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MERCURE INTERNATIONAL PETROLEUM
PTY LTD
NORTHERN SIMPSON DESERT
SEISMIC SURVEY
April - May 1964
MERCURE INTERNATIONAL PETROLEUM
PTY LTD
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SEISMIC SURVEY
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<td>Traverse ND 1</td>
<td>12</td>
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<tr>
<td>Traverse ND 2</td>
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SUMMARY

A seismic reconnaissance survey was carried out during April-May 1964 in OP 64/1 (Northern Territory) for the Mercure International Petroleum Pty Ltd.

Two perpendicular traverses were covered by continuous reflection profiling in the central part of the permit. A relatively deep sedimentary section thinning northwards was anticipated in this area.

Along both traverses a high amplitude continuous horizon was easily followed. Assuming an overburden velocity of 2,100 m/sec, its depth increases regularly 500 to 940 metres below mean sea level, from north to south. It can be tentatively considered as representing an upper-Jurassic formation. No structures were revealed at this level.

A deeper horizon, also dipping south occurred 400 to 650 metres below the upper horizon. It appeared in contact with steep line-ups and diffracted events. A refraction probe showed that the deeper horizon corresponds to a high velocity: 6,100 m/sec refractor. Since no faster refracted events were recorded it could represent a basement formation.
INTRODUCTION

Following a contract between the MERCURE INTERNATIONAL PETROLEUM PTY LTD on one hand, and the COMPAGNIE GENERALE DE GEOPHYSIQUE (Australian Branch) on the other, the latter carried out a seismic survey in permit to explore O. P 64/1 in Northern Territory, where MERCURE INTERNATIONAL PETROLEUM PTY LTD is the operator.

The party included 45 men with 5 key men expatriated from France. It was capable of operating either with seismic reflection or refraction equipment. A bulldozer crew was added for clearing tracks and seismic traverses.

Drilling began on the 13th of April and was completed on the 19th of May, 1964.

Seismic operations were conducted from the 24th of April until the 1st of June, 1964.

During the survey 142.7 km (89 miles) of new reflection lines, 19.2 km (12 miles) of refraction lines, in-line offset and velocity spreads were carried out.

Mr. J. MABRUT, Engineer Geophysicist, headed the party which was supervised by Mr. C. DIKOFF, Engineer Geophysicist.
CHAPTER I

GEOLOGICAL AND GEOPHYSICAL DATA

1. GEOLOGICAL DATA

Permit O.P. 64/1 is situated on the northwest boundary of the Great Artesian Basin. The surface formations consist of scattered outcrops of Tertiary or recent unconsolidated deposits, with extensive occurrences of sand dunes. (Fig 1)

Considering the geology of the neighbouring areas the section is thought to be as indicated below.

<table>
<thead>
<tr>
<th>Age</th>
<th>Lithology</th>
<th>Thickness</th>
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</thead>
<tbody>
<tr>
<td>Tertiary</td>
<td>Alluvium-Sands</td>
<td>About 100 ft.</td>
</tr>
<tr>
<td>Cretaceous</td>
<td>Winton fm.arkose &amp; claystone</td>
<td>More than 500 ft.</td>
</tr>
<tr>
<td>Cretaceous</td>
<td>Wilgunya fm.dark shales</td>
<td>About 1500 ft.</td>
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<tr>
<td>Jurassic</td>
<td>Lateral equivalents from Blythesda to Bundamba</td>
<td>Perhaps 1000 ft.</td>
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<tr>
<td>Regional unconformity</td>
<td></td>
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<tr>
<td>Permian</td>
<td>Possibly exists-should be a</td>
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<tr>
<td>Devonian</td>
<td>lateral equivalent of the Pinke or Pernjara formations</td>
<td>?</td>
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<tr>
<td>Ordovician</td>
<td>Possibly exists -should be a lateral</td>
<td></td>
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<tr>
<td>Middle and</td>
<td>equivalent of the Pacoota to Mareenies</td>
<td></td>
</tr>
<tr>
<td>upper Cambrian</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
There is practically no information available regarding a possible connection between the Amadeus, the Great Artesian and the Georgina Basins, and several hypotheses can therefore be entertained. However the B.M.R. regional gravity work indicated the presence of a negative trend situated south of the Boulia area, which could be interpreted as suggesting a connection between the Amadeus and the Great Artesian Basins.

Where they do exist, reservoirs are expected:
- In the base of the Jurassic,
- In the Cambro-Ordovician,
- And in the upper Proterozoic / Cambrian.

There is a possibility of finding some lenticular calcareous and sandy formations (equivalent of the Toolebuc formation), within the Wilgunya formation, the latter being a good oil-bearing rock (black shales).

2. GEOPHYSICAL DATA

2.1- Gravity

The permit is probably situated, as far as ante-Permian formations are concerned, along the south-western border of the Georgina Basin.
The Bouguer anomaly maps, see Pl 6, suggest the existence of a trough crossing permit 64/1 from the south-east to the north-west. The Artesian Basin is expected to thin northwards.

The gravity trough is bordered by 'high' anomalies probably related to high compartments of the basement. Most of the planned seismic work occurred within this trough. Therefore the seismic traverses were expected to cross a relatively deep zone with a sedimentary section thinning progressively towards the northwest and more abruptly towards both flanks of the trough.

2.2- Aeromagnetics

An aeromagnetic survey was carried out in 1962 for the Bureau of Mineral Resources over a large part of the Simpson Desert.

The main features of a reinterpretation made by C.G.G., over OP 64/1 are shown on Plate 6.

A magnetic basement high with a northwest-southeast trend was outlined. It coincides with the possible gravity 'high'.

Eastwards, the depth to the magnetic basement (below the mean sea level) varies between 1,500 and 2,000 metres. The accuracy of the depth estimations, due to the loose network of aeromagnetic lines was estimated to be of the order of 15%.

2.3- Seismic

No seismic work had been conducted on OP 64/1 permit and therefore no information was available on the area.

A seismic survey was carried out by the French Petroleum Company (Australia) in 1963 between Oodnadatta and Poeppel's Corner (O.E.L. 20 and 21).
Among other things this survey has shown that the quality of the results in the Simpson Desert is directly related to the coefficient of multiplication of holes and geophones.

Since the Survey was to take place in similar conditions, it was thought that the same techniques could be applied. This was confirmed by the first part of the "Kilpatha Seismic Survey", carried out in OP 36, immediately before the "Northern Simpson Desert Seismic Survey".
CHAPTER II
OBJECTIVES & PROGRAMME

1. OBJECTIVES

The objectives of the survey were defined by MERCURE INTERNATIONAL PETROLEUM COMPANY as follows:

1- To study the structural shape of the basin by the seismic reflection method.
2- To draw up an inventory of the markers by carrying out a refraction probe.
3- To assess and compare the relative effectiveness of both the seismic reflection and refraction methods.
4- To check if the available gravity and aeromagnetic data are directly related to the structural shape of the basin.

It was considered that the study planned in 1/ could reveal the presence of deep reflected information, recorded below an unconformity and representing pre-Mesozoic sediments (chapter 1. Geological data).

2. PROGRAMME

It was planned to meet the above objectives by conducting the seismic work along two traverses.

Traverse ND 1 was to be covered in continuous reflection profiling across the permit as indicated on figure 1. This traverse appears as an extension of the line K 1 carried out by Australian Aquitaine Petroleum in their permit O.P. 36.

A refraction probe was planned to be located approximately in the middle of ND 1. This work was to be conducted simultaneously with offset and velocity shots.

Traverse ND2 was planned perpendicular to ND 1 extending from Hay River in the east to the western side of the gravity and magnetic
From the results obtained by F.P.C.A. and A.A.P. reflection work it was decided to use 36 geophones per trace and 24 holes at Kelly depth per shot point. In addition this technique was to be checked during the course of the work so as to ensure optimum recording.

3. Programme timetable

Traverse ND1 was shot between the 24th of April and the 10th of May 1964.

The refraction probe: S ND1, was carried out from the 12th to the 15th of May. It was limited to 8 bases (19.2 km) since a limiting high velocity refractor was recorded with shooting distances from 5 km outwards.

Traverse ND2 was shot between the 16th of May and the 1st of June 1964.
CHAPTER III

TECHNIQUES & OPERATIONS

1. TECHNIQUE

The reflection method used during the survey was the conventional split spread recording. Twenty four recording traces are laid down and the shot is fired mid-way between traces 12 and 13.

The refraction probe consists in recording a certain number of consecutive spreads from two fixed shot points. This allows two time-distance curves to be plotted: one "direct" and one "reverse", the distance between the shot points being of the order of 30 kilometres.

The Gardner-Layat interpretation method used by C.G.G can be applied to the refraction probes if a given refractor is recorded on reversed profiles over several bases. This method is adapted from L.W. Gardner: "An aerial plan of mapping subsurface structures by refraction shooting" (Geophysics 1947, volume XII, page 221).

The longitudinal offset and velocity spreads are recorded along the normal reflection traverses. Consecutive spreads are recorded from a given shot point up to the critical distance, where reflection events are replaced by refraction arrivals. The refraction technique of radio transmission is used for the time breaks.

Details concerning the technique used are given in Appendix V.

2. OPERATIONS

Parallel sand ridges, only 500 to 1,000 yards apart, showing a prevailing north-northwest direction, cover the whole permit. Trails had to be cleared by bulldozers to make them accessible for heavy vehicles.

Small bushes and spinifex-type vegetation hamper the movements of sand equipped vehicles beyond cleared lines. Travelling across the dunes on east-west lines is quite difficult, and several times, the dozers had to
The seismic party included 48 men and 19 vehicles. The dozer crew consisted of 5 operators, 2 dozers and 3 light vehicles.

The main camp was located along the north-south traverse ND 1; it consisted of air-conditioned trailers.

The supply problems were the most difficult to solve. Water was taken from Kilpahta native well 82 miles to the south. All tinned foodstuffs, fuel and explosives were transported by the party's vehicles from a dump settled at Cowarie Station, 250 miles south of the camp.

Cowarie Station was the furthest point accessible by two wheel drive vehicles coming from Marree or Birdsville. A Cessna 185 chartered plane delivered weekly perishables and mail from Birdsville.

Daily radio communications were maintained with the Royal Flying Doctor Service base at Cloncurry, and with MERCURE INTERNATIONAL PETROLEUM PTY LTD in Brisbane.

Surveying operations were conducted with a WILD TO theodolite. Ties were made to Poeppel Corner's tellurometric station and to the INT 32 astronomical station along Hay River. The former station was the origin of elevations whilst the latter was chosen as origin for the co-ordinates.

Drilling was done by air with two Mayhew 1,000 air-water combination drills. Drilling was easy, as only sandy formations were met. The usual reflection shot point pattern comprised 24 holes in 4 lines parallel to the traverse and drilled to a depth of 15 feet. 5 5/8" and 4 3/4" insert bits were used.

The reflection spread consisted of 24 geophone traces, 50 meters apart with 36 geophones in 3 parallel lines at each trace. A 120 Lb charge (24x5lbs) was used.
In refraction, 24 traces were also recorded. The distance between traces was 200 metres, i.e. each fourth reflection trace corresponded to a refraction geophone location. 12 Hall Sears refraction geophones were laid down at each trace. Surface shooting was used for the refraction work.

The recording unit was a pulse-width modulated magnetic assembly with C.G.G. amplifiers. It was equipped with a simultaneous SIE-PRO 11 galvanometric monitor and a sequential play-back Electrotech MTD. A C.G.G. designed corrector allowed the magnetic tapes and variable area play-backs to be processed on the field. These play-backs were corrected trace by trace, for both static and move-out corrections.

Details concerning the operations are shown in Appendixes I, II & VI.
CHAPTER IV

RESULTS

1. INTERPRETATION

All distances and depths are in metres or kilometres, the velocities are in metres per second and the seismic times in milliseconds.

1.1- Refraction

The "operational diagram" (PI 7) gives the particulars of the refraction shots recorded.

All picked arrivals are plotted on the "Time-distance curves" (PI 8).

The high velocity arrivals were interpreted by the Gardner-Layat method, which gives the delay curve shown on PI 9.

1.2- Reflection

The longitudinal offset shots fired along traverse ND1 are presented on PI 10.

One example of a reflection field play-back cross-section is enclosed (PI 11), it is a photo-reduction at a scale of 1.5" to 600 metres (which is the distance between shot points).

Depth cross-sections along the traverses are submitted at a scale of 1/100,000 (PI 12 & 13). They allow a comparison with the refraction results and the offset shots.

PI 14 is a schematic contour map of the main horizon ('A' horizon).

2. REFLECTION WORK

The record quality did not vary appreciably along the two traverses.

A high amplitude continuous horizon named "A", was easily followed and the picks are considered reliable. From a study of the move-out corrections the average vertical velocity down to "A" horizon increases southwards from 1,900 to 2,200 m/sec (App. VII). However, in order to give a better correlation with adjacent reflection surveys, the contour map of the "A" horizon was calculated with an overburden velocity of 2,100 m/sec.
The depth to the "A" horizon increases southwards, from 500 to 940 metres b.m.s. No structures were outlined on the "A" horizon.

The second horizon called "D" represents the lower limit of the reflections conformable with "A". Below the "D" horizon only scattered and steep line-ups or diffractions occur. This suggests that it may be an erosional surface.

The refraction shooting showed that this eroded level followed as the "D" in reflection work has a velocity of 6,100 m/sec. 360 metres to the north and 660 metres to the south of OP 64/1 separate "A" and "D" horizons.

3. Refraction work

From the results of the offset shots, the horizontal velocity of "A" horizon is nearly 3,500 m/sec. It was also recorded on the refraction probe as a distinct second arrival from a distance of 5 to 10 Km.

The high velocity marker was recorded from a shooting distance of 3 km to 18 km. The actual velocity determined by the Gardner-Layat method is 6,100 m/sec. No faster event was recorded.

4. TENTATIVE IDENTIFICATION

On the basis of the results obtained in adjacent areas, the "A" horizon can be tentatively considered as representing an upper-Jurassic formation (Blythesdale).

The "D" horizon, below which no high velocity marker was detected, could then represent some basement formation (Proterozoic?).
CHAPTER V
DISCUSSION OF RESULTS AND INTERPRETATION

PART ONE: Reflection results

Along both traverses ND1 and ND2 only one horizon is continuous and reliable. The signal is characterized by 3 or 4 strong cycles.

It obviously corresponds to a velocity discontinuity; the occasional line-ups pickable above "A" are curved due to sudden changes of the move-out times (see Pl 11).

Below this "A" horizon, conformable line-ups are pickable down to the "D" horizon. The quality of the "D" is variable, and affected by the presence of steep line-ups which interfere with it. The "D" is associated with numerous diffracted events which suggest that it is the envelope of an eroded surface.

Underneath, no continuous horizons are pickable except multiple reflections: SP 38-40, 46-48 and 51-52 of PL 11.

It may be assumed that the "A" represents Upper-Jurassic formations (Blythesdale or Mooga) which appear as strong reflectors all over the Great Artesian Basin.

The velocity surveys give an average overburden velocity of 2,100 m/sec, the actual values increasing slightly and progressively southwards (refer to Appendix VII). The average vertical velocity down to the "D" horizon is assumed to be of the order of 2,500 m/sec, the "A-D" interval velocity being 3,300 m/sec.

These values of 2,100 m/sec and 2,500 m/sec were used for the depth calculations of the "A" and "D" horizons: Pl 12 and 13.

Traverse ND 1: The "A" horizon dips very gently and regularly to the south-east. The average dip is 0.65% or 1 degree.
The "A-D" interval thins to the north-west, from 660 to 360 metres.
The "D" is not very regular: there is a change of slope below SP 38 to 44 and some anomalies below SP 80 to 85 and 97 to 102.
Steep events below the "D" were noticed from the south end of the traverse up to SP 40. They were not migrated and were plotted using the same 2,500 m/sec velocity. This means that no accuracy can be expected from information appearing below the "D". The aim was merely to give an idea of the dip. It is assumed to be generally southwards with, however, north dipping zones below SP 125-128, 90-82 and 56-47.

**Traverse ND 2**: The "A" horizon shows a synclinal shape with the greatest depth below the SP 220.

On the flanks of this syncline the slight culminations are outlined at SPs 190, 245 and 265. The "D" horizon is quite irregular and three prominent anomalies correspond to the above mentioned culminations. Events below the "D" are very scarce. Those that occur indicate a dip towards the axis of the syncline.

On two occasions, very deep arrivals were recorded: SP 192 to 194 and 244 to 247; these presumably originate in the intra-basement.

**Schematic contour map**: The more reliable "A" horizon was mapped.

Plate 14 shows the monoclinal appearance of the Mesozoic on the central part of OP 64.

It is assumed that the axes have a northwest-southeast direction. The main one corresponds to the wide syncline seen on traverse ND 2.

Three high secondary axes outline the anomalies located on the same traverse.
PART TWO: Refraction results

A refraction probe over eight bases was carried out along traverse ND 1, in the central area of OP 64.

Shots were fired from both ends of the probe and in the middle of each spread: between traces 12 and 13, as indicated on the "Operational Diagram" (Pl 7).

All charges were shot on the surface.

Shallow markers were recorded from 0 to 3 km, with a horizontal velocity of 1,910 - 1,930 m/sec (Pl 8).

A rapid break separates these refractors from the high velocity marker recorded up to the maximum shooting distance of 18 km.

At distances between 4 and 7 km some strong later arrivals can be picked with velocities around 3,300 m/sec.

The high velocity arrivals display a constant high amplitude and high frequency signal: 25 c.p.s., with a split peak. This is particularly visible on the direct shots. No faster arrivals were measured from the records. The first refracted arrivals from the centre shots were used to calculate corrections. A plot of the relative intercepts for the high velocity marker is given on Pl 9.

The actual marker velocity is 6,100 m/sec and the delay times range from 445 to 495 milliseconds.

The value of 800 metres used for the offset is considered to be the most probable.
OFFSET SHOTS

VELOCITY SHOTS

TRAVERSE N.D.1

Shots n° 1 and 2  surface shots reflection recording instrument settings filters 1/20 - out, A.G.C. slow

Shots n° 3, 4, 5 and 6  surface shots refraction recording instrument settings filters out - 1/40, A.G.C. medium
PART THREE

1-OFFSET SHOTS

A series of longitudinal offset shots was performed from SP 55, which is one of the refraction probe shot points. Six reflection spreads were recorded, as shown on fig. 3.

The assembled play-backs shown on Pl 10 allow a very good correlation of reflection and refraction events to be made. The strong reflection "A" loses its energy as the shooting distance increases. The corresponding refracted events are weak and their horizontal velocity is about 3,500 m/sec. Reflection "D" which is not very strong, correlates with high velocity arrivals (6,000 m/sec) recorded as first events from a 2 km shooting distance.

Later arrivals from the sub-weathered layers can be picked as a 1,900 m/sec refractor and another line-up of unknown origin, with a 2,950 m/sec velocity can also be seen.

2. REFLECTION-REFRACTION COMPARISON

The depth cross sections of traverses ND1 and ND 2 (Pl 12 and 13) present a synthesis of the results obtained by reflection and refraction methods.

On Traverse ND 1, a delay-time to depth conversion for the 6,100 m/sec marker was made using an overburden velocity of 2,500 m/sec. Details of the computation are given in Appendix VII.

The 6,100 m/sec refractor which has been identified as being the "D" reflector on the offset shots, appears to be approximately 60 metres shallower than "D". But, no cycle correction has been applied to the reflection picks, whilst in refraction a cycle correction reducing the data to the first breaks was adopted. This explains the 60 metre difference.

In conclusion, it may be pointed out that both methods give quite comparable results, as far as the "D" horizon is concerned.
VELOCITY SHOTS.

Template Used.
PART FOUR

1. Comparison with previous geophysical results

A comparison was attempted on the depth cross-sections (Pl 12 and 13) where the Bouguer anomaly and points of estimated depth of the magnetic basement (after a C.G.G. reinterpretation) were plotted.

A comparison can also be done between the maps presented: Pl 6 and 14.

The B.M.R's gravity maps and the map drawn by C.G.G. after a reinterpretation of the aeromagnetic data show similar features (see Pl 6). The main one is the existence of a relatively deep zone thinning towards the northwest and bordered by magnetic highs and heavy gravity anomalies.

Geologically, this could be explained by a penetration to the northwest of the Great Artesian Basin limited by high zones of the basement.

Traverse ND 1 located along the axis of the syncline, shows a rise of the basin with a thinning of formations comprised between the "A" and "D" horizons (Pl 12). It may be assumed that the "A" represents the Blythesdale and the "D" or the 6,100 m/sec refractor the base of the sedimentary section.

The depth of the basement below m.s.l would be of the order of 1,500 metres to the south and 800 m to the north of the traverse. The aeromagnetic map gives 2,000 m to the south and 1,500 m to the north.

In the east-west direction, traverse ND2 shows a synclinal shape with the lowest point below SP 220."A" and "D" horizons thin eastwards. This traverse has not been extended enough eastwards to reach the aeromagnetic and gravity 'high' which borders the syncline.
Westwards, the corresponding 'high' correlates with the rising of the seismic horizons. However, the anomalies located below SP'245 and 26 have a limited extension. They cannot be related to the gravity 'high' which probably reflects intra-basement phenomena.

It must be remembered that the density of the gravity measurements is of the order of one point every twenty shot points, thus, same details could not be reached by the seismic and gravity methods.

On the western half of the traverse ND 2 the depths of the "D" horizon and the magnetic basement are nearly the same: 1,200 to 1,500 metres b.m.s.l. (see Pl 13).

The present seismic survey, therefore, confirms the general features given by the previous gravimetric and aeromagnetic surveys.

2. ACHIEVEMENT OF OBJECTIVES

Objectives stated in chapter II were met satisfactorily:

1- The structural attitude of the sediments was indicated by two reflection levels, "A" and "D".

No evidence was obtained of the existence of pre-Mesozoic sediments.

2- Several markers were recorded. The main one, recorded from a shooting distance of 3 km, showed a horizontal velocity of 6,100 m/sec. No faster events were pickable.

3- The deepest events recorded in seismic reflection and refraction appear to coincide: "D" horizon is a refractor with a horizontal velocity of 6,100 m/sec.

4- The aeromagnetism proved a valuable method for conducting reconnaissance surveys over the studied area.

No definite conclusions could be drawn concerning the gravimetry since the existing network is too loose to give any detailed information.
CONCLUSIONS

During the seismic survey carried out from the 24th of April to the 1st of June 1964 in OP 64/1 lease, valuable information was supplied by the seismic reflection and refraction methods.

A strong and continuous reflector, called "A" was easily followed on both traverses ND1 and ND2. It dips gently southwards. Its depth below m.s.l. with an assumed overburden velocity of 2,100 m/sec, is 500 metres at the northern end of traverse ND1 and 940 metres close to the southern limit of OP 64/1.

These two perpendicular reflections traverses did not reveal interesting structures.

According to information obtained in adjacent areas, it is assumed that the "A" horizon is upper-Jurassic (Blythesdale).

A deeper horizon, called "D" was also studied. The interval "A"-"D" thins northwards from 660 to 360 metres. The refraction probe performed along the north-south traverse showed that the "D" corresponds to a 6,100 m/sec high velocity marker.

This high velocity and the lack of faster refracted events suggest that the "D" could represent a basement formation.

Therefore, there is no evidence of the existence of an ante-Mesozoic basin. The petroleum interest is limited to post-D formations which give rise to quite reliable seismic data.

The aeromagnetism proved a valuable method for conducting reconnaissance surveys over this part of the Simpson Desert.
No definite conclusions were drawn concerning the gravimetry since the existing network is too loose to give detailed information.

C. DIKOFF
Seismic Supervisor

S. LEMONDE
Australian Branch Manager

Brisbane, August 1964
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LIST OF PERMANENT MARKERS 22
# APPENDIX I

## PERSONNEL

### 1. SEISMIC PARTY

The personnel required by the agreement and present on the Party is listed below:

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<th>Quantity</th>
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<td>Seismologist</td>
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<tr>
<td>Computers</td>
<td>2</td>
</tr>
<tr>
<td>Administrative Assistant</td>
<td>1</td>
</tr>
<tr>
<td>Surveyor</td>
<td>1</td>
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<tr>
<td>Surveyor Helpers</td>
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</tr>
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<td>Field Manager</td>
<td>1</td>
</tr>
<tr>
<td>Drillers</td>
<td>2</td>
</tr>
<tr>
<td>Driller - Helpers</td>
<td>3</td>
</tr>
<tr>
<td>Mechanics</td>
<td>2</td>
</tr>
<tr>
<td>Observer</td>
<td>1</td>
</tr>
<tr>
<td>Junior Observer</td>
<td>1</td>
</tr>
<tr>
<td>Recording Assistant</td>
<td>1</td>
</tr>
<tr>
<td>Shooters</td>
<td>2</td>
</tr>
<tr>
<td>Helpers</td>
<td>9</td>
</tr>
<tr>
<td>Camp Boss</td>
<td>1</td>
</tr>
<tr>
<td>Cooks</td>
<td>2</td>
</tr>
<tr>
<td>Helpers</td>
<td>3</td>
</tr>
<tr>
<td>Drivers</td>
<td>8</td>
</tr>
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</table>

Total: 45

In agreement with A.A.P., the following personnel was added to the above basic composition:

<table>
<thead>
<tr>
<th>Position</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanic - Helper</td>
<td>1</td>
</tr>
<tr>
<td>Shooters - Helpers</td>
<td>2</td>
</tr>
</tbody>
</table>

Total: $45 + 3 = 48$
The Party leader, the seismologist, the field manager, the observer and the surveyor were expatriated from France.

The large complement was necessary for several reasons:
- Extra personnel were needed on the spot, for replacing sick or non available personnel (heat, difficult working conditions in the Simpson Desert).
- Difficulties in replacing resigning personnel (lack of communications)
- A large team of drivers was needed to transport the supplies over long distances (see Appendix VI).

2. CIVIL ENGINEERING PARTY

The bulldozing crew consisting of 5 operators was supplied by "Continental Rubber", Brisbane.
# APPENDIX II

## EQUIPMENT

### 1. VEHICLES

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>1 Land Rover (long wheel base, 109 inches)</td>
</tr>
<tr>
<td>Surveying</td>
<td>1 Land Rover (long wheel base, 109 inches)</td>
</tr>
<tr>
<td>Field Manager</td>
<td>1 Land Rover (long wheel base, 109 inches)</td>
</tr>
<tr>
<td>Drilling</td>
<td>2 International R190 4 x 4 trucks equipped with DC3 tyres 1700 - 16</td>
</tr>
<tr>
<td></td>
<td>1 Land Rover (short wheel base, 88 inches)</td>
</tr>
<tr>
<td>Recording</td>
<td>1 Bedford RLHC3 4 x 4 recording truck</td>
</tr>
<tr>
<td></td>
<td>5 Land Rovers (long wheel base, 109 inches)</td>
</tr>
<tr>
<td>Camp</td>
<td>4 Bedford RLHC3 4 x 4 supply trucks</td>
</tr>
<tr>
<td></td>
<td>3 Bedford RLHC3 4 x 4 water trucks (one of them, with a mobile tank, was usable as a supply truck).</td>
</tr>
</tbody>
</table>

*Note:* 1 Land Rover, long wheel base, was kept at the disposal of AAP.

### 2. CAMP

The camp consisted of air-conditioned trailers:
6 sleeping-units, one kitchen, one office and one workshop.
The trailers were towed by the Party's trucks, or the dozers when conditions were very bad.

The necessary power was supplied by 3 Diesel plants:
two 18KVA on a trailer, and one 3KVA.
One 7KVA power plant and one electric water pump were also available.

### 3. SPECIAL EQUIPMENT

#### 3.1 Surveying equipment
1 Wild To theodolite
4 Staffs with meter and centimeter graduations, compasses, binoculars.

#### 3.2 Drilling equipment
Drilling system: 2 Mayhew 1,000 equipped for air/water drilling.
Mud - pump : Gardner - Denver 5" x 6", 895 p.s.i.
Air compressor : Gardner - Denver, WCG type.
Kelly length : 18 ft.
Kelly diameter : 3 3/4 "
Drilling pipes : 45 (15' stems).

3. 3- Recording equipment

One recorder type "CGG 59" with pulse-width modulated magnetic recording. Sequential field play-back facility with the CGG MTD Corrector allowing for variable area or wiggly line reproductions.

One SIE - PRO 11, 25 trace photographic recorder.
Two CGG SBT 1,000 automatic blasting boxes, 1,000 V output.

3. 4- Geophones

Reflection 900 Hall Sears "Junior" geophones, 245 ohms, 20 c.p.s. Twelve geophones are connected in parallel on a basic jumper.
Refraction 300 Hall Sears refraction, 215 ohms, 45 c.p.s. geophones.

3 Hall Sears geophones are connected in parallel on a jumper.

3. 5- Cables

Reflection 8 cables, unit length 200 metres, with three take-outs by cable.
Refraction 25 cables, unit length 300 metres, with one take-out by cable.

3. 6- Radios

Four VHF, PTCA 8002 type, frequency modulation, for the radio transmission of the time breaks.
Five "PYE" HF 20A for communication with the Flying Doctor Base, flying camps, dumps and supplying vehicles.

3. 7- Engineering (supplied by "Continental Rubber" Brisbane)

1 Caterpillar D7
1 Allis Chalmers HD 11
1 International R120) for transportation
1 Jeep Willys ) of
1 Land Rover ) personnel
On two occasions, the Party used the services of the grader and the bulldozer owned by Mr. Mitchell of Mona Downs Station.

3. 8- Airplane
One CESSNA 185 from Western Air Co and a pilot based in Birdsville.
All the history statistics of the survey are presented on Fig 5.

1. HISTORY

The present survey followed the first stage of the "KILPATTHA SEISMIC SURVEY" in OP 36 (Northern Territory) and was carried out by the same crew.

The main events of the survey are tabled below:

First drilling : 13th of April 1964
Last drilling : 17th of May 1964
First Seismic shot: 24th of April 1964
Last shot : 1st June 1964

The Party then moved to the south and completed the "Kilpattha Seismic Survey".

The contract called for 190 hours of production time per month. However, AAP agreed to a schedule of 230 hours of production time per month in order to permit a rest leave of about 10 days every 10 weeks.

The crew worked six days a week and the working day consisted of about 8.85 production hours with a break of half an hour at lunch time.

2. STATISTICS

2.1- Seismic statistics

In reflection, the average production was 0.93 spreads and 0.48 km of new traverse per production hour, which does not include the travelling time from camp to working site.

Production was slowed down on the east-west traverse ND2 where the recording trucks sometimes had to be towed across the sand dunes.

In refraction the average daily production was two bases of 2.4 km with 5 shots.
2.2 Drilling statistics

Two drills were used. The average production was 144 feet per drill per production hour, this included the travelling time from one shot point to another.

The normal shot point pattern consisted of 24 holes drilled at 15' depth, so that an average of 2 1/2 hours was necessary for the drilling of one shot point and travelling to the next one. Here again, production was slowed down by the difficult dune crossings on traverse ND 2.

2.3 Dozing statistics

A considerable work was done by the two dozers which worked approximately 12 hours per day each.

A total of 914 1/2 hours was worked i.e. nearly three hours were needed for the production of one seismic hour. Actually:

- 836 1/2 were dozing hours
- 66 1/2 were towing hours and
- 11 1/2 were hours used to open an airstrip, which gives the following percentage:

  - Dozing : 91.5%
  - Towing : 7.2%
  - Airstrip : 1.3%

2.4 Air charter statistics

The light plane was mainly used for transportation of supplies. It was also used for transportation of personnel and for reconnaissance purposes.

A total of 142 3/4 hours was flown.
Among these, 13 1/4 hours were reconnaissance flights.
### Statistics Northern Simpson Desert Seismic Survey 1964

#### Seismic Reflection

<table>
<thead>
<tr>
<th>Months</th>
<th>Lines</th>
<th>Production</th>
<th>Recording Time</th>
<th>Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>APRIL</td>
<td>ND1</td>
<td>69</td>
<td>54</td>
<td>0.80</td>
</tr>
<tr>
<td>MAY</td>
<td>ND1-ND2</td>
<td>216</td>
<td>174</td>
<td>0.93</td>
</tr>
<tr>
<td>JUNE</td>
<td>ND2</td>
<td>10</td>
<td>10</td>
<td>1.00</td>
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#### Seismic Refraction

<table>
<thead>
<tr>
<th>Months</th>
<th>Lines</th>
<th>Spreads</th>
<th>Bases</th>
<th>Lines</th>
<th>Ratios</th>
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</thead>
<tbody>
<tr>
<td>APRIL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Drilling

<table>
<thead>
<tr>
<th>Months</th>
<th>Production</th>
<th>Recording Time</th>
<th>Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>APRIL</td>
<td>293 3/4</td>
<td>129</td>
<td>156</td>
</tr>
<tr>
<td>MAY</td>
<td>288 1/2</td>
<td>109</td>
<td>131</td>
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</table>

#### Drilling Stores

<table>
<thead>
<tr>
<th>Consumable Stores</th>
<th>Drilling Stores</th>
<th>Explosives(lb)</th>
<th>Detonators</th>
</tr>
</thead>
<tbody>
<tr>
<td>INSERT BITS</td>
<td>INSERT BLADES</td>
<td>GAS PIPE</td>
<td></td>
</tr>
<tr>
<td>4 3/4</td>
<td>4 3/4</td>
<td>4 3/4</td>
<td></td>
</tr>
<tr>
<td>5 5/6</td>
<td>4 3/4</td>
<td>4 3/4</td>
<td></td>
</tr>
<tr>
<td>HD 11 D7</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>APRIL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAY</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Remarks

- Drilling: 13/4 to 19/5/64
- Seismic Shots: 24/4 to 1/6/64
APPENDIX IV

EXPERIMENTAL WORK

1. OBJECTIVES
   The previous "Kilpattha Seismic Survey" carried out in OP 36, showed a northwards thinning of the section which gives reflections.
   In view of this the experiments were aimed at reducing the shot pattern.

2. TECHNIQUE SELECTED
   The pattern used on OP 36 was compared with a single deep hole, all other parameters remaining unchanged (total charge, instrument settings).

3. FIELD OPERATIONS (fig 6)
   On ten shot points: SP 50 to 59 of traverse ND1, the pattern of 24 holes drilled at 15 ft, charged 5 lbs per hole, was compared to a deep hole drilled at 75 to 120 ft, loaded with the same 120 lbs charge.

4. CONCLUSIONS
   These experiments confirmed the previous conclusions made in the area: shots at greater depths do not improve the records and in most cases, give poorer results.
<table>
<thead>
<tr>
<th>No.</th>
<th>S.P.</th>
<th>Date</th>
<th>Depth in feet</th>
<th>Charge in Lbs</th>
<th>Filter</th>
<th>Recording</th>
<th>Hole Pattern</th>
<th>Graph Pattern</th>
<th>X</th>
<th>e</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
<td>28/27</td>
<td>15'</td>
<td>120</td>
<td>1/20</td>
<td>24</td>
<td></td>
<td>3 lines</td>
<td>600m</td>
<td>50m</td>
<td>Deep holes do not improve the results, especially below the unconformity. On the hole pattern records, we can see some line-ups which cannot be seen on the single hole records.</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td></td>
<td>120'</td>
<td></td>
<td></td>
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<td></td>
<td>12</td>
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<td></td>
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<td>95'</td>
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<td></td>
</tr>
<tr>
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<td>57</td>
<td></td>
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<td></td>
<td>1</td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>58</td>
<td></td>
<td>15'</td>
<td></td>
<td>24</td>
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</tr>
<tr>
<td>2</td>
<td>58</td>
<td></td>
<td>75'</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>59</td>
<td></td>
<td>15'</td>
<td></td>
<td>24</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>59</td>
<td></td>
<td>105'</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hole pattern: 4 lines of 6 holes parallel to the traverse
10 metres between holes
20 metres between lines.

X = Distance between S.P.
e = Distance between traces.
APPENDIX V

TECHNIQUE

1. REFLECTION

The reflection method used during the survey is the conventional split spread recording. Twenty four recording stations are laid out and the shot is fired mid-way between stations 12 and 13.

Half of the spread, i.e. twelve recording stations are then shifted forward and the following shot is performed in the middle of the new spread.

2. REFRACTION

2.1 Refraction probe: a probe consists in recording a certain number of consecutive refraction spreads from two fixed shot points. This allows two time-distance curves to be plotted: one called "direct" and one called "reverse". An inventory of the markers is done, each marker being characterized by its horizontal velocity. The distance between the shot points, variable with the depth to be investigated, is of the order of 30 kilometres.

2.2 Continuous profiling: the Gardner - Layat method of continuous profiling is used by C.G.G. since 1952. This method is modified and adapted from L.W. Gardner: "An aerial plan of mapping subsurface structures by refraction shooting" (Geophysics 1947, volume XII, page 221). The result of the interpretation is a delay curve. It is recalled that the delay-time is easily converted into depth, using the formula:

\[
\text{depth} = k \times \text{delay} \times \frac{V}{\sin \theta}
\]

with:
- \(k\) = anisotropy factor
- \(V\) = overburden velocity
- \(\sin \theta\) = overburden/marker velocity
3. SPECIAL TECHNIQUES

3.1- Longitudinal offset spreads: consecutive reflection spreads are recorded from a given shot point up to a distance where reflected events are replaced by refracted arrivals. Reflection instrumental settings are used for the centre and the first offset spreads. Then refraction instrumental settings are used (see Fig. 3.).

These spreads allow a correlation of reflection and refraction events.

3.2- Velocity spreads

A velocity survey by the Gardner method was possible after the addition of one offset spread to the previous spreads. The spreads used are shown on Fig. 4.

Spread 1 is associated with spread 4, and spread 2 with spread 3. The Gardner method is described in "Geophysics", April 1947.
APPENDIX VI
FIELD OPERATIONS

1. NATURAL CONDITIONS

The distance from the surveyed area to inhabited points was considerable. Birdsville, the nearest town, was at more than 400 miles from the main camp. The direct route, along F.P.C. (A) traverse M, was accessible by Land Rovers (see Pl 3).

The seismic traverses were accessible by heavy vehicles, only after bulldozers had cleared tracks along the sand hills. Crossing these dunes was a great problem even for Land Rovers, because of the steep flanks of the dunes and their closeness; 500 to 1,000 yards only separate the successive sand ridges. In addition, small bushes and thick spinifex hampered the traffic outside cleared tracks.

The weather was warm and dry during the survey. The temperature dropped noticeably after a heavy rain, which occurred on the first of May.

2. CAMP

Only one main camp was used during the survey. It was located at the crossing of traverses ND 1 and ND 2.

3. LOGISTICS

The supply problems were the most troublesome the Party had to solve. This was mainly due to the fact that the southern supply dump at Cowarie Station, 250 miles from the camp, was the nearest point accessible by conventional vehicles. An intermediate dump, was located 10 miles north of Mona Downs, (Pl 3). Supplies were quickly moved from Cowarie to this dump, situated west of the Diamantina River flood area.

In April, an "Autocar" 30 ton carrier was hired by MERCURE INTERNATIONAL. Between the 6th of April and the 1st of May
four trips were made between Birsville and Cowarie, and four others from Cowarie to a point 30 miles north of Mona downs. It was then withdrawn since it was not even able to reach Poeppel's Corner.

3.1- Water supply
Water was taken from the Kilpattha Native well, 82 miles south of the camp, and transported in two 800 gallon water tanks, equipped with a vacuum filling system. This native well was deepened and equipped to ensure a regular production. It took 5 hours to fill up one 800 gallon tank. Each trip took 14 hours at the beginning, and 12 hours after the improvement of the southern trail following the rain on the first of May.

3.2- Food supplies
Perishable like bread, vegetables, fruit and butter, were forwarded once a week from Charleville by the chartered CESSNA. Meat was forwarded once a week from the Alton Downs Homestead by the same plane. Tinned food stuffs were delivered at the beginning of the survey by a carrier from Adelaide as far as Cowarie. The party trucks then transported them 250 miles to camp. Some tinned supplies were also airfreighted from Betoota towards the end of the survey.

3.3- Fuel and lubricants
Deliveries were arranged to Cowarie by SHELL OIL CO, the nearest point accessible by two wheel drive vehicles. A dump was located there and then the fuel was brought in by the Party's trucks. Because of the distance and the bad conditions of the trail from Cowarie to the camp, the driving time was 18 hours for an empty truck, and 20 hours for the return trip. A round trip took roughly 50 hours including loading and unloading and a quick servicing at Cowarie.
All fuels were supplied in 44 gallons drums.

3.4- Explosives
The same problems as above, arose, with the supply of explosives and detonators. Deliveries were made in Cowarie Station and the transportation to camp was done by the Party's trucks.

ICI explosives were used, mainly "Ligdyn AN 25" in 1½ lb cartridges for the reflection work, and "Nitrolite" in 80 lbs bags for the refraction surface shots. The latter was mixed with diesoline in the field.
ICI 30 ft and 15 ft detonators were used.

3.5- Conclusions
The enumeration of all these supply problems was thought necessary, to explain the number of drivers and mechanics included in the seismic Party (refer to Appendix 1)
4. COMMUNICATIONS

4.1 Radio

Daily sessions were arranged with the Flying Doctor Service base at Cloncurry for telegram transmission and medical advice. Other sessions with Birdsville and the Mona Downs Station in the south, were arranged in order to ensure a better supply service for the Party and a good control of the vehicles during their trip to Cowarie.

Daily sessions with Messrs A.A.P. in Brisbane were also made with a single side band radio transmitter.

4.2 Mail

The mail was brought from Birdsville and Charleville by the light plane at least once a week.

4.3 Air Service (Pl 3.)

4.3.1 Regular lines: the only regular flight in the area connects Birdsville to Brisbane once a week, through Bedourie and Betoota.

4.3.2 Chartered plane: the CESSNA 185 attached to the crew operated from Birdsville. A landing strip had to be built close to the main camp. One of the dozers worked on it for 11½ hours. Old tyres trailed behind a truck were used to maintain the airstrip in normal condition. The usable landing strips are indicated on Pl 3.
5. **SURVEYING OPERATIONS**

5.1 - **Alignment and pegging**
Alignment was done with the use of a Wild To theodolite for the beginning of a traverse. After a few hundred yards, the bulldozer driver worked forward alone, keeping the previous alignment by observation of the track behind him. On the top of the sand hills, rods were used so as to keep the correct bearing, which was checked from time to time by the surveyor.

The pegging was done link by link with the aid of a 50 metre long cable. The shot point patterns were pegged after the first dozer had cleared the traverse, and were cleared by the second bulldozer.

5.2 - **Levelling**
The levelling made with a Wild To theodolite requires a knowledge of the instrumental declination. For this purpose a sun observation was conducted at the crossing of the traverses which gave an angle of $+6^\circ 19'$.

5.3 - **Documents used**

Map: Northern Simpson Desert. Scale: 1/250,000
(by the National Mapping Division)

Aerial photographs: Scale: approximately 1/50,000

Photomaps: compilation.

5.4 - **Tie of the survey**

Elevation: There are no bench marks in the surveyed area. Ties were made to permanent markers built up by the Survey Branch of the Department of the Interior along the Hay River. Elevations are based on the Queensland State Datum which agrees with the town datum at Alice Springs and does not require any correction for reduction to the mean sea level.

Ties were also made to the astronomical station INT 32 along Hay River and to Poeppel Corner, to the South, which was chosen as origin for the elevations. A misclosure of 5.16 metres was found between Poeppel's Corner and INT 32. Elevations were not compensated. The elevation of Poeppel's Corner Station, as determined by a tellurometric survey of the Department of Lands of South Australia in 1963, is 77 ft a.m.s.l. ± 15 ft. (23.50 ± 4.50 metres).
Planimetry: The astronomical station INT 32, situated along the Hay River, was considered as an origin for the planimetry of the whole area. A tie was made to Poeppell Corner, giving misclosures of 365 metres in longitude and 35 metres in latitude. Co-ordinates were not compensated.

5.5- Projection system
The projection system adopted is the UTM Australian zone 5. The connecting co-ordinates were converted to enable the metric system to be used. However, on the location map, at a scale of 1/250,000 the UTM-yard grid is drawn.

5.6- Permanent markers
10 feet long iron pipes (2" diameter) on which the name of the traverse and the number of the shot point are welded, were placed every 6 km, that means every tenth shot point.

A list of these markers, with corresponding co-ordinates and elevations, is given at the end of the appendices.

6. DRILLING OPERATIONS
The drilling was conducted with two Mayhew 1,000 water/air drills. On all shot points, air drilling was carried out. During the reflection survey, ten test holes were drilled until 120 ft but the average depth was 15 ft. 5 5/8" and 4 3/4" insert bits or insert blades were used.

In order to check the water supply possibilities, several holes were drilled along the Hay River down to a depth of 145 ft, at the crossing of traverses ND 1 and ND 2 to 190 ft, and near shot point 220 of traverse ND 2 to 90 ft. This water search was unsuccessful.

The shot point pattern consisted mainly of 24 holes drilled to 15 ft. This was quite easy, as the formations encountered were sandy. Soft clay was found in the deep holes.

7. SHOOTING OPERATIONS
The holes were loaded just after being drilled. This operation in sandy formations had to be very fast, to prevent the holes from collapsing. The electrical connections were done by two shooter-helpers, who were added to the basic crew, in order to improve the production of the recording crew.

Four cartridges of 1 ½ lb were the normal charge per hole.
by the two shooters and the preloading of holes drilled for reflection shooting was notably slowed down. The two shooters operated on each side of the refraction spread, moving from one shot point to another, according to the radio instructions given by the observer.

Surface shooting was performed. One 80 lbs bag of Nitrolite mixed with one gallon of diesoline was used as unit charge with one 1 1/4 lb "Ligdyn" cartridge as a primer. The bags, laid down at 10 metres intervals, were connected by a string of primacord ("Cordtex" manufactured by ICI), which has a detonation velocity of 20,000 ft/sec. The use of primacord has been developed by C.G.G. since experiments in North Africa have shown that the seismic energy transmitted by a group of charges, can be increased if these charges, lined in the direction of the spread, are connected by a string of primacord, the detonation velocity of which is close to the velocity of the marker to be studied.

8. RECORDING OPERATIONS

The field techniques applied in both reflection and refraction were the classical ones:
- split spread recording in reflection
- continuous probe in refraction (refer to Appendix V)

In reflection 24 traces were used, the shot point being in the centre of the spread. The characteristics of the spreads were:
- distance between shot points: 600 metres
- 24 traces with 50 m. between traces
- 36 geophones per trace in 3 lines, 10 m. apart and parallel to the traverse, 5 m. between geophones.

The shot point was made up of 24 holes, divided in two patterns of 2 lines of 6 holes each, parallel to the traverse, the distance between lines being 20 metres, the distance between holes 10 metres and the hole depth 15 ft.

The shot point and geophones set ups are illustrated on Fig. 2; for the in-line offset shots, the reflection spread was used with surface shots.

In refraction the spread was displaced by 12 traces after completion of the recordings.

Each trace consisted of 12 H.S. refraction geophones in four lines perpendicular to the traverse, separated by three metres.
The distance between geophones is 10 metres on a string of four. The distance between traces was 200 metres.

Special shots for the weathering zone survey were carried out every ten shot points. Two cables with 12 take outs, were laid down, the intervals being of 5 metres on the first cable and 15 metres on the second. The spread length was therefore 225 metres.

8. 1- Instrument settings for recording in reflection

Filters : 1/20 - out
A.G.C. : slow
Suppression : initial gain : - 27 to - 36 db.
            : delay : 400 m/sec.
            : final gain : maximum
Expander  : initial gain : - 24 to - 36 db.
            : slope : 120 db.
            : delay : 400 milliseconds.

For the in-line offset shots, reflection settings were used up to a distance of 1,800 metres. Beyond 1,800 metres, refraction settings were employed.

8. 2- Instrument settings for recording in refraction

The main parameters used for recording in refraction are the filter setting and the gain. The A.G.C. was not used, except for the centre shot, and the filter setting was : out - 1/40.

No set figure can be given for the input gain, as this parameter varies in proportion to the noise level, the shooting distance and the charge of explosives. Values of gain actually used for each shot are shown on the operational diagram (PL. 7.).

8. 3- Special recording

8.3.1. Offset shots

As explained in Appendix V, the first offset spread (distance from the shot point: 600 to 1,800 metres) was shot, with the usual reflection recording settings. The charge and the shot point pattern were the same as for the centre shot.

For longitudinal offsets superior to 1,800 metres, refraction recording settings were used.

Shots were performed on the surface with charges increasing with the distance from 80 to 400 lbs.
8.3.2. Velocity shots

The standard settings for recording in reflection were used.

8.3.3. Weathering shots

Recording for weathering shots was done without using the filters or the A.G.C.

The initial gain was variable with the shooting conditions:
-30 to -42 db.

The charge was usually 2.5 Lbs buried in a 2 ft deep hole.

9. PLAY-BACK OPERATIONS

For both reflection and refraction, recording was made on magnetic tapes, Carter type.

A galvanometric monitor was recorded at the same time on a 6" wide sensitized paper, 8" for 1 second. (paper speed)

The magnetic tapes were processed immediately after recording by the field play-back unit on electro-sensitive support, 4" wide, speed of 7.5" per second.

9.1 - In reflection, such play-backs are used for interpretation purposes: computation of static corrections, analysis of the curvature of the reflections. Except for the filter setting which was 2/20 - 1/55, all settings were identical to the recording settings. The pen gain was 5, 6 or 7, according to the level of energy.

9.2 - In refraction, settings were also identical to the recording ones, but the pen gain was adjusted in order to improve the energy level when either it was too high or too low on the directly recorded galvanometric monitor. So, the pen gain varied from 3 to 7. It must be stressed that this setting was kept constant during the play-back processing of a given tape, in order to preserve the relative amplitude of each trace.

9.3 - Special play-backs: Same rules applied to the offset and velocity spreads which, according to the recording settings used, are considered as reflection or refraction records.
C.G.G. 59

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APPENDIX VII

REDUCTION AND PRESENTATION OF DATA

1. REFLECTION

1.1- Static Corrections (Fig 7)

The reference plane was chosen at 100 m above mean sea level. The elevation correction merely consists in transferring geophones and shotpoints to the datum plane. Calculation of the time involved requires a knowledge of the elevation (surveying data) and of the subweathered layer velocity, which is the correction velocity. The weathered zone correction consists in replacing the travel time in the weathered zone by the theoretical time required to travel through that zone with the velocity of the sub-weathered layer.

The computation of the field corrections necessitated a knowledge of the depth "h" and velocity of the weathered layer 'Vo' and the velocity of the sub-weathered layer,'Ve', information deduced from the weathering zone special shots.

The velocity of the weathered zone is about 700 m/sec and its thickness ranges from 20 to 60 metres. The horizontal velocity of the sub-weathered zone ranges from 1,800 m/sec to 2,400 m/sec with an average value of 2,000 m/sec. The latter value was used for calculation of elevation corrections.

Static corrections were determined for each recorded station using a method based on the comparison of templates recorded on a spread shot from two adjacent shotpoints. It is derived from the "Plus minus method of interpreting seismic refraction sections" Hagedoorn ("Geophysical Prospecting" Vol 7 No 2).

1.2- Dynamic Corrections (Fig 8-9)

The move-out corrections were deduced from an analysis of the reflections, and was carried out on each traverse.

An example of this process is given on Fig 8 and 9.

The CGG designed "MTD Corrector" allows corrections up to 200 milliseconds with any desired steps. The move-out values are applied in one millisecond units according to the T - delta T curve.
For $400 \leq P \leq 1,400$ metres,
$V_m = 1,750 + 0.76 \cdot (P - 400)$.

Vertical time $t$
Vertical velocity $V$
Depth $P = \frac{Vt}{2}$

Travel time $T$

$\Delta T = T - t$

$\Delta T$
1.3- Interpretation documents
The magnetic tapes were processed at the camp and assembled in variable area cross-sections: Vertical scale 7.5 inches for 1 second two-way time, horizontal scale 1/8,000. Each section consists of ten corrected play-backs.

2. REFRACTION
2.1- Surface corrections - A similar method of data reduction was applied to the refraction measurements (same datum plane and same velocity values were chosen).

2.2- Interpretation documents -
The following documents concerning the refraction probe SND 1 are included in the report:
- Operational diagram (Pl 7)
- Time-distance curves (Pl 8)
- Interpretation plate (Pl 9)

These plates are self-explanatory and it should be noted that on the diagram, in order to represent both direct and reverse spreads, two slant lines are drawn, on which are reported the bases actually shot.

3. DEPTH CROSS-SECTIONS
3.1- Velocity information
The interpretation of T-delta T curves presented on Fig 8 and 9 provides some velocity information which can be used for a time to depth computation.

Between SP 12 and 49 the vertical time of "A" horizon increases from 650 to 800 milliseconds (two-way, uncorrected times). This would correspond to an increase of the overburden velocity from 1,900 m/sec to 2,100 m/sec. (graph T-V of fig 8).

On the southern part of the traverse: SP 50 to 120, the vertical time of "A" horizon increases from 800 to 1,050 m/sec. The T-V graph of fig 9 shows a corresponding increase of overburden velocity from 1,950 to 2,200 m/sec.

3.2- Reflection
For the time depth conversion of the "A" horizon a constant overburden velocity of 2,100 m/sec was adopted. Little information is available concerning "D" horizon, since the velocity spreads gave poor results.

It was assumed that the A-D interval velocity is of the order of the horizontal velocity of the "A" horizon given by the refraction and offset shots i.e. 3,300 m/sec.

A calculation made at SP 55 of traverse ND 1 (PL 12) gives the following results:
T-ΔT ANALYSIS

Traverse ND1 S.P. 50 to 120

For 600 ≤ P ≤ 1,600 metres
Vm. = 1,820 + 0.69 (P - 600).

Vertical time τ
Vertical velocity V
Depth P = \( \frac{V}{2} \)

\( \Delta T = T - \tau \)
COMPAGNIE GÉNÉRALE DE GÉOPHYSIQUE

a/ data: depth of "A" 670 metres b.m.s.l.
   A-D time interval: 260 m sec.

b/ A-D interval: \( \frac{260}{2} \times 3.3 = 430 \) metres

Depth of "D": 670 + 430 = 1,100 metres

\[
\frac{1100}{V} = \frac{670}{2.1} + \frac{430}{3.3} = 319 + 130 = 449
\]

so \( V = \frac{1100}{449} = 2,450 \) m/sec

A value of 2,500 m/sec was used for the time depth computation of "D" horizon.

3.3 - Refraction

Since the offset spreads proved that, the 6,100 m/sec refractor and "D" reflector originate from the same formation, an overburden vertical velocity of 2,500 m/sec was used for the depth computation of this marker.

It is recalled that the formula used was:

\[
\text{Depth} = \text{delay} \times \frac{V}{\cos \theta}
\]

and that \( \sin \theta = \text{overburden velocity} / \text{marker velocity} \).

With \( V = 2,500 \) m/sec and a marker velocity of 6,100 m/sec:

\[
\sin \theta = 0.41 \quad \text{and} \quad \cos \theta = 0.912
\]

\[
V / \cos \theta = 2.74 \quad \text{and} \quad \text{depth} = 2.74 \text{ delay}
\]
### LIST OF PERMANENT MARKERS

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**Astronomical station**

| INT 32 | 539,041 | 1,755,987 | 87.41 |

**Note**: Transverse Mercator projection system. Australian belt zone 5.

The Astronomical station INT 32 is the origin of coordinates calculated in the metric system.

The origin of elevations is the Poeppel's Corner Tellurometric station. Elevations are in metres above the mean sea level.