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COMPAGNIE GÉNÉRALE DE GÉOPHYSIQUE

AUSTRALIAN AQUITAINE PETROLEUM PTY. LTD.

KILPATTHA SEISMIC SURVEY

January - June 1964

P.R. 64/12[redacted]

TABLE OF CONTENTS

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LIST OF ILLUSTRATIONS

PLATES NOT INCLUDED IN THE REPORT

Variable are reflection cross -sections

Traverse K 1	:	17 plates
Traverse K 2	:	11 plates
Traverse K3	:	5 plates

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

I. FIGURES

II. PLATES

8- Operational diagram
9- Interpretation diagram
10- Time-Distance curves
11- Interpretation plate

12- Offset shots - Traverse K 1
13- Offset shots - Traverse K 2
14- Specimen of reflection cross-section -Traverse K1
15- Specimen of refraction records -Probe SK 1

16 to 18 Reflection and synthesis reflection -Refraction
16- Depth cross section - Traverse K1
17- Depth cross section- Traverse K 2
18- Depth cross section-Traverse K 3
19- Schematic contour map -"A" horizon - Scale 1/250,000

PLATES NOT INCLUDED IN THE REPORT

Variable are reflection cross -sections

Traverse K 1	:	17 plates
Traverse K 2	:	11 plates
Traverse K3	:	5 plates

SUMMARY

From February to June 1964 ,132 miles of reflection traverses ,25 miles of refraction lines ,offset and velocity spreads were carried out by COMPAGNIE GENERALE DE GEOPHYSIQUE in permit to explore OP 36 (Northern Territory) for AUSTRALIAN AQUITAINE PETROLEUM PTY LTD.

Along all traverses two continuous horizons were followed . They are nearly conformable and dip gently to the south-west . The first one, at a depth of 940 to 1,400 metres b.m.s.l. presumably belongs to an upper-Jurassic formation . The deeper horizon, at a depth of 1,560 to 2,140 metres b.m.s.l. could represent a Proterozoic formation in the northern half of the permit and a Paleozoic formation in the southern half.

Only small amplitude undulations were outlined in the sedimentary section .

INTRODUCTION

Following a contract between the :
AUSTRALIAN AQUITAINE 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 OP 36 in Northern Territory, where AUSTRALIAN AQUITAINE 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 dozing crew was added for clearing tracks and seismic traverses .

Preparatory work was done from the 2 nd of January until the 17 th of February 1964, following a dozing program in December 1963.

Drilling began on the 14 th of February and was completed on the 18 th of June , 1964.

Seismic operations were conducted from the 18 th of February until the 21 st June 1964.

There was an interruption between the 13 th of April and the 2 nd of June 1964 since the same Party carried out the " Northern Simpson Desert Seismic Survey " in OP 64/1 for MERCURE INTERNATIONAL PETROLEUM PTY LTD .

During the survey, 212.4 km (132 miles) of new reflection traverses , 40.8 (25 miles) of refraction lines, in-line offset and velocity spreads were carried out .

Mr . Jean . 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 OP 36 is situated close to 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 :

Age	Lithology	Thickness
Tertiary	Alluvium-Sands	about 100 feet
Cretaceous	Winton form. arkose & claystone	more than 500ft
Cretaceous	Wilgunya form. dark shales	about 1500 ft
Jurassic	Lateral equivalents from Blythesdale to Bundamba	perhaps 1000 ft
	Regional unconformity	
Permian) Devonian	Possibly exists-should be a lateral equivalent of the Pinke or Pertnjara formations	?
	Important angular and regional unconformity	
Ordovician) Middle and) upper Cambrian)	Possibly exists-should be a lateral equivalent of the Pacoota to Mareenies formations	?
Lower Cambrian upper Proterozoic	Lateral equivalent of the Bitter Springs form. to the Goyder form.	Several Thousands ft

The sedimentary section thins from the southeast to the northwest .

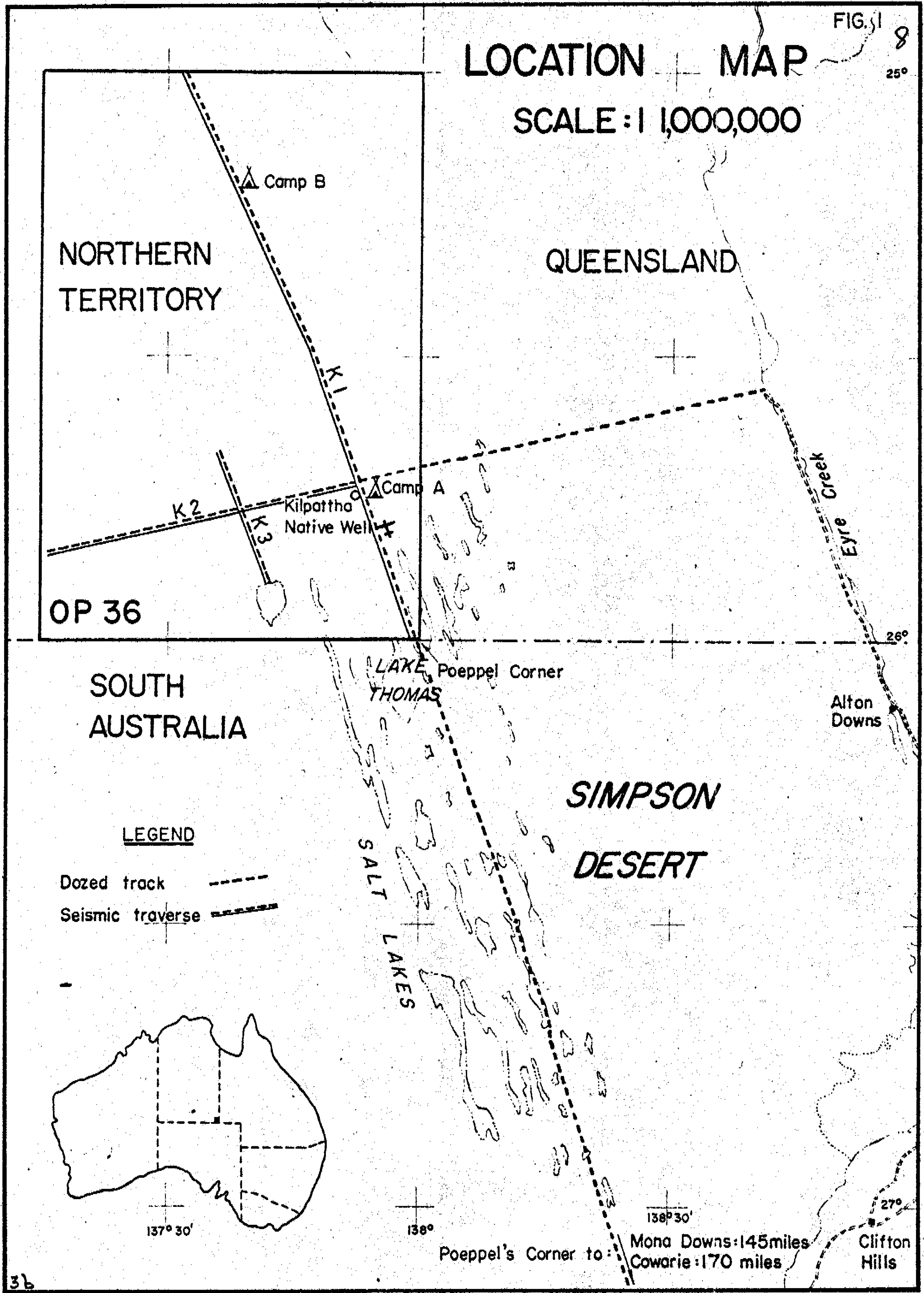


FIG. 1
LOCATION MAP
SCALE : 1 1,000,000
25°
Camp B
NORTHERN
TERRITORY
QUEENSLAND
K1
Camp A
K2
Kilpattha
Native Well
K3
Eyre Creek
OP 36
26°
LAKE
THOMAS
Poeppel Corner
SOUTH
AUSTRALIA
Alton
Downs
SIMPSON
DESERT
LEGEND
Dozed track
Seismic traverse
SALT LAKES
27°
137° 30'
138°
138° 30'
Poeppel's Corner to: Mona Downs: 145 miles
Cowarie: 170 miles
Clifton
Hills

The B.M.R. regional gravity work has indicated the presence of a negative trend situated south of the Boulia area, which could be interpreted as outlining a connection between the Amadeus and the Great Artesian Basins (Toko syncline).

There is little other information available regarding a possible connection between the Amadeus, the Great Artesian and the Georgina Basins, and several hypotheses can be entertained.

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 lenticular calcareous and sandy formations (equivalent of the Toolebuc formation), within the Wilgunya formation, which is a good source rock (black shales).

2. GEOPHYSICAL DATA

2.1 A gravity survey consisting of 225 stations was carried out on behalf of Associated Freney Oil Fields N.L. by Mines Administration Pty Ltd., in May 1961 (Gravity Survey on Oil Permit 36 Northern Territory).

Copies of the final report of this survey are on file at the Bureau of Mineral Resources.

The object of this survey was to determine the thickness of sedimentary section in the area and to delineate any structural feature within the sedimentary section.

Using a density contrast of 0.4 between the Mesozoic and the underlying formations the thickness of the Mesozoic section has been computed as increasing from 3,300 feet in the northwest corner of the permit to 7,000 feet in the southeast.

A gravity high which occurs in the southwest is possibly related to geological structures within the sedimentary section while the remainder of the anomalous gravity features are considered to be related to the basement (see Pl 7.).

From the general configuration of the B.M.R gravity work over adjacent areas, it is possible that a " high " axis AB , showing a northwest-southeast bearing crosses the permit as indicated on Pl 7 .

2.2 Aeromagnetic results

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 the reinterpretation made by C.G.G. over OP 36 are shown on Pl 7 . A magnetic basement high with a northwest-southeast trend was outlined in the northern part of the permit . It coincides approximately with the possible gravity " high " axis AB .

