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FINAL REPORT

on the

WEST WALKER CREEK PROSPECT SEISMIC SURVEY

Oil Permit 43

Northern Territory

Submitted to

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

by

NAMCO GEOPHYSICAL COMPANY

DALLAS

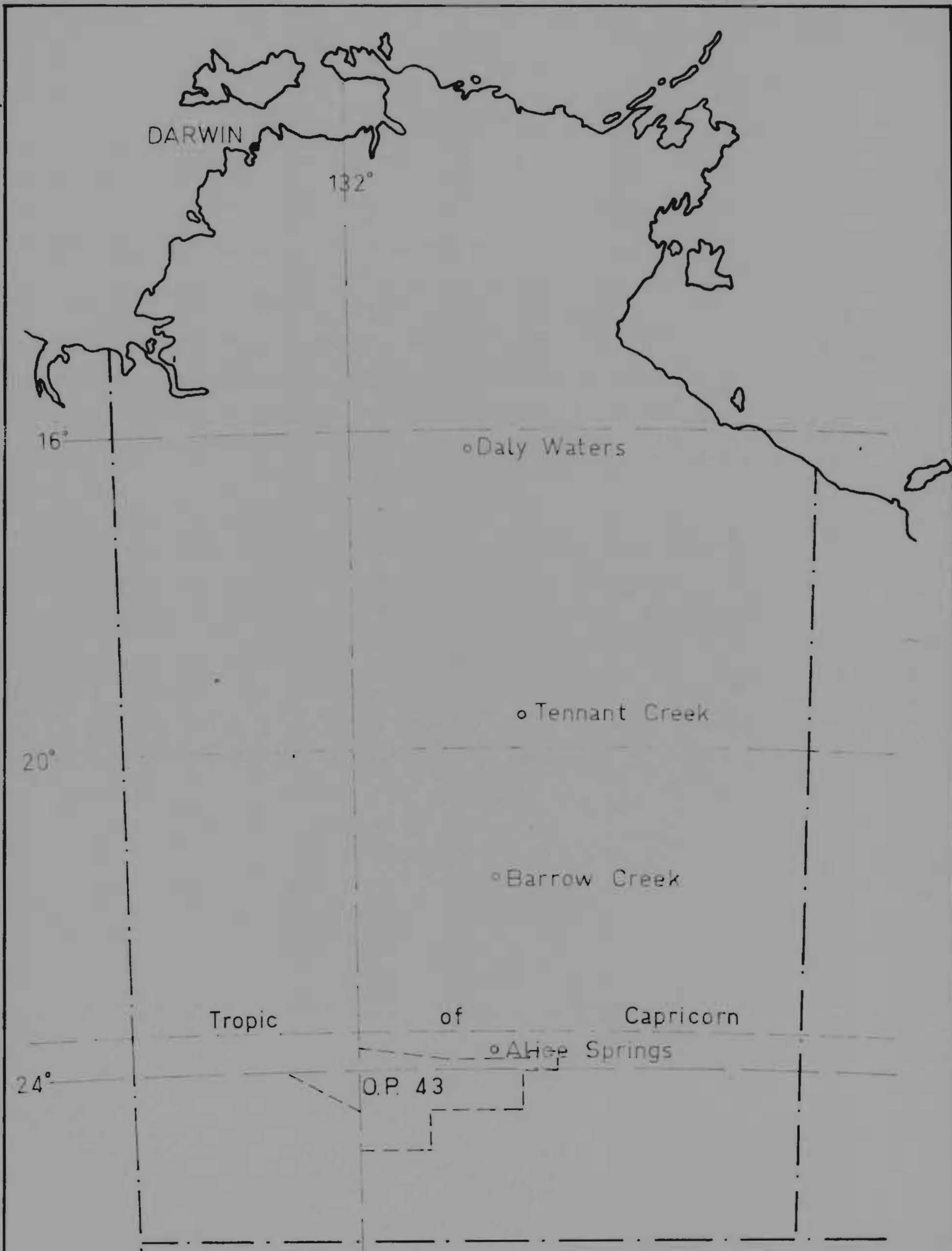
C O N T E N T S

ABSTRACT

A reflection seismic survey was conducted during August, 1965 for Magellan Petroleum (N.T.) Pty. Ltd. by Party 85 of Namco Geophysical Company within Oil Permit 43 in the Northern Territory of Australia.

