the following horizons were also made:

d) Base Cambrian
e) Bitter Springs Salt
f) Heavy Tree Quartzite

3.3.3 MAPPING PROCEDURE

Initially the three horizons; Stairway, Pacoota, and Goyder were picked and tied around the field using the 1982 Mereenie survey only. Once this was done, the 1973 Thumper data, shot by Magellan, was integrated where the quality of the data was good enough. The 1981-1982 Pancontinental lines were also included in the interpretation where they had an effect on the understanding of the Mereenie field.

Because all three surveys in this interpretation used different seismic reference datums, bulk shifts had to be applied to bring all the events to the same level. Below are the shifts applied:

Survey	Datum (metres)	Shift (msecs)
Mereenie	650	0
1973 Thumper	550	+80
1981/82 Pancon	850	-40

3.3.4 DEPTH CONVERSION

Time-depth curves for all three horizons were calculated using data from the east end of the field.

Initial depths for each horizon were calculated using the RMS velocities annotated at the top of the section. A plot of two way time against depth was made and a best fit straight line was fitted to the values using the least squares method. Using the original two way times, new depths were calculated. Where the seismic line tied with a well, the percentage difference was calculated between the well depth and the predicted seismic depth. The percentage values (correction factors) were then contoured and all depth values readjusted to give the final depths.

The equations for the time depth curve as calculated are as follows:

Top Stairway — c.c. .983
Depth = 2.4824 (T.W.T.) - 163.18

Top Pacoota — c.c. .986
Depth = 2.577 (T.W.T.) - 202.07

Top Goyder — c.c. .985
Depth = 2.7453 (T.W.T.) - 324.91

If a similar method is used to produce a time-depth curve for the Pacoota from the time-depth curve for EM #2, EM #4, EM #6, then the following equation is arrived at:

Top Pacoota c.c. .999
$$\text{Depth} = 2.38 \ (\text{T.W.T.}) - 196.64$$

As a further check against the method used time-depth curves were calculated for the Pacoota and Goyder using seismic information from the north and centre of the field. The following equations were arrived at:

Top Pacoota c.c. .8651
$$\text{Depth} = 2.4598 \ (\text{T.W.T.}) - 257.03$$

Top Goyder c.c. .956
$$\text{Depth} = 2.725 \ (\text{T.W.T.}) - 404.28$$

3.3.5 <u>TYPE SECTION - Line MM82-09</u> (Plate 14)

The Stairway is picked as the middle peak of a rather weak doublet. This horizon is not consistent over the whole field.

The Pacoota is also picked as the middle peak of another rather weak doublet. It again is not consistent over the whole field. This is attributed to surface conditions rather than any inferred geologic change in the formation top.

The Goyder is picked as the small peak at the top of a prominent triplet. This triplet is probably caused by the dolomite horizon which is near the top of the Goyder and has a stronger reflection coefficient compared to the surrounding sands. The seismic character of the Goyder is fairly consistent throughout the whole field.

The base Cambrian is identified as a low frequency trough overlying a fairly strong angular unconformity. This horizon has not been mapped owing to its lack of continuity on the seismic data.

A large salt pillow is also identified within the Bitter Springs formation. This feature can be seen on several of the cross lines from the survey.

The ringing events below the Bitter Springs Salt Pillow is interpreted as the Heavy Tree Quartzite and Basement.

The following table shows the exact position of all the events for line MM82-09 V.P. 1120, along with estimated thicknesses and depth below mean sea level from the RMS velocity at that location:

Horizon	T.W.T. (msecs)	Depth (ft.)	Thickness (ft.)
T. Stairway	690	2952	
			1154
T. Pacoota	825	4106	
			1158
T. Goyder	960	5264	
			3152
Base Cambrian	1300	8416	
			4173
T. Bitter Springs Salt	1750	12589	
			1397
T. Heavy Tree Qtzite	1900	13986	

4. INTERPRETATION RESULTS

The mapping has revealed that the Mereenie field is comprised of four main structural units.

4.1 MEREENIE THRUST

This is a prominent thrust zone which bounds the southwestern flank of the Mereenie structure. It has its maximum throw in the western half of the field (3000 feet at the Pacoota level - line MCF-06 - Plate 8) and decreases in a southeasterly direction. (1000 feet estimated throw at eastern extremity of license area). The thrust direction is indicated as originating from the northeast which ties the Mereenie Thrust zone to the Alice Springs orogeny. It has its root in a decollment zone in the Bitter Springs Salt which is seen to underlie the whole field. Mapping shows that the thrust zone intersects the oil bearing sands of the Pacoota formation thus confirming that it is an element in the hydrocarbon trapping mechanism. There is also evidence for reverse faulting on the northeastern flank of the field northeast of NWM #1 (P81-GE8, P81-TV3, from 1981 Pancontinental survey).