Another anticlinal axis was outlined in the southeastern corner of OP 36. The trend of this feature is not definite as the variation in depth to the magnetic basement is quite small : 2 to 2.5 kilometres b.m.s.l. as shown on Pl 7 . Also due to the loose network of aeromagnetic lines the accuracy of the depths was estimated to be of the order of 15%.

2.3 Seismic

No seismic work had been conducted on OP 36 permit. A seismic survey was carried out by COMPAGNIE GENERALE DE GEOPHYSIQUE for 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 .

CHAPTER II

OBJECTIVES & PROGRAMME

1. OBJECTIVES

The objectives of the survey were defined by : AUSTRALIAN AQUITAINE PETROLEUM PTY LTD 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

2.1 Initial Programme :

The survey was to start from the south-eastern part of the lease where a topographical tie to Poeppel's Corner was recommended .

The first reflection traverse was planned to cross the whole permit from Poeppel's Corner to the north- northwest ,according to the prevailing direction of the dunes .

Further experimentation was planned since the work carried out for FRENCH PETROLEUM COMPANY (Australia) in the Simpson Desert showed that a geophone and a hole multiplication was the best way to improve the seismic results .

The seismic work started with the geophone and shot hole patterns adopted for French Petroleum Company (Australia) : 24 holes at 15 feet depth and 36 geophones in three parallel lines .

The main purpose of the experiments was to determine whether the shot point coverage should be extended and whether this should be perpendicular or parallel to the traverse . In addition ,the effect of increasing the number of holes was also examined .

The refraction probe had to be laid out along the first reflection traverse and at a location where interesting reflection results were obtained.

Refraction surface shooting would allow an increase in the advance of the drilling over the recording crew .

2.2 The first extension of the programme was communicated to the Party by AUSTRALIAN AQUITAINE PETROLEUM PTY LTD on the 13 th of May 1964.

This programme included traverse K 2 starting from camp A (SP 151 of traverse K 1) to the western boundary of the permit crossing a positive gravity anomaly. In the centre of this 65 km long traverse longitudinal offset shots had to be recorded to correlate reflection and refraction arrivals combined with velocity spreads.

2.3 At the beginning of June a second extension of the programme was requested. This consisted of a reflection traverse K 3 of 50 shot points perpendicular to the previous one K 2. Thirty shot points would be located south of the intersection and 20 shot points north of the same intersection.

Initially ,this traverse K 3 was located on the gravity high west of Kilpattha native well but when traverse K 2 showed that this gravity high did not correspond to a seismic structure ,the traverse was shifted on a seismic " high " located between SP 243 and 253 .

2.4 Programme Timetable

Reflection traverse K 1 and refraction probe SK 1 were shot between the 18 th of February and the 22 nd of April, 1964 , with an interruption of 23 days (13 th of March - 4 th of April) due to local leave .

Traverse K 2 was shot between the 3 rd and the 16 th of June and traverse K 3 between the 17 th and the 21 st of June 1964 .

CHAPTER III

TECHNIQUE & 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 consisted in recording a certain number of consecutive spreads from two fixed shot points . This allowed 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 refraction method was the Gardner-Layat method of continuous profiling used by C.G.G. since 1952 particularly in desertic areas . 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 longitudinal offset and velocity spreads were recorded along the reflection traverses. Consecutive spreads were 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 was used for the first break. 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 hampered the movements of sand equipped vehicles beyond cleared lines . Travelling across the dunes on east-west lines was very difficult and, several times the dozers had to tow the drills or the recording truck.

The standard Party comprised 45 men and 19 vehicles .The dozer crew consisted of 5 operators ,2 dozers and 3 vehicles .

Two main camps were settled along the south-north traverse. They consisted of air - conditioned trailers . The supply problems were the most difficult to solve . Water was taken from Kilpattha native well ,but all tinned foodstuffs ,fuel and explosives were transported by the Party's vehicles from a dump settled at Cowarie station : 170 and 210 miles south of the camps . This was the shortest point accessible by two wheel drive vehicles coming from Marree or Birdsville .

A CESSNA 185 chartered plane delivered weekly perishables and mail from Charleville or Birdsville .

Radio communications were maintained with the Royal Flying Doctor Service Base at Cloncurry.

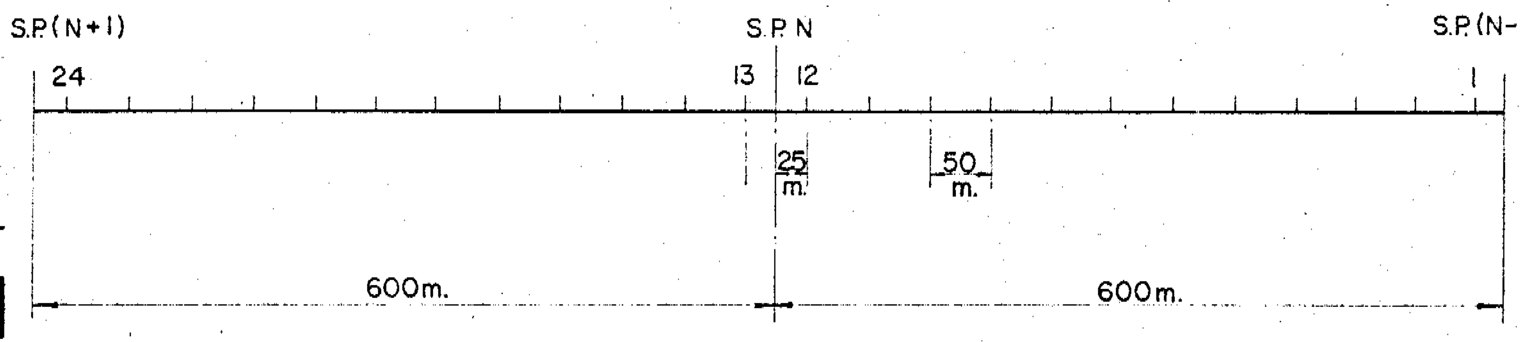
Surveying operations were conducted with a WILD TO Theodolite. Ties were made to Poeppel Corner's tellurometric station and to INT 32 astronomical station along Hay River .The former station was chosen as origin for the elevations and co-ordinates .

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 drilled to a depth of 15 feet. 5 5/8 " and 4 3/4" insert bits were mainly used. The reflection spread consisted of 24 geophones traces,50 metres apart with 36 geophones in 3 parallel lines at each trace . A 120 Lb (24 x 5 lb s) charge was used (see fig 2) .

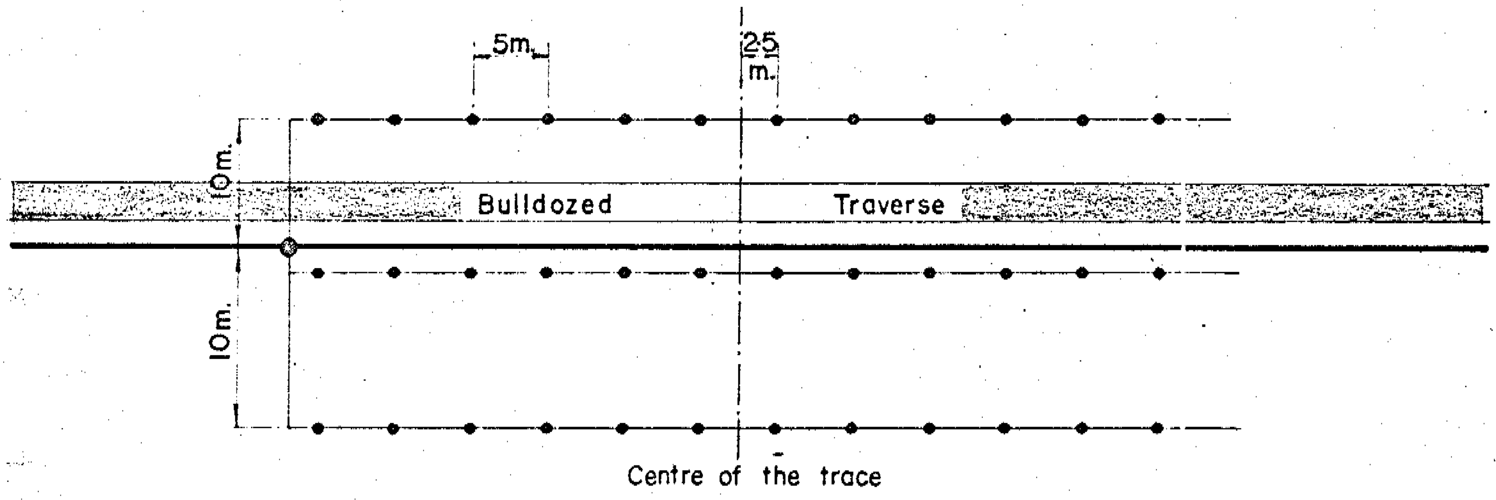
In refraction 24 traces were also recorded. The distance between traces was 200 metres , i.e each fourth reflection trace corresponded to a refraction geophone location . 12 Hall Sears refraction geophones were laid down at each trace .

FIG. 2

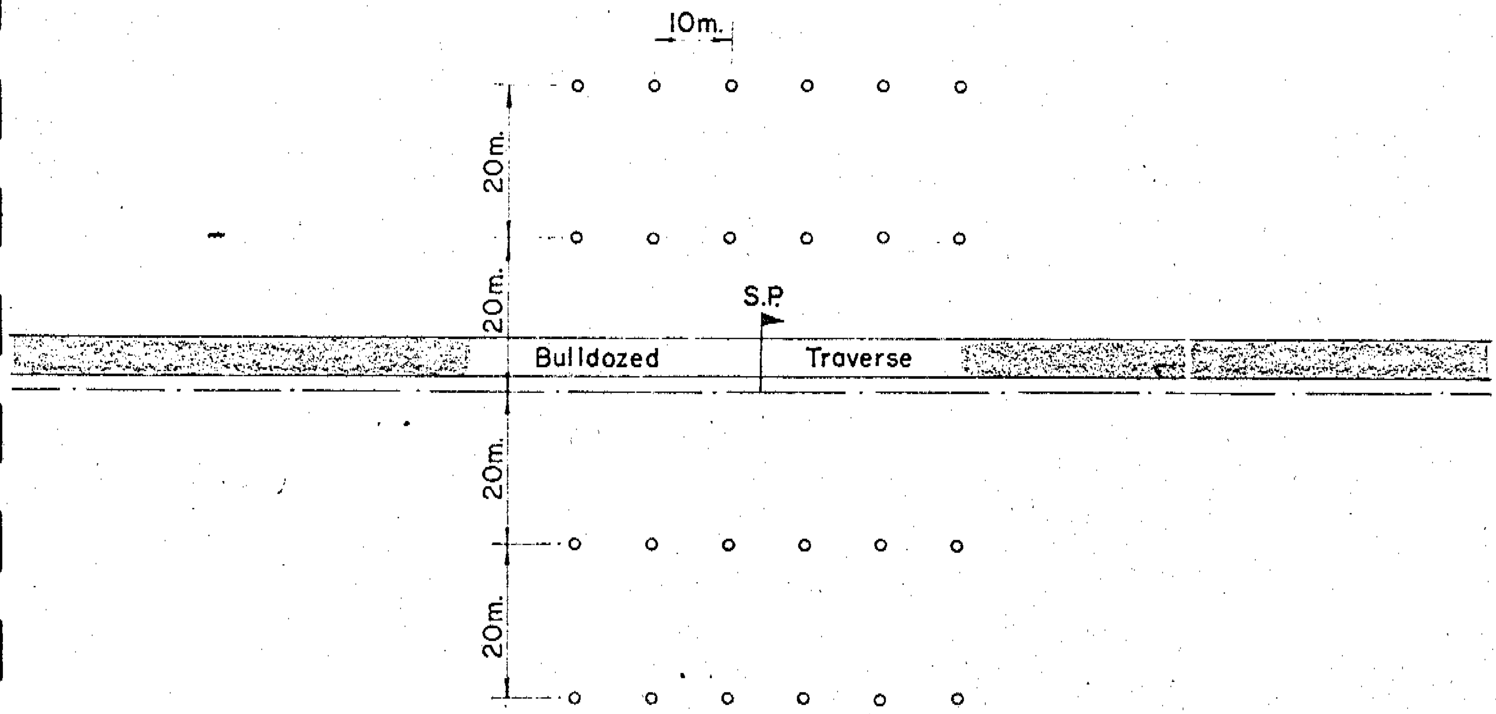
REFLECTION SPREAD



GEOPHONE PATTERN



HOLE PATTERN



Surface shooting was used for the refraction work. The"C.G.G. 59" recording unit was a pulse-width modulated magnetic assembly with C.G.G. amplifiers . It was equipped with a simultaneous SIE- PRO 11 photographic recording oscillograph and a squential play-back Electrotech MTD.

A C.G.G. designed corrector allowed the magnetic tapes and variable area play-backs to be processed in the field. These play-backs were corrected trace by trace ,for both static and move-out corrections.

Details concerning the operations are shown in Appendices I, II and VI.

CHAPTER IV

RESULTS

1. INTERPRETATION

All distances and depths are in metres or kilometres, velocities are expressed in metres per second and seismic times in milliseconds two-way time .

1.1 Refraction

The "Operational diagram" (Pl 8) gives the particulars of field operations concerning the probe SK 1 and the refraction line . An analysis of the records led to the " Interpretation Diagram " (Pl 9).

All picked arrivals were plotted on the " Time-distance curves" (Pl 10) and the interpretation of high velocity arrivals by the Gardner-Layat method is shown on Pl 11.

A photo reduction of assembled refraction recordings is presented on Pl 15 .

1.2 Reflection

The longitudinal offset shots fired along traverse K 1 and K 2 are presented on Pl 12 and 13 .

One example of a reflection field play-back cross section is enclosed (Pl 14) . It is a photo-reduction at a scale of 1.5" to 600 metres (distance between shot points) .

Depth cross-sections along the traverses are submitted at a scale of 1/100,000 (Pl 16 to 18) . They allow a comparison with the refraction results and the offset shots .

Pl 19 is a schematic contour map of the main horizon ('A'horizon).

2. REFLECTION WORK

The record quality did not vary appreciably along the 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 and the two velocity surveys the average vertical velocity down to "A" horizon increases southwards from 2,100 to 2,300 m/sec (App VII). However ,in order to give a better correlation with adjacent reflection surveys,the depth cross-sections and the contour map of the "A" horizon were calculated with a constant overburden velocity of 2,100 m/sec.

A second horizon : 'D' , less continuous than 'A' may be followed along all traverses . The velocity surveys gave an overburden velocity of about 2,500 m/sec and this value was used for the depth computation.

Along traverse K1 ,'A' and 'D' horizons dip regularly southwards, the former from 950 metres to 1,360 metres b. m. s. l. , the latter from 1,560 to 2,100 metres b.m.s.l. These figures indicate a southward thickening of 130 metres of section over a horizontal distance of 120 Km.

A fault ,F 1,downthrown 60 metres on the south side,crosses the traverse at SP 94 and separates a northern zone with steep line-ups and diffractions below the 'D' from a southern zone where scattered reflections can be picked 50 to 200 milliseconds below the horizon .

On the east-west traverse K 2 the 'A' and 'D' horizons show a slight west dip,interrupted by two faults F 2 and F3 . The main indication of this traverse is a high anomaly limited eastwards by F2 .

The major feature of traverse K 3 is a fault which correlates with fault F2 of traverse K2 as shown on the schematic contour map (Pl 19 .).

This map shows a general south-west dip of the 'A' . Along the monocline several small amplitudes undulations exist such as the high zone H but their closures to the north are questionable .

3. REFRACTION WORK

3.1 Refraction probe SK 1 (Pl 9 ,10 and 11)

Low velocity arrivals were recorded from 0 to 3 km. A high velocity refractor was then recorded up to the maximum shooting distance of 27 km. Some later arrivals ,recorded for shooting distances of 5 to 10 km showed apparent velocities of 3,700 to 4,000 m/sec .

The high velocity refractor was computed by the Gardner-Layat method., over 15 bases of 2.4 km. Its actual horizontal velocity is 6,000 m/sec

A velocity change : 6,000 to 5,450 m/sec (?) was found near fault F 1 (Pl 11 and 16).

3.2 Offset spreads (Pl 12 and 13)

The offset spreads of traverse K 1 showed that the later arrivals : 3,700 - 4,000 m/sec recorded in refraction correspond to the 'A' reflector and that the 6,000 m/sec marker coincides with the 'D'horizon.

In the central part of traverse K 2 ,the apparent horizontal velocities of 'A' and 'D' are 3,750 and 5,580 m/sec respectively .

A 4,410 m/sec arrival was also recorded .

4. TENTATIVE IDENTIFICATION

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

The 'D' horizon,below which no higher velocity marker was detected in the northern half of the permit, could represent an eroded basement formation. To the south ,D presumably represents the top of the pre-Mesozoic formations .

CHAPTER V

DISCUSSION OF RESULTS AND INTERPRETATION

PART ONE : REFLECTION RESULTS

Along the three surveyed traverses only one horizon : "A" is quite continuous and reliable. The signal is characterized by 3 or 4 strong cycles.

Above this horizon some scattered reflections are pickable, these can be followed continuously for 2 to 5 shot points only .

Below the 'A', conformable line-ups are pickable down to a second "D" horizon. The features of the deep events differ north and south of the faulted zone F 1 , which is located below SP's 85 -95 on traverse K1:

- north of F1, 'D 1' is affected by the presence of steep line-ups and diffractions. This strongly suggests that the 'D' is the envelope of an eroded surface .

- south of F1 , the 'D' is the limit of the continuous reflections. In places , intermitent reflectors may be followed 50 to 200 milliseconds below the 'D', especially along traverse K1 (see Pl 14 SP's 101-115).

Depth cross sections of the 'A' and 'D' horizons along the traverses were drawn using the results of velocity surveys. These surveys showed a slight and progressive increase of the vertical velocities with depth but, for reasons explained in Appendix VII , constant vertical velocities were assumed: 2,100 m/sec down to the 'A' and 2,500 m/sec down to the 'D' horizons.

Traverse K1 (Pl 16): The 'A' and 'D' horizons dip regularly southwards from the northern end of the traverse to the crossing with traverse K 2. The only fault noticed : F1, is narrow and shows a throw of 60 metres to the south.

Shallower events are pickable at 700 milliseconds , i,e, 350 msec above the 'A' between SP's 20 and 50, 98 and 105 (see Pl 14) and 119 and 135.

These were not converted to depth .

South of the crossing with traverse K 2, the 'A' is nearly horizontal but nevertheless shows a small culmination between SP's 190 and 198.

The 'D' horizon is interrupted in places and, when questionable, the continuity was obtained by correlating it as the most continuous horizon below the 'A'. Between SP's 100 and 132 and at places, southwards, elements of reflectors were picked below the 'D' horizon. These and the steep events noticed north of fault F 1 were plotted on Pl 16 using a constant 2,500 m/sec vertical velocity.

This means that no accuracy must be expected from the information shown below the "D1" north of F 1.

The aim was merely to give an idea of the dip and to point out the difference between the northern and southern parts of this traverse.

The "A-D" interval thins northwards from 760 to 620 metres along the 120 km long traverse.

Traverse K 2 (Pl 17):

'A' and 'D' horizons are continuous and almost conformable. Two narrow but distinct faults : F2 and F3 show a down throw to the east of 60 and 30 metres. Both faults limit structural anomalies to the east. The most important, near F 2, could affect all the sedimentary section as it exhibits a surface expression corrected for the effect of the surface sands.

A slight 'anticlinal' feature appears between SP's 206 and 220. Strong and very deep events were picked between SP's 255 and 263, 301 and 309. They presumably orginate well within the basement.

Traverse K 3 (Pl 18)

Results are quite comparable with those of traverse K 2. The main feature is the fault F 2, with a downthrow of 60 to 80 metres to the south.

Schematic contour map (Pl 19):

The more reliable 'A' horizon was mapped.

There is little doubt about the direction of fault F 2 in the vicinity of traverses K2-K3. It is not possible however, to affirm that F2 correlates with

F1, seen on traverse K 1 : this would imply a slight change of direction and make this feature very important . This correlation is not confirmed by the refraction and the previous geophysical results as it will be seen in Parts 3 and 4 of this chapter .

The 'A' horizon dip to the southwest. Along the monocline several small amplitude undulations may exist like those outlined by faults F2 and F 3.

The fault F 2 cuts off the high zone H on the east and could then be of some interest if closure to the north is found .

PART TWO :REFRACTION RESULTS

1. Refraction probe SK 1 (Pl 9,10,11 and 15)

A refraction probe over twelve bases (17 miles) was carried out along the northern part of traverse K1.

Plate 15 presents the assembly of photoreduced 'direct'shots .

Low velocity refracted arrivals were recorded for shooting distances up to 3 km (Pl 10)

At about 4 km a very short 4,000 m/sec arrival was recorded from SP 21/7 ('reverse' shots) . It is possibly the same marker which gives rise to strong later arrivals recorded at distances of 5 to 10 km (3,680 m/sec of Pl 15) .

A rapid break at 4 to 5 km, separates the low velocity arrivals from a high velocity marker recorded up to the maximum shooting distance of 27.6 km. Its apparent velocity is 5,880 m/sec in direct and 6,120 m/sec in reverse shooting . The signal has a frequency of approximately 25c.p.s. and a characteristic split peak .

Some interfered zones can be noted in direct shooting (Pl 15) presumably due to the presence of minor faults on bases 13 to 17 .

Although the apparent velocity increases slightly with the shooting distance it is very likely that the same formation acts as a refractor for shooting distances ranging from 5 to 27.6 km .

2. Refraction line SK 1 (Pl 8-9-11)

Along bases 10 to 21 and along three additional bases to the south shots were recorded from distances of 8.4 to 13 km (Pl 8).

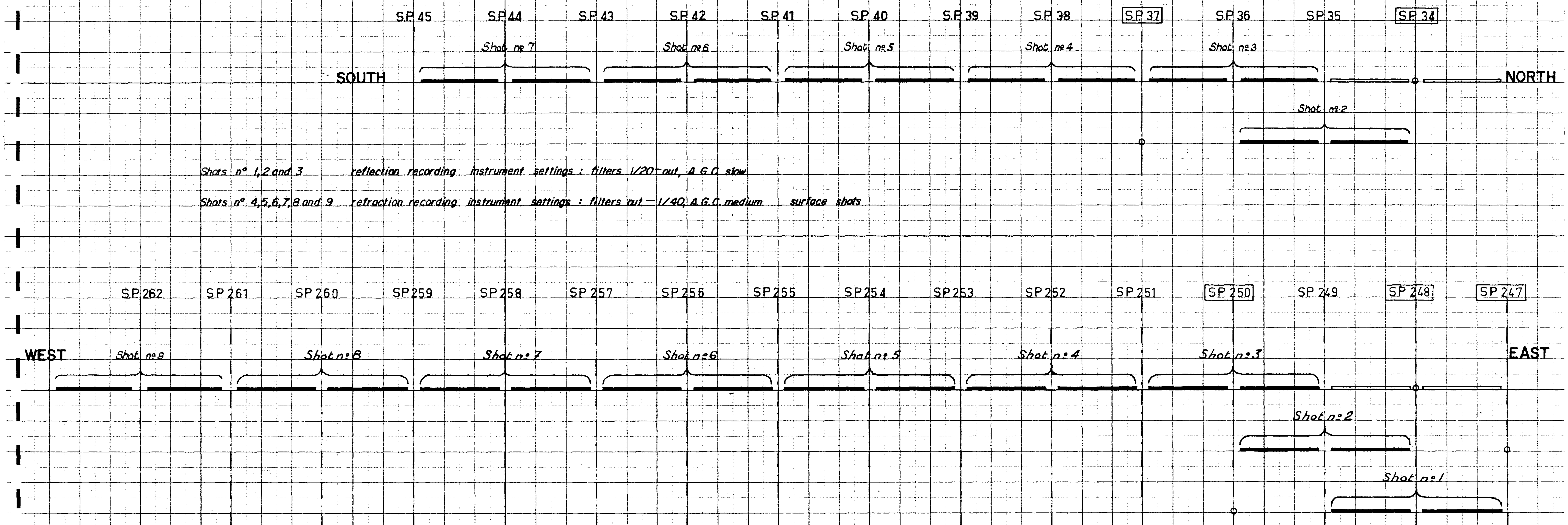
These recordings were easy to correlate since the features of the refractor and its apparent velocity did not change for spreads shot from adjacent shot points (Pl 9) .

The Gardner-Layat method was applied to the calculated intercepts (Pl 11) . The actual marker velocity is very close to 6,000 m/sec except for the two southern bases where a sudden velocity change occurs . The 5,450 m/sec value calculated over only two bases is questionable. Two possible minor faults are suggested on bases 14 and 16. The offset value of 1,800 metres was determined after a comparison of the integrated intercept curves .

The delay times vary from 625 milliseconds in the north to 705 msec on base 21.

FIG. 3

OFFSET and VELOCITY SHOTS
TRAVERSES K1 and K2



PART THREE

1. OFFSET SPREADS

A series of longitudinal offset shots was conducted from SP 34 of traverse K 1 and SP 248 of traverse K 2.

The assembled play-backs are shown on Pl 12 and 13.

1.1 Traverse K1 - SP 34 (Pl 12)

Two shallow reflections may be picked between 500 and 800 millisec. They would correspond to the 2,050 and 2,570 m/sec refracted events.

The 'A' and 'D' horizons are probably the third picked cycles of the corresponding reflectors. The 'A' loses its energy as the shooting distance increases . Corresponding refracted events are weak and their horizontal velocity ranges from 3,800 to 4,000 m/sec .

The 'D1' correlates with a 6,200 m/sec high velocity refractor recorded as a first event from a shooting distance of 4 km .

1.2 Traverse K 2 -SP 248 (Pl 13)

Shallow reflections are also pickable between 300 and 800 millisec. They correlate with 2,300 to 2,940 m/sec refracted events . Correlation of the 'A' and 'D' reflections with refracted arrivals recorded beyond 5.4 km is not very reliable because of an interference zone extending from 5.4 to 6.6 km. However, it is thought that 'A' correlates with 3,750 m/sec and 'D' with 5,580 m/sec arrivals .

Strong 4,410 m/sec events may originate from an intermediate formation which should not act as a good reflector .

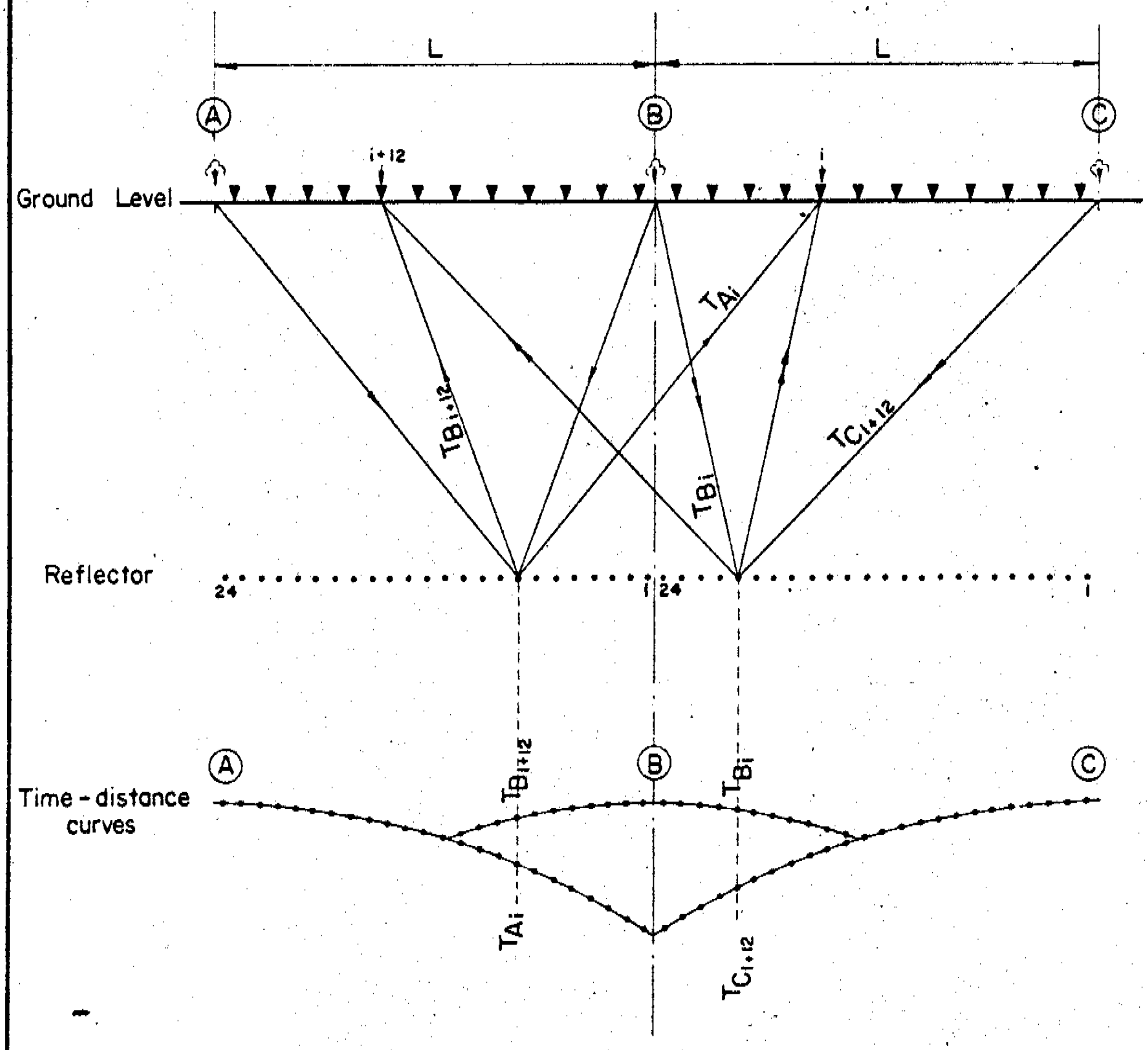
Some strong later arrivals corresponding to shallow markers were outlined (2,300 and 2,760 m/sec).

2. VELOCITY SPREADS

Velocity surveys were possible along traverses K 1 and K 2 with the addition of three spreads to the offset spreads (Fig 3) .

VELOCITY DETERMINATION

GARDNER METHOD



Calculation Formula :

$$V^2 = \frac{4L^2 \cos^2\alpha}{\left(T_{A_i}^2 - T_{B_{i+12}}^2\right) + \left(T_{C_{i+12}}^2 - T_{B_i}^2\right)} \simeq \frac{4L^2}{D^2}$$

They were interpreted by the Gardner method, the principle of which is shown on Fig 4 a and by the Dix method (Fig 4 b).

Both methods gave similar results :

- On traverse K1 ,SP's 34 to 37 : 2,100 m/sec for the vertical velocity down to the 'A' horizon ,
- on traverse K2 ,SP's 247 to 250 : 2,350 m/sec with an approximation of 50 m/sec for the 'A' horizon and 2,550 to 2,700 m/sec ,the values being questionable ,for the 'D' horizon .

3. REFLECTION - REFRACTION COMPARISON

The depth cross-sections of traverse K 1 and K2 (Pl 16 and 17) present a synthesis of the results obtained by reflection and refraction methods .

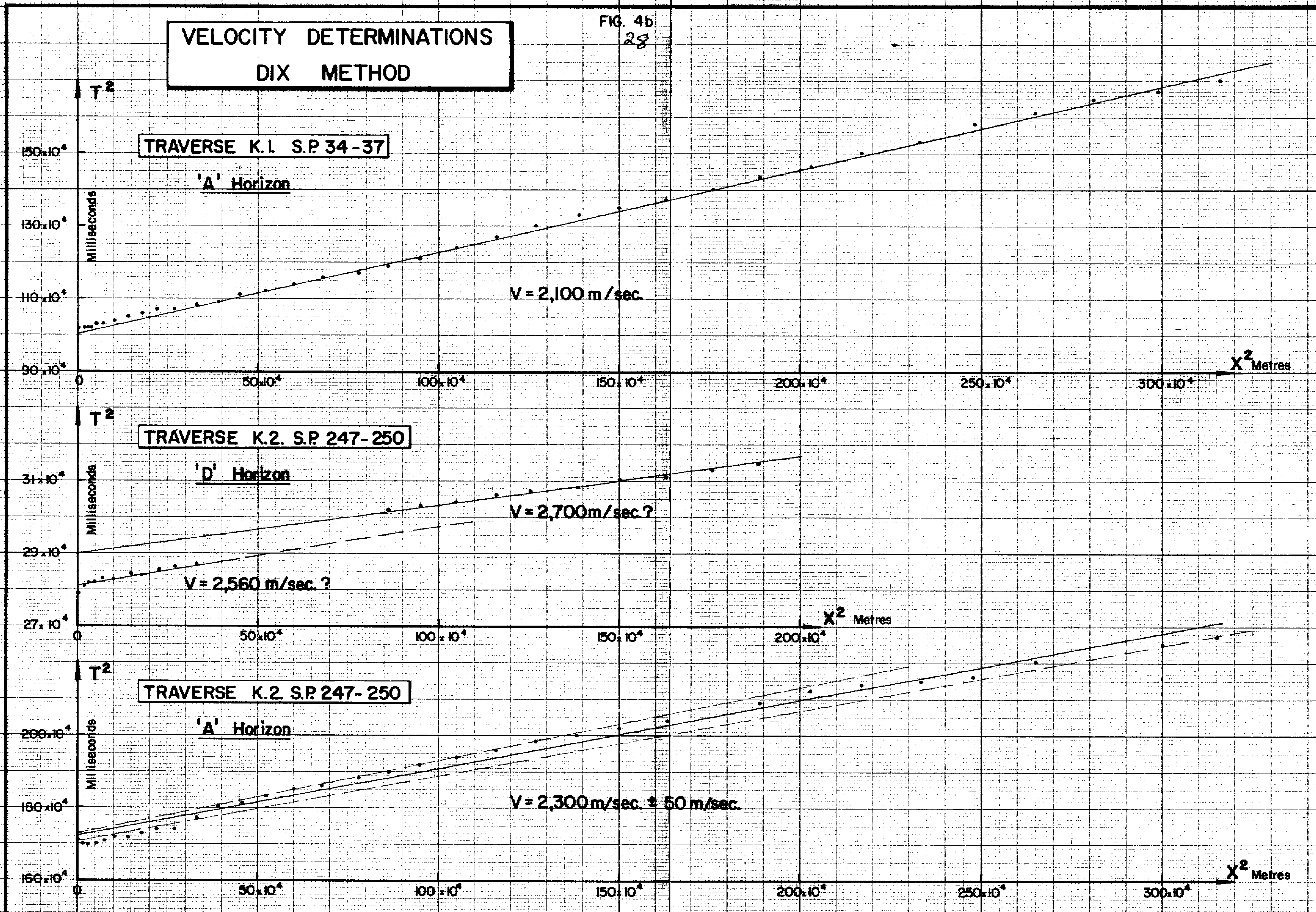
On traverse K 1,a delay-time to depth conversion for the 6,000 m/sec marker was made using an overburden velocity of 2,500 m/sec . Details of the computation are given in Appendix VII .

This marker was identified as being the 'D1' reflector on the offset spreads (Pl 12). Actually, some discrepancies of the order of one cycle appear between them . They may be explained by the minor faults seen in refraction(bases 14 and 16) and by questionable correlations in reflection (SP's 34 and 44 ,57 and 59).

The refracted events with 3,800 to 4,000 m/sec velocities correlate with the 'A' horizon .

The velocity change noted in refraction(bases 22 and 23) corresponds to an area of steep events in reflection, suggesting the existence of a burried high .

It also appears that the new 5,450 m/sec velocity, although questionable, is close to the velocity indicated for the 'D' by the offset spreads of traverse K 2 (5,580 m/sec). Thus, north of F 1 the horizontal velocity of the deep events would be of the order of 6,000 m/sec and the south of F 1 of the order of 5,600 m/sec .



VELOCITY DETERMINATIONS
DIX METHOD
FIG. 4b
28
TRAVERSE K.1. S.P. 34-37
'A' Horizon
V = 2,100 m/sec.
T²
Milliseconds
150x10⁴
130x10⁴
110x10⁴
90x10⁴
X² Metres
0
50x10⁴
100x10⁴
150x10⁴
200x10⁴
250x10⁴
300x10⁴
TRAVERSE K.2. S.P. 247-250
'D' Horizon
V = 2,700m/sec.?
V = 2,560 m/sec. ?
31x10⁴
29x10⁴
27x10⁴
TRAVERSE K.2. S.P. 247-250
'A' Horizon
V = 2,300 m/sec. ± 50 m/sec.
200x10⁴
180x10⁴
160x10⁴

4. TENTATIVE IDENTIFICATION

On the basis of results obtained in adjacent areas the 'A' horizon can be tentatively considered as representing upper-Jurassic formations (Mooga or Blythesdale group) .

The 'D1' horizon, below which no higher velocity marker was detected in the northern part of the permit could represent the eroded surface of some basement formation (Proterozoic ?).

South of the fault F 1, lower velocities found for the 'D', of the order of 5,600 m/sec , and the existence of reflections below this horizon suggest that it could represent the top of pre-Mesozoic, possibly Paleozoic formations . Another difference between the two zones is the existence of 4,400 m/sec refracted arrivals in the south (offset spreads of traverse K 2). This velocity value is close to the one attributed to Permian deposits .

PART FOUR

1. COMPARISON WITH PREVIOUS GEOPHYSICAL RESULTS

A comparison was attempted between the seismic depth curves (Pl 16 to 18), the Bouguer anomaly curve and the estimated basement depth points .

A comparison is also possible between the contour map of the 'A' horizon (Pl 19) and the geophysical data map (Pl 7)

1.1 Aeromagnetism

The estimated depth points shown on traverse K 1 and east of traverse K 2 were calculated with a horizontal slab hypothesis. This positions the magnetic basement 400 metres below the 'D' horizon .

The other values were calculated with the infinite vertical dyke assumption . These correspond to the depth of the 'D' (Pl 17-18).

It is also noted that the boundary of the change in the deep events : SP's 85 to 95 of traverse K 1 (Chapter V - Part one) is outlined by the magnetic faults intersecting this traverse between SP's 60 and 85 .

1.2 Gravity

The possible gravity ' high ' axis AB may be related to the important change of character occuring on the 'D' from SP's 85 to 95.

On the other hand, the thickness of the Mesozoic section, the base of which is represented by the 'D' horizon , is in fair agreement with the values calculated from the gravity results : along traverse K 1, the 'D' dips from 1,500 metres b.m.s.l. (5,000 ft) to 2,100 metres (7,000 ft) and the gravity values are 3,200 ft and 7,000 ft (Chapter I -2-1) .

The large gravity high intersected by traverse K 2 could be related to intra-basement phenomena .

2. ACHIEVEMENT OF OBJECTIVES

Objectives stated in Chapter II were met satisfactorily :

1 - The structural attitude of the sediments is indicated by two reflection levels : 'A' and 'D' .

The existence of reflections below the 'D' south of fault F 1 allied to a velocity of 5,500 -5,600 m/sec for the 'D' marker suggest the possibility of pre-Mesozoic (possibly Paleozoic) formations, but no apparent unconformity was found .

2 - Several refraction markers were recorded . The main one was pickable beyond the shooting distance of 4 km and showed a horizontal velocity of 6,000 m/sec in the northern part of OP 36 .

3 - The deepest continuous events recorded by the seismic reflection and refraction appear to coincide in the northern part of traverse K 1: the 'D 1' horizon is a refractor with a 6,000 m/sec velocity .

In the southern part of the permit , the 'D' horizon seems to have a horizontal velocity of the order of 5,600 m/sec but it was not checked if higher velocity markers existed beyond a shooting distance of 9 km .

-4 The aeromagnetic method is valuable for conducting reconnaissance surveys over the studied area . It seems to give a good approximation of the basement depth .

The spacing interval of the gravity stations and the barometric levelling method used during the previous survey are not suitable for delineating the local gentle structures characteristic of the sedimentary section .

CONCLUSIONS

Valuable information was obtained from seismic reflection and refraction operations carried out from February to June 1964 in OP 36.

A strong and reliable reflector, presumably originating in the upper-Jurassic, was easily followed along all traverses. It was mapped with an assumed overburden velocity of 2,100 m/sec. The main feature of this horizon is its general south-west dip from 940 metres b.m.s.l. at the northern limit of OP 36 to 1,420 metres- Several small amplitude undulations were obtained but their extension is very limited and the northern closures are questionable at the present stage.

A deep, 620 to 760 metres lower horizon was also followed. In the northern part of the permit, it is affected by steep line-ups and diffractions. Its horizontal velocity, determined by refraction shooting, is 6,000 m/sec. Therefore, it could represent the eroded surface of a basement formation, possibly Proterozoic.

In the southern half of the permit, the horizontal velocity of this marker is lower, of the order of 5,600 m/sec and reflections are pickable 50 to 200 milliseconds below. This area is, therefore, more interesting and pre-Mesozoic, possibly Paleozoic formations could be present.

A further seismic work would be necessary :

- Refraction shooting for a survey of the horizontal velocities and a determination of the total thickness of the sedimentary section,

- Reflection shooting for a better knowledge of the structural attitude of the sediments.

The aeromagnetism proved a reliable method of conducting reconnaissance surveys over the area .

The density of the gravity network was too loose and the levelling method not accurate enough to delineate the small and gentle structures characterizing the sedimentary section .

C. DIKOFF

Seismic Supervisor

S. LEMONDE

Australian Branch Manager

Brisbane - September 1964

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APPENDICES

TABLE OF CONTENTS

COMPAGNIE GÉNÉRALE DE GÉOPHYSIQUE

APPENDIX I

PERSONNEL

1. SEISMIC PARTY

The personnel required by the agreement and engaged on the Party are listed below :

Party Leader	1
Seismologist	1
Computers	2
Administrative Assistant	1
Surveyor	1
Surveyor Helpers	3
Field Manager	1
Drillers	2
Drillers-Helpers	3
Mechanics	2
Observer	1
Junior Observer	1
Recording Assistant	1
Shooters	2
Helpers	9
Camp Boss	1
Cooks	2
Helpers	3
Drivers	8
Total..............	45

In agreement with A.A.P., the following personnel were added to the above :

Mechanic-Helper	1	(as from the 24 th of February 64)
Shooters-Helpers	2	(as from the 10 th of April 64)

Total..... 45 + 3 = 48

The Party Leader, the seismologist, the field manager, the observer and the surveyor were expatriated from France.

The large crew complement was needed to operate efficiently under the difficult conditions encountered in the Simpson Desert. In addition, special field techniques were used to obtain good quality data. These factors are discussed in Appendix VI.

2. CIVIL ENGINEERING PARTY

The bulldozing crew, consisting of 6 operators was supplied by " Continental Rubber ", Brisbane. They handled the civil engineering equipment as a semi-autonomous party .

APPENDIX II

EQUIPMENT

1. VEHICLES

Office : 1 Land Rover (long wheel base ,109 inches)

Surveying : 1 Land Rover (long wheel base , 109 inches)

Field Manager : 1 Land Rover (long wheel base ,109 inches)

Drilling : 2 International R 190 4 x 4 trucks equipped with DC 3 tyres 1700 x 16

: 1 Land Rover (short wheel base - 88 inches)

Recording : 1 Bedford RLHC3 4 x 4 recording truck
5 Land Rovers (long wheel base ,109 inches)

Camp : 3 Bedford RLHC3 4 x 4 Water trucks (one of them with a mobile tank ,was usable as a supply truck) .
4 Bedford RLHC 3 4x4 Supply trucks.

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

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 18 KVA on a trailer , and one 3 KVA.One 7 KVA power plant and one electric water pump were also available .

3. SPECIAL EQUIPMENT

3.1- Surveying equipment

1 Wild TO theodolite

4 Staffs with metre and centimetre 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 lenght	: 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 lenght 200 metres,with three take-outs per cable.

Refraction: 25 cables,unit lenght 300 metres,with one take-out per cable.

3.6- Radios

Four PYE VHF,PTCA 8002 type,frequency modulation,for radio transmission of the time breaks.

Five PYE HF 20 A for communication with the Flying Doctor Base, camps,dumps and supply vehicles .

3.7- Engineering (supplied by " Continental Rubber " Brisbane)

1 Caterpillar D7

1 Allis Chalmers HD 11

1 International R 120)

1 Jeep Willys) For transportation of personnel and supplies

1 Land Rover)

1 Moore Scoopmobile until the 14 th of March 1964

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 .

APPENDIX III

HISTORY AND STATISTICS

All the history and statistics of the Survey are presented on Figure 5.

1. HISTORY

Extensive preparatory work was necessary before the seismic work could start . (refer to plate 4).

This work lasted from December 1963 to the 17 th February 1964, and can be subdivided into five stages :

1 st stage - December 1963: a dozing crew with a Caterpillar D 7 reopened and extended traverse M laid out by F. P. C (A) in September-October 1963, thus connecting Eyre Creek with the OP 36 lease. 213 hours were worked.

2 nd stage - 2 nd to 6 th of January 1964 : the Party arrived in Birdsville on the 2 nd and prepared the equipment for entering the Simpson Desert. One dozer worked on the above mentioned track and supplies were carried from Birdsville to a dump located on Eyre Creek, 42 miles north of Alton Down Homestead .

3 rd stage- 7 th to 12th of January 1964: all vehicles , supplies and equipment were taken to the dump between the 7 th and the 11 th of January. A second bulldozer was added to the crew from the 7 th of January.

A reconnaissance along traverse M showed that despite the work done by the dozer travelling would be very difficult for light vehicles and even impossible for heavy trucks and trailers because of the damage caused to the dozer track by winds and dust storms .

An assessment of the situation revealed that it would be quasi impossible and unsafe to attempt to supply the crew without permanent maintenance of the track along F. P. C. (A). traverse M. Such an operation was considered uneconomical and it was therefore planned to look for another way to supply the crew in the Simpson Desert, either from the north or the south .

STATISTICS KILPATTHA SEISMIC SURVEY 1964

FIG. 5 40

SEISMIC

REFLECTION

MONTHS	LINES	Recording Time: PRODUCTION	Recording Time: TRAVELLING	Recording Time: TOTAL	Production: NEW SPREADS	Production: REPLACED	Production: RESHOT	Production: SPECIAL SPREAD	Production: TOTAL	Production: NEW KILOM. OF LINE	Ratios: SPREAD PER PROD. HOUR	Ratios: KILOM. PER PROD. HOUR
FEBRUARY	K 1	103 3/4	12 3/4	116 1/2	85		11		96	51.0	0.92	0.49
MARCH	K 1	95 3/4	17 1/2	103 1/4	63		1		64	37.8	0.67	0.40
APRIL	K 1	77	8	85	51	1			52	30.6	0.66	0.40
MAY												
JUNE	K 2 - K 3	185 3/4	22 1/2	208 1/4	155	1	3	9	168	93.0	0.90	0.50
		462 1/4	60 3/4	513	354	2	15	9	380	212.4	0.82	0.46

REFRACTION

MONTHS	Recording Time: WORKING DAYS	Recording Time: PRODUCTION	Recording Time: TRAVELLING	Recording Time: TOTAL	Spreads: NEW	Spreads: RESHOT	Spreads: PROBE	Spreads: TOTAL	Bases: NEW	Bases: REPLACED	Bases: PROBE	Bases: TOTAL	Lines: KILOMETRES	RATIOS: BASES PER PROD. HOUR	RATIOS: SPREADS PER PROD. HOUR
FEBRUARY															
MARCH															
APRIL	7	71 3/4	6 3/4	78 1/2	21	6	18	45	3	2	12	17	40.8	0·24	0·6
MAY															
JUNE															
	7	71 3/4	6 3/4	78 1/2	21	6	18	45	3	2	12	17	40.8	0·24	0·6

REMARKS

DRILLING:
14/2 to 12/4/64
and 22/5 to 18/6/64

SEISMIC SHOTS:
18/2 to 22/4/64
and 2/6 to 21/6/64

One 'MOORE - SCOOPMOBILE' used from the 2nd. January to the 14th. March.

Contractual Leave : 13th March - 4th April 1964

DRILLING

MONTHS	Drilling Time: PRODUCTION TIME	Drilling Time: TRAVELLING	Drilling Time: TOTAL	Production: SHOT POINTS	Production: HOLES	Production: FOOTAGE	Ratios: FOOTAGE PER PROD. HOUR	Ratios: FOOTAGE PER TOTAL HOUR
FEBRUARY	211	38 1/2	249 1/2	95	2,345	31,935	152	128
MARCH	133 1/2	24 3/4	158 1/4	65	1,530	22,950	172	145
APRIL	76 1/2	14 1/4	90 3/4	40	962	14,199	186	156
MAY	121 1/2	15 1/2	137	57	1,370	20,610	170	150
JUNE	254	32	286	144	3,163	49,885	196	174
	796 1/2	125	921 1/2	401	9,370	139,579	176	152

DOZING

MONTHS	HD 11: HOURS	HD 11: REM'KS	D7: HOURS	D7: REM'KS
December			213	
January	303		242	
February	344 1/4		305	
March	184		157	
April				
May	162		83 3/4	
June	151 1/4		262 1/2	
	1,144 1/2		1,263 1/4	

CONSUMABLE STORES

Drilling Stores: INSERT BITS 4 1/4	INSERT BITS 4 3/4	INSERT BITS 5 5/8	INSERT BLADES 4 1/4	INSERT BLADES 4 3/4	INSERT BLADES 5 5/8	GAS PIPE 2"	Explosives (lb): GEOPHEX 10 lb	GEOPHEX 5 lb	LIGDYN 1¼	QUARRY MON 1¼	NITROLITE	Deton^r.: 30'	Deton^r.: 15'
		1					150		9,335			2,380	
		1						200	8,765			1,517	
							1,850	2,950	0		13,150	2,802	450
		3		2					8,278			1,438	
		2		2		36			4,500	7,800	5,520	1,137	2,983
		7		4		36	2,000	3,150	30,878	7,800	18,670	9,274	3,433

4 th stage -13 th of January to 3 rd of February 1964

It was first decided to look for an access from the north. A cyclone occured on the 13 th and 14 th of January with a rainfall of about 11 inches in 28 hours in the Birdsville area. A reconnaissance by air and road indicated that access into the Simpson Desert from the north was impossible due to flooding.

In order not to delay the operations any longer it was decided to pull all the trucks and trailers with the dozers as far as the first camp site (camp A). At the same time the possibility of an access from the south for subsequent supply convoys was investigated .

The travelling was organized in two shifts in order to reduce each trip to a maximum duration of 3 days. The third trip took longer as the track was damaged by the previous passages.

During this operation an access from the south seemed possible via Clifton Hill, Cowarie and Mona Downs Station provided a track was cleared between Camp A and Mona Downs Station. This clearing was done by one of the dozers starting from Camp A and heading south along the sand hills. On the first of February the route from Birdsville to Camp A via Cowarie was opened and the last group of trucks which left Birdsville on the 30 th of January arrived at Camp A on the 3 rd of February .

The situation on the 3 rd of February was as follows :

- All equipment was at Camp A,
- An airstrip was cleared near Camp A,
- A permanent water supply was available at Mona Downs, 135 miles south of Camp A,
- An access to the Desert was opened from the south. However, an interruption of the access was expected during the southwards flow of the flood waters from the north .

5 th stage- 4 th to 17 th of February 1964

A few days later the above access was interrupted between Birdsville and Mona Downs by the Flooding of the Diamantina River. Two trucks, which had left Camp A on the 4 th of February in order to bring back fuel and lubricant from Birdsville, were stopped on their way back to Camp A and had to go back to Birdsville .

Once more the only way to reach the camp, from Birdsville, was along traverse M. A fifth convoy was organized and with the help of a HD 11 dozer carried the fuel from Birdsville to the camp.

Food supplies from Brisbane held up at Windorah by the flood, were transported to Birdsville by a chartered DC 3 and then, from Birdsville to the camp by a Cessna light plane .

As from the 11 th February, when the flood had receded, supplies (explosives, fuel, food) were sent from Adelaide or Marree to Cowarie where they were picked up by the Party's vehicles.

Routine operations

The main events of the survey are as follows:

First drilling	:	14 th of February 1964
Last drilling	:	18 th of June 1964
First Seismic shot	:	18 th of February 1964
Last Seismic shot	:	21 st of June 1964.

The drilling was interrupted between the 13 th of April and the 22 nd of May and the seismic operations, between the 23 rd of April and the 2 nd of June for the " Northern Simpson Desert Seismic Survey " which was carried out by the same party .

The contract called for 190 hours of production time per month. However, A.A.P. agreed to a schedule of 230 hours of production time in order to permit a rest leave. This leave was taken from the 13 th of March to the 4 th of April 1964. 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 (Fig. 5)

2.1- Seismic statistics :

In reflection, the average production was 0.82 spread and 0.46 km of new traverse per production hour, which does not include the travelling time from camp to working site .

Production was slowed down on traverse K.2 which was perpendicular to the main direction of the sand dunes .

In refraction, the average production was 0.6 km (0.24 base) and 0.6 spread per production hour .

2.2- Drilling statistics :

Two drills were used. The average production was 176 feet per production hour, which includes only the travelling time from one shot point to another . The shot point consisted normally of 24 holes drilled to a depth of 15' i,e, 360 feet of drilling, so that an average of 2 hours was necessary for the drilling of one shot point and travelling to the next one.

The operations were slowed down by the very difficult travelling on traverse K.2 where the drills had sometimes to be towed by the dozers .

2.3- Dozing statistics :

As explained above, a large amount of work was done by the dozers before the start of the seismic operation itself. Each dozer worked approximately 12 hours per day .

The total of 2,407 3/4 hours shown in Fig 5 may be split as follows :

-	Access roads	Seismic lines	Towing	Airstrip	Other	Total
December	213					213
January	302		190	53		545
February	148	415 3/4	65 ½	10	10(1)	649 ¼
March		271	58	12		341
May		245 3/4 (a)	unknown part of (a)			245 3/4
June		272 3/4	13		128(2)	413 3/4
Total	663	1205 ¼	326 ½	75	138	2407 3/4
Percentage	27.5%	50 %	13.5%	3%	6%	100%

Remarks :

(1) Working on Kilpattha native well .
(2) Withdrawal of dozers to Cowarie.

The total seismic production hours were : 462 $\frac{1}{4}$ (reflection) + 71 3/4 (refraction) = 534 hours .

The above statistics show that 2.2 dozing hours along the traverses were necessary for the production of one seismic hour.

2.4- Air charter statistics :

The CESSNA 185 chartered plane was mainly used for transportation of supplies . It was also used for transportation of personnel and for reconnaissance purposes .

A total of 442.35 hours was flown.

Among these 40 hours were reconnaissance flights .

APPENDIX IV

EXPERIMENTAL WORK

1. OBJECTIVES

1.1 The first experiments, were aimed at improving the record quality by :

a/ increasing the number of shot holes

b/ by altering the direction of the shot hole coverage either perpendicular or parallel to the line or the traverse .

1.2 A second series of experiments was aimed at reducing shot hole pattern by the use of deep holes .

2. TECHNIQUE SELECTED

2.1 Five groups of four holes were shot separately and compared to five holes also shot separately . The disposition of the holes is shown on Fig. 6.

Records obtained with shots at B and D were compared with those obtained with shots at A and C.

This comparison indicates if it was worth extending the shot point coverage along the traverse or in a perpendicular direction .

2.2 The multiple hole pattern was compared to a shot pattern of 4 holes in line drilled to a greater depth, the total charge per shot remaining unchanged.

3. FIELD OPERATIONS

3.1 The first experiments were made at SP's 130 and 131 of traverse K1 A unit charge of 5 lb was adopted .

3.2 On three shot points : 336 to 338 of traverse K3, the normal pattern of 24 holes in four lines of six, charged 5 lb per hole, was compared to four deep holes drilled at 90 ft, charged 30 lb per hole .

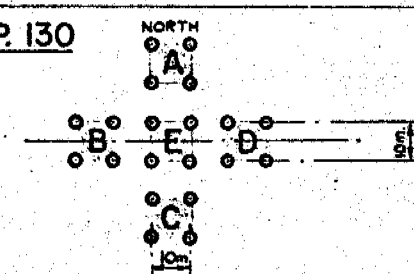
A.A.P. EXPERIMENTS C.G.G

O.P. 36 KILPATTHA SURVEY TRAVERSE KI

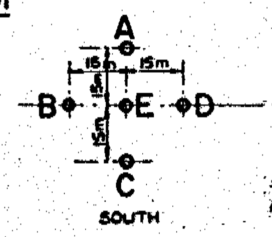
No.	S.P	Date	Depth in feet	Charge in Lbs	Filter	Recording	Hole Pattern	Geoph. Pattern	X	e
2	130 A	27/2/1964	15	20	1/20 Out	Filters : 2/20-out A. G. C: slow Suppression Init. gain: -30 Delay: 400 msec Final gain: max Expander Initial gain: -27 Slope: 160 db/oct Delay: 400 msec	4 holes	3 lines of 12 parallel to the traverse	600m	50m
3	" B	"	"	"			"		"	"
4	" C	"	"	"			"		"	"
5	" D	"	"	"			"		"	"
6	" E	"	"	"			"		"	"
2	131 A	"	15	20	1/20 Out		1 hole	"	"	"
3	" B	"	"	"			"		"	"
4	" C	"	"	"			"		"	"
5	" D	"	"	"			"		"	"
6	" E	"	"	"			"		"	"

Remarks

S.P. 130



S.P. 131



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

FIG. 6

46

4. CONCLUSIONS

4.1 Results were better with groups of holes (SP 130) than with single holes (SP 131).

The comparison of spreads recorded from the various groups : A,B,C,D,E, did not lead to any definite conclusions concerning the shot point coverage.

It was however decided to increase it as follows :

- The initial pattern of 6 lines of 4 holes parallel to the traverse with a distance between lines of 15 metres and between holes of 10 metres was replaced by the pattern shown on Fig. 2.

The total coverage, for a similar amount of dozing increased from 2,700 m^2 to 4,000 m^2 .

4.2- The second series of experiments confirmed the conclusions previously made in the area : Deeper shots do not improve the record quality and in most cases give poorer results than shallow multiple hole shot points.

A.A.P. EXPERIMENTS C.G.G

O.P. 36 KILPATTHA SURVEY TRAVERSE K3

No	S.P.	Date	Depth in feet	Charge in Lbs	Filter	Recording	Hole Pattern	Geoph Pattern	X	e	Remarks
1	336	19/6/64	15	120	1/20 out	Filters: 2/20 -out AGC :slow Suppression Init :gain:-24 delay:400msec Final gain:max Expander: Initial gain:-18 Slope: 200 db/oct Dealy: 400 msec	24 holes	3 lines of 12 parallel to the traverse	600m	50m	4 holes in line : 10 metres between holes, along the traverse.
2	336	"	90	120	"		4 holes		"	"	
1	337	"	15	120	"		24 holes		"	"	
2	337	"	90	120	"		4 holes		"	"	
1	338	"	15	120	"		24 holes		"	"	
2	338	"	90	120	"		4 holes		"	"	

The comparison between shots 1 and 2 shows that the increased depth gives poorer results than the hole pattern,

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

FIG. 7

APPENDIX V

TECHNIQUE

1. REFLECTION

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

Half of the spread ,i.e twelve recording stations were then shifted forward and the next shot was fired in the middle of the spread .

2. REFRACTION

2.1- Refraction probe:

A probe consisted in recording a certain number of consecutive refraction spreads laid down between two fixed shot points. This allowed two time-distance curves to be plotted : one called " direct" and one called " reverse " according to the location of the shot in respect to the recording spreads . An inventory of the markers was made, each marker being characterized by its horizontal velocity . For this survey the distance between the shot points, which varies with the depth to be investigated, was limited to 30 kilomtres .

2.2- Continuous profiling :

The Gardner-Layat method of continuous profiling has been 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). Recording is conducted with twenty four recording stations. After completion of the shots at one location twelve recording stations are shifted forward.

The result of the computations is a delay time curve. The delay-time is easily converted into depth using the formula :

$$\text{Depth} = k \times \text{delay} \times \frac{V}{\cos \theta}$$

with : k = anisotropy factor

v = overburden velocity

sin θ = overburden velocity / 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 the 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

Along traverse K1 a velocity survey by the Gardner method was possible with the addition of one offset spread to the previous spreads (3-1)

On traverse K 2 two longitudinal offset spreads were added (see Fig 3) so that different spread combinations could be used to allow interpretation by the Gardner or Dix methods . The principle of the Gardner method is given on Fig 4 a . Both methods have been published in Geophysics , in the April 1947 issue for the Gardner method and in the January 1955 issue for the Dix method .

APPENDIX V

FIELD OPERATIONS

1. NATURAL CONDITIONS

The distance from the surveyed area to inhabited points was considerable. Birdsville, the nearest town, was at more than 300 miles from the first camp. The direct route, along F. P. C. (A). traverse M, reopened in December, was accessible only by Land Rovers. (see Pl 4).

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

A few dry lakes where travel was easy were found at the beginning of the survey near Poeppel's Corner .

The weather conditions were particularly hot and dry during the months of January to April. The sand was very loose and travelling was quite a problem for all vehicles between 11 am and 5 pm. The temperature dropped in May, and living conditions improved . The surface hardened and travelling was easier .

2. CAMP

The first camp was located near the Kilpattha native well , on line K1 (Camp A-SP 151).

It was moved 40 miles to the north, along the same traverse when travelling between camp and worksite became too long (Camp B-SP 50).

For the second period of the survey the main camp was settled on camp A location, which is very close to the crossing of lines K1 and K2.

A fly camp was installed at the crossing of traverses K2 and K3.

3. LOGISTICS

Supply problems were the most troublesome the Party had to solve. This was mainly due to the great distances separating Cowarie (the closest point accessible by conventional vehicles) from the main camps: 170 and 210 miles of sandy trail. An intermediate dump was located 10 miles north of the Mona Downs Station: supplies were quickly moved from Cowarie to this dump situated west of the Diamantina River Flood are .

3.1- Water supply

Water was taken from the Kilpattha native well near the first camp. It was transported in two 800 gallon water trucks equipped with a vacuum filling system. The native well was deepened and equipped to ensure regular production. Five hours were necessary for the filling of one 800 gal.tank . The driving time was 8 hours from the second camp.

3.2- Food supplies

Perishable like bread, vegetables, fruit and butter were forwarded once a week from Charleville by the chartered light plane. Tinned foodstuffs were delivered at the beginning of the survey by a carrier from Adelaide as far as Cowarie, Party trucks transported them from Cowarie to A and B camps (170 and 210 miles)

3.3- Fuel and lubricants

Deliveries were arranged to Cowarie by SHELL OIL CO. A dump was located there, and then the fuel was brought in by the Party's supply trucks.

Because of the distances and the bad conditions of the trail from Cowarie to the main camp , the driving time was 10 hours to camp A and 13 hours to camp B for an empty truck.

More than 11 and 14 hours were necessary for loaded trucks. The round trip took roughly 34 hours from camp A and 42 hours from camp B including loading and unloading operations and a quick servicing of the truck at Cowarie . All fuel was supplied in 44 gallon drums.

3.4 Explosives

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

I.C.I explosives were used for the reflection work, mainly "Ligdyn AN 25 " in $1\frac{1}{4}$lb cartridges and " Quarry Monobel" in 1/3 lb cartridges. "Nitrolite" in 80lb bags was used for the refraction surface shooting. It was mixed with 7% diesoline in the field .

I.C.I 30 ft coiled and 15 ft spooled detonators were used exclusively.

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 session were arranged with Birdsville and the Mona Downs Station in the South in order to ensure a better supply service for the Party and good control of the vehicles during their trip to Cowarie.

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

4.2- Mail

At least once a week the light plane brought mail from Birdsville and Charleville .

4.3- Air Services (Pl 3)

4.3.1- Regular Lines

The only regular line in the area connects Birdsville to Brisbane once a week, through Bedourie and Betoota .

4.3.2- Charter Planes

The CESSNA 185 attached to the crew operated from Birdsville. Two landing strips were built close to the first main camp. A total of 75 hours were spent by the dozers for building and maintening the airstrips in normal conditions.

The usable landing strips of the area are indicated on Pl 4..

5. SURVEYING OPERATIONS

5.1 Alignment and pegging

Alignment was done using a Wild TO theodolite for the beginning of the traverses. 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 to keep the correct bearing, which was checked by the surveyor from time to time.

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

5.2 Levelling

Levelling made with a Wild TO theodolite requires a knowledge of the instrument declination.

For this purpose 8 sun observations were made. They gave values ranging from 6° 13' to 6° 31' for the instrumental declination.

5.3 Documents used

Map: Southern Simpson Desert. Scale 1/250,000 (by the National mapping division)

Aerial photographs at a scale of approximately 1/50,000.

Photomaps : Compilation.

5.4- Survey Ties

- elevation - There are no bench marks in the surveyed area. The survey origin is the elevation of Poeppel's Corner station, as determined by a Tellurometric survey of the Department of Lands of South Australia in 1963 : 77 ft a.m.s.l. ± 15 ft (23.50 ± 4.50 metres).

Ties were made to the astronomical station INT 32 along Hay River in OP 64 lease and to the intersection of traverses L and M (F.P.C(A), seismic survey in 1963) in ATP 66P and 67P leases .

The first tie gave a misclosure of 5.16 metres (Pl 6). Elevations were not adjusted since Poeppel's Corner Station and INT 32 station do not belong to the same system.

The second tie gave doubtful results. It is to be recalculated, an error most probably occurs between traverses K1 and M.

Planimetry - The Poeppel Corner's tellurometric station was chosen as origin for latitude and longitude co-ordinates . A tie was made to INT 32 astronomical station which gave misclosures of 35 metres in latitude and 365 metres in longitude . For the reason mentioned above, co-ordinates were not adjusted .

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, the UTM-yard grid is drawn on the location map at a scale of 1/250,000 (Pl 1).

5.6- Permanent markers

10 feet long iron pipes (2" diameter) with the name of the traverse and the number of the shot point welded on were placed every 6 km, that is 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 air/water drills. All shot points were air drilled. The shot point pattern consisted mainly of 24 holes drilled to a depth of 15 feet .

Formations encountered were sandy and drilling was easy. 5 5/8" and 4 3/4" insert bits and insert blades were mainly used .

Several holes were drilled along traverses K1 and K2 down to a depth of 120 ft. in order to check the fresh water resources of the area.

Drinkable water was found only at the Kilpatha and Perlanna native wells and at shallow depth . The former was deepened and used for a permanent water supply .

7. SHOOTING OPERATIONS

7.1 Reflection work

The shooting teams consisted of one shooter and one shooter-helper with each drill. Holes were loaded just after being drilled. This operation had to be very fast in sandy formations to prevent the holes from collapsing. The shooter-helpers added to the basic crew were in charge of the electrical connections.

The standard charge was four cartridges of 1¼ lb per hole.

7.2 Refraction work

Reflection drilling continued during the refraction work. Preloading operations were slowed because only the shooter-helpers remained with the drills.

The two shooters performed the refraction surface shooting , one on each side of the refraction spread. They moved from one shot point to another according to radio instructions given by the observer .

The unit charge consisted of one 80 lb bag of " Nitrolite" mixed with one gallon diesoline.

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 primacord detonation velocity chosen,is the one close to the velocity of the marker to be studied.

8. RECORDING OPERATIONS

Standard field techniques were used in both reflection and refraction

-Split spread recording in reflection

- Continuous probe in refraction (refer to Appendix V)

8.1 Reflection work

Recording was conducted on 24 traces,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 into two patterns of 12 holes drilled to