The objective of the survey was to determine the crestal configuration of the west end of the Walker Creek anticline and to define the presence, if any, of east plunge along the axis of the fold.

The results of the survey suffer from very poor data on the crest of the fold and tend to be inconclusive. Very little east plunge has been described and the fold has been depicted as gradually west-plunging.



Scale 192 miles to an Inch.

LOCATION MAP

1. INTRODUCTION

The West Walker Creek Prospect Seismic Survey was conducted within Oil Permit 43 of the Northern Territory for Magellan Petroleum (N.T.) Pty. Ltd., the registered office of which is at Mitchell Chambers, Mitchell Street, Darwin, N.T. The Location Map (frontispiece) shows the regional location of the area.

The geophysical contractor was Namco Geophysical Company of Dallas, Texas, U.S.A., with Australian headquarters at 15 Franklin Street, Adelaide, South Australia. Details of equipment and personnel used are presented in Appendices I and II, respectively. Commencement and completion dates, along with other statistical data, are presented in Appendix III.

Oil Permit 43 is located in the south-central section of the Northern Territory. From Alice Springs the survey area is accessible by the main south road to the Henbury Airport corner, then west on the Tempe Downs Station track; beyond the station the access is more laboured and follows old unimproved tracks to Tempe Tent Hill.

The West Walker Creek Prospect is located within the confines of the sandstone bluffs edging the valley of West Walker Creek. The meanders of the creek and its tributaries dissect the low lying sand hills within the valley; the deep erosional cuts of the creeks present numerous barriers to seismic operations and necessitate the use of bulldozing, creek filling and detours in working the area.

The climate of the area is normally fine and clear. Although one inch of rain fell prior to the commencement of the survey, the area is normally arid and surface water is restricted to several deep pools along creek courses.

2. OBJECTIVES OF THE SURVEY

The objective of the survey was to determine crestal configuration of the west end of the Walker Creek anticline. If east plunge could be demonstrated under the Pertnjara siltstone valley west of the exposed core of the anticline, structural closure would be established and a drilling location could be selected.

3. LOCAL GEOLOGY*

The Walker Creek prospect is part of an anticlinal trend at least 120 miles long. Structures forming this trend include, from west to east, Glen Edith Hills, Mereenie, and Walker Creek anticlines. The part of the crest on which seismic work was planned was the twelve mile stretch between the east plunge of the Mereenie and the west plunge of the Walker Creek anticlines, which is here designated the "West Walker Creek Anticline".

The core of the West Walker Creek anticline is outlined by rim-rock of Devonian Pertnjara sandstone. Pertnjara siltstone forms the bedrock along the crest. The saddle separating the Mereenie and West Walker Creek anticlines is demonstrated by the outcrop pattern of the Pertnjara formation, and also by surface dips of the beds. Thus there is no doubt that the Mereenie and Walker Creek folds have separate culminations.

A saddle between the west plunge of Walker Creek anticline and the West Walker Creek anticline is a possibility that cannot be proved by surface geology.

Field work has demonstrated that there is a zone 8 to 10 miles long along the axis where no plunge is indicated by the structure of the rim-rock. A separate closure is possible and it is reasonable to speculate that a significant amount of closure could exist at depth. Analogies can be shown with both the

James Ranges anticlinal trend to the northeast and the Johnny's Creek - Petermann Hills anticlinal trend to the south. In the James Ranges two distinct culminations are present that would not be evident from the Pertnjara outcrop pattern alone. Likewise in the anticlinal trend to the south, separate culminations are known in the older rocks: Tempe Downs, Johnny's Creek, Parana Hill and Petermann Hills. Although these culminations are well defined by the Ordovician - Cambrian outcrop pattern, they are poorly indicated in the Mereenie formation.