4.2 MEREENIE ANTICLINE

This is an elongate feature which runs parallel to the entire length of the Mereenie Thrust zone. It is generally asymmetric with less crestal inflection on the plunging nose to the southeast. The anticline can be subdivided into two major culminations which parallel the thrust zone but are offset with respect to each other. The southeastern culmination is the larger of the two and has a relief of over 750 feet (Plate 8). The northwestern culmination is smaller in areal magnitude but has a relief of over 1000 feet (Plate 7). Hydrocarbons have been found in EM #9, 8, and 6 outside the closing contour of 1750 feet below mean sea level for these two culminations. This indicates that a third mechanism is present in the trapping of hydrocarbons, besides the thrust zone and structural relief, in the Mereenie field. The axis of the anticline is also observed to migrate away from the thrust zone as it climbs up into progressively younger horizons.

4.3 REVERSE FAULTING

Four reverse faults have been identified cutting the Mereenie anticline. These faults exhibit an increasing rate of throw towards the west end of the structure (100 feet to the west on MM82-15 and 1500 feet to the west on MM82-24 in comparable structural positions). This is attributed to the more intense thrusting seen on the western end of the field. These faults tend to die out as they move away from the thrust zone. It is expected that more of these reverse faults exist on the field but the quality and spacing of the data is not adequate to detect them. However, the evidence at the east end of the field indicates that here they are not a major influence in trapping of hydrocarbons. Where their throw increases in the west they may be more important.

Normal faults are noticed at the Cambrian level on MM82-16 (Plate 15) which become reverse faults at the same level on MM82-12 (Plate 16). This reversal of these normal faults is attributed the Mereenie Thrusting. It is also possible that the reverse faults mapped at the Pacoota level are themselves old normal faults which have been reactivated and penetrated to higher levels.

4.4. MEREENIE SYNCLINE

Evidence for this syncline is only seen on lines MM82-10, MM82-20, and MM82-06 (Plate 17) on the southwestern side of the Mereenie Thrust zone. The axis of this syncline lies underneath the Mereenie Thrust Sheet west of line MCF-10. Obviously the potential for a second field below the present one is good where the Pacoota abuts against the thrust zone but predicting the depth to this zone is difficult from the available data.

4.5 EVIDENCE FOR GROWTH DURING PACOOTA DEPOSITION

An apparent isopach map (Plate 13) for the Pacoota interval was also prepared using the depth values for Pacoota and Goyder. It should be emphasized that these values are only apparent thicknesses and do not take into account the dip of the formations. Therefore, if we take an average dip of 15 degrees from the horizontal, a thickness of 1300 feet becomes 1255 feet. The isopach map shows a general thickening of the Pacoota to the northeast.

Along the crest of the structure, the thickness ranges from 1000-1200 feet with localized thicker and thinner zones.

On the southwestern flank of the structure, two prominent thins can be seen where the thickness decreases to 700 feet.

The mapping would, therefore, indicate that during the deposition of the Pacoota formation there was salt movement at depth which created local highs and lows.

It should be emphasized, however, that there are only five wells (at the time of writing) which penetrate to the Goyder to give us real isopach measurements and also the methods used to convert the formations to depth also have inherent inaccuracies in them. From 403 sample points of seismic thickness, we calculate the mean thickness (M) to be 1102 feet. This corresponds to five well observations giving M to be 1049 feet.

The conclusion, therefore, is that there is evidence for growth of the Mereenie structure during deposition of the Pacoota but that until further wells are drilled, this concept should be treated with caution.

5. R E C O M M E N D A T I O N S

5.1 O.L. 5

The amount and quality of data recorded in O.L. 5 is considered to be sufficient for determining the structure of the field in this area, and that no further useful information could be gained by a similar survey.

5.2 O.L. 4

Because the quality of the data recorded in this area is less than that in O.L. 5, it leaves the interpretation more open to question. Lack of well control is also a major problem in tying through no data areas. Further seismic is recommended to try and improve the mapping of this Lease. Particular attention should be paid to the near surface noise problems in different parts of the field and the length of the spread should be tuned to the depth of the Pacoota as it varies over the field. Any future wells that are drilled in this Lease, in the near future, should also have well velocity check shots carried out on them to improve our depth conversion techniques.

6. CONCLUSION

The Mereenie Seismic Survey has provided a comprehensive subsurface interpretation of the Pacoota sandstone for the first time. The thrust fault at the north flank of the field has been identified and several cross faults associated with it have also been mapped. Well ties and projections at the eastern end of the field have conformed with the seismic picks to within ± 30 feet.

Data at the western end of the field are less reliable but are of sufficient quality to allow subsurface predictions to be accepted with reasonable confidence. Further drilling on the west end is necessary prior to programming future seismic surveys.