Furthermore, the west end of the Mereenie anticline shows no closure in the Pertnjara and Mereenie formations. Contours on the Pacoota demonstrate about 200 feet of closure, whereas the gas column indicates the presence of at least 1,400 feet of closure. Therefore, closure in the Ordovician can be significant where no closure is evident in the overlying Devonian rocks.

A complete section of Ordovician rocks comparable to those of the gas-bearing Mereenie anticline can be anticipated in the subsurface. By comparison with the exposures in the deeply eroded core of Walker Creek anticline, a thick section of Cambrian can be expected. The following chart gives the forecast stratigraphic section and the comparative sections to the east and west:

	Mereenie Wells	West Walker Ck. Anticline	Walker Ck. Anticline
Pertnjara Siltstone		Up to 1350'	
Mereenie	1825	1800	1760
Stokes	1015	1000	1000
Stairway	775	680	590
Horn Valley	230	215	200
Pacoota	990	1075	1160
Goyder	670+	800	800
Undifferentiated Cambrian	?	2400+	2400+

4.* PREVIOUS GEOPHYSICAL WORK

1. Seismic work - nearest seismic work consists of B.M.R. shooting 20 miles to the north east on the north side of the Gardiner Range, Gardiner Range - Gosse's Bluff - MacDonnell Range Traverse, and limited shooting on and northwest of Mereenie anticline, 30 miles west-north-west, by Namco, 1963 and United, 1964.

2. Gravity work - the B.M.R. Reconnaissance Gravity Survey, 1959-1961, covers this area with the seven-mile grid spacing.

   No other geophysical work that would contribute to this particular area is known to have been done.

   * By Magellan Petroleum (N.T.) Pty. Ltd.

5. FIELD PROCEDURES

The continuous reflection profiling method of seismograph exploration was used in acquiring subsurface data. The normal shot point spacing was eighteen hundred feet along the lines. Using twelve detector elements per group, eleven seismometer groups were spaced at 150 feet intervals between shot points, the twelfth group was centred at the adjacent shot point to provide completely reversed end trace times. The standard detector interval within each group was about 14 feet. Refer to Figure 1, Typical seismometer spread.

Recording of the seismic signals was accomplished using SIE GA-22A seismic amplifiers, a PR011 oscillograph, and an SIE PMR-20 FM tape recorder and field playback unit. A monitor seismogram and a magnetic tape recording were recorded simultaneously on each shot using a 1-20 = 2-100 filter setting with each seismometer group independently activating its respective galvanometer and magnetic tape trace. The magnetic tapes were later played back through the field playback machine using a two section 25-60 filter setting, selected as optimum for the area.

Shot holes were obtained by two combination air-water drills. For the most part, a water injection, air-drilling procedure was used. The drilling conditions were fair; however, sandstone boulders, near surface sand and long water hauls impeded drill production.

All of the instrument spreads were chained then surveyed for horizontal and vertical control by alidade and plane table. The datum for the elevations was bench mark 75-22 near Tempe Downs Homestead. A base line was run from the homestead to the prospect using three American Paulin Surveying Altimeters in a double repeat technique to carry elevation control into the prospect. The traverse may suffer from disturbed atmospheric conditions during the course of the survey but the order of accuracy is considered to be ± 8 feet. Shot point locations are based on aerial photography and although the relative shot point positioning is accurate to within 300 feet, geodetic control is rather sparse in the area and prohibits accurate positioning.

6. QUALITY OF DATA

The quality of the data must be termed poor. Data on Lines 1 and 2 are considered the best obtained and the dips suggested provide a good measurement of the attitudes across the fold. The data on Lines 3 and A are extremely poor and the interpreter must rely on short reflection segments to make an intepretation.

During the course of the survey some experimental shooting was performed. Initially a comparison of six and twelve detectors per group at S.P.1, Line 2 suggested that twelve elements gave slightly better noise cancellation; the six phones were spaced at intervals of 15 feet for a group spacing of 75 feet, the twelve phones were placed 15 feet apart over a group interval of 150 feet. A deep hole at this location folded after the first shot; the second shot placed just above the water table gave probably one of the better recordings taken during the survey.

Deep holes (to 125 feet) at shot points 2 and 3 with shots placed below the 70 foot water table gave poor to fair results.

At shot point 4 on Line 1, fifty feet of near surface sand underlain by hard sandstone and a good water bearing formation was penetrated. The record appears lower in natural frequency with prominent noise patterns extending the recorded length of the seismogram.
A three hole pattern drilled to a depth of 95 feet, loaded with 10 pounds of powder was shot at SP 5. The holes were placed in a triangular pattern with a 200 foot base and 141 foot legs. There was no improvement in the signal to noise ratio detectable. A single hole at the same location gave similar results.

A sixteen hole pattern with hole spacing of 40 feet to form a square rotated 45° to the line was drilled at shot point 8, A total charge of 20 pounds of powder 1¼ pounds per hole appeared to give some noise cancellation, but the following two shot points on the same line gave similar results with a single 110 foot hole.

Various other patterns were attempted with little improvement. In addition, SP 6, Line 3 was drilled to 240 feet and shot up the hole to see if much deeper shots would improve the results. No improvement was observed.

Finally, several spreads were shot on Line A between shot points 10 and 17 with shot points offset 1800 feet. The noise problem persisted; however, on playback the data were "stacked" with the standard coverage to reinforce reflected signals. It is considered that this technique gave the maximum improvement in data, and it is recommended that common depth point techniques be seriously considered in future exploration programmes in the area.

7. INTERPRETATION PROCEDURES

Observed reflection times were corrected to a datum plane established at 1,700 feet above mean sea level using the standard uphole procedure with a correctional velocity of 10,000 feet per second within the zone from the shot reference position to the datum plane. Subsequent shots in the hole were corrected to the reference shot using a factor equal to the difference in uphole times.

Standard cross sections were plotted as the primary interpretation. Later, individual static trace corrections were computed for record section programming.

Variable density-galvanometer trace playback sections were prepared. The vertical scale of the record sections was 7.5 inches per second; horizontal scale was 1" = 500 feet. Playback filter was 2-38 = 2-65 with slow AGC.

The final interpretation was performed on the record sections.

The nearest velocity control available was that recorded by the survey of East Mereenie No. 1. Using the interval velocities suggested by this survey in conjunction with the prognosticated formation thicknesses, horizon identifactions have been attempted. These identifications must be considered speculative in view of the quality of data at hand.

8. DISCUSSION OF RESULTS

The results of the subsurface control obtained by the survey are presented herewith in the form of two structural control maps based on reflections tentatively identified as Horizon "A", Near Stokes, Enclosure I; Horizon "B", Near Pacoota, Enclosure II; a time interval or isochron map analysing the time difference between Horizons "A" and "B", Enclosure III; a dip map illustrating apparent dips in the zone below 2.0 seconds, Enclosure IV; and a shot point location and surface elevation map, Enclosure V.

Enclosures I through III are contoured on an interval of 0.025 seconds while Enclosure V is contoured on a twenty feet interval.

The two subsurface maps are based on reflection events found on Lines 1 and 2 but obscured on Lines A and 3. Where the event cannot be followed a system of phantom dips was employed to arrive at the probable dip within each zone. In the performance of this study, reflected segments within the zone between the expected arrival position and no more than 0.2 seconds later were used in estimating dips. It should be emphasized that the accuracy of the data values at each shot point where this phantoming has been performed is greatly reduced; although the configuration as depicted has been attempted conscientiously, the overall reliability of the maps is poor.

As shown, the contouring depicts a gently west plunging anticline with minor axial plunge reversal between shot points L-A-14 and L-1-5.

The profile of the data through Line 2 suggests an acceleration of dip on the north flank of the feature between shot points 4 and 6. If the correlations are correct, one might expect normal faulting in this area.

The interval study between the two horizons represents a rather hazardous analysis because geological evidence suggests gentle

Stairway thickening to the northwest with gentle Pacoota thickening to the southeast; the resultant change over the interval studied amounts to very few feet. In any case, Enclosure III has been attempted to determine crestal thinning and the relative difference of dip between the two levels. The only major departure from conformity of the events occurs on the north end of Line 1 where gross divergence has been displayed. The isochron map will probably fail under severe examination.

Enclosure IV attempts to display the average dips below 2.0 seconds reflection time. Data is generally poor and may be harassed by surface reverberations.

9. CONCLUSTIONS AND RECOMMENDATIONS

The results of the survey suffer from poor reflection quality recorded throughout the area. The data allow fair delineation of the minor axis of the West Walker Creek anticline; however, plunge measurements along the major axis can only be accomplished using reflection segments not generally continuous between adjacent shot points. Overall reliability is poor.

The West Walker Creek anticline has been depicted as a gently west plunging feature with no prominent axial reversal.

The problem of record quality appears to be most severe in the Amadeus Basin when control lines traverse major structurally high features. Although the experimentation of the crew was restricted by the amount of equipment at hand, sufficient experimentation was performed to disclose that much improvement would not be gained by standard recording techniques unless extremely large geophone patches or multiple hole layouts were used. It would seem most appropriate to consider common depth point procedures or "shot popping" methods for data enhancement and reinforcement in future assignments in the area, particularly when surface structures are crossed. In this area, "roll-along" could be used on a crestal line, however, the sandstone bluffs edging the valley would confine the programme to several spreads on cross-lines. Due to the relative difficulty of access to the area, it is suggested that these elaborate shooting arrangements be attempted over similar more accessible features prior to embarking on a costly experimental programme in West Walker Creek.

NAMCO GEOPHYSICAL COMPANY

R.L. MILLIKEN,
PARTY CHIEF

H.E. BOWMAN
SUPERVISOR

November 25, 1965.

APPENDIX I

EQUIPMENT

A. GEOPHYSICAL EQUIPMENT

1 Complete set of 24-channel S.I.E. GA-22 seismic instruments.

1 Complete S.I.E. PMR-20 magnetic recording system.

450 EVS reflection geophones, 20 cycle, arranged six per string.

3 Reflection geophone cables for 1800-foot S.P. spacing.

1 Complete set of shooting equipment, including multi-hole blasters.

1 Complete set of surveying equipment.

1 International Model 160 4x4 recording truck with winch, power steering and sand tyres.

2 International Model 160 4x4 combination cable and shooting trucks with winches, power steering and sand tyres.

2 Heavy duty Mayhew 1000 combination air-water drills with 667-CFM air compressors, 5x6 Gardner-Denver mud pumps, 300 feet of drill pipe each, and mounted on International Model 192 4x6 trucks with winches, power steering and sand tyres.

2 Heavy duty water trucks with 1200-gallon flat tanks mounted on International Model 192 4x6 trucks with winches, power steering and sand tyres.

3 New Toyota 4x4 trucks with oversize tyres for surveying, administration and field management.

3 Model T-2 American Paulin System Surveying Altimeters furnished by Magellan Pet.

B. CAMP EQUIPMENT

1 Machine Shop Trailer manufactured by Elder Trailer Company and complete with drill press, benches, vices, air compressor, and all necessary tools and equipment for making repairs on any of the vehicles and equipment provided.

B. CAMP EQUIPMENT (continued)

1 Welding trailer, complete with both arc and acetylene welding equipment and supplies.

1 Elder office trailer, complete with printing machine, office machines, drafting equipment McGukin dip plotter and supplies.

1 Shower and utility trailer with laundry machine.

1 Elder all-electric kitchen trailer completely equipped with all necessary appliances and utensils.

1 Elder dining trailer completely equipped with all necessary furniture, fixtures and tableware.

1 Elder power trailer, complete with two 25-KW diesel generators.

1 1200-gallon camp water trailer complete with pressure system and connections for kitchen and shower trailers.

1 Complete complement of tents, beds, linens etc. for accommodating all personnel and visitors.

1 Complete set of radio equipment for communication on the Flying Doctor system.

1 Supply truck capable of hauling fuel and explosives.

APPENDIX II

PERSONNEL

Party Chief	R.L. Milliken
Seismologist	Owen B. Smith
Computer	W.M. Roberts
Surveyor	G.W. Cozby
Observer	Ed. W. Dollar
Chief Driller	T.R. Daniel
Driller	J. Morris
Shooter	J. Band

The basic crew consisted of a total of twenty (20) men.

Technical and administration supervision was provided by Mr. H.G. Bowman.

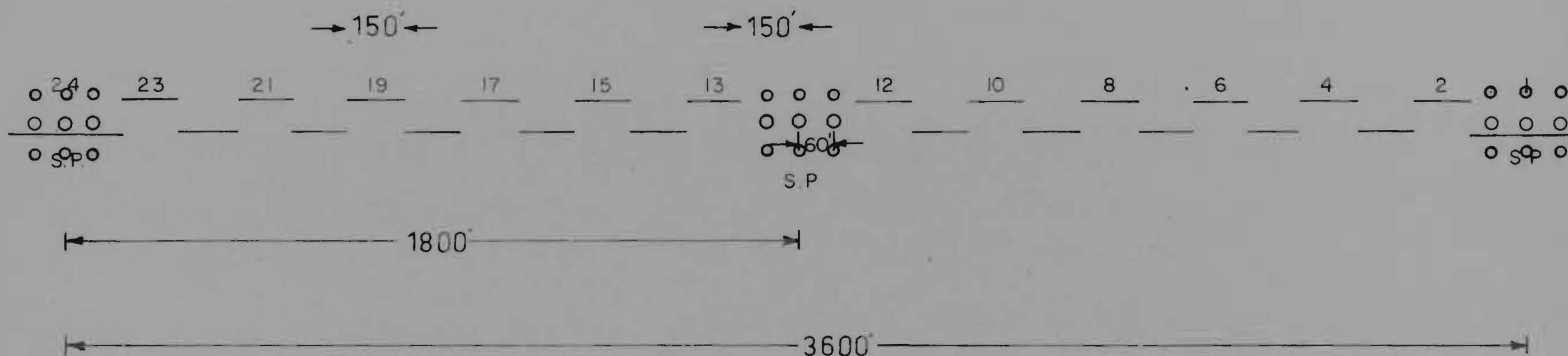
Mr. E.A. Krieg acted as client's representative for Magellan Petroleum (N.T.) Pty. Ltd.

APPENDIX III

STATISTICAL DATA

Starting date, first shot	August 20, 1965
Completion date, last shot	August 31, 1965
Total number of shots	78
Total number of holes shot	57
Average holes per day	5.32
Total miles of subsurface coverage	15.78
Total number of moving days	2.0
Days lost due to weather	Nil
Days lost due to holiday	Nil
Days lost due to equipment repair	Nil
Total number of field days recording	10.72
Total number of field hours, recording	72.0
Total number of driving hours, recording	35.2
Total pounds of dynamite used	1230
Average pounds of dynamite per shot	15.77
Total number of detonators used	119
Total number of drill shifts in field	22.15
Total number of drill hours in field	154.8
Total number of drill hours driving	66.7
Total number of holes drilled	91
Total footage drilled	8218
Average number of holes drilled per shift	3.7
Average depth of holes in feet including patterns	90.3
Average depth of weathering in feet	47'
Rock bits used	5
Insert bits used	14
Mud used, bags	Nil
Bran used, bags	Nil

TYPICAL REFLECTION SPREAD LAYOUT



24 Traces

12 Seis per trace

1 to 9 hole patterns

1800' — 0 — 1800' Reversed split spread

150' foot Group intervals

15' foot Seis intervals

FIG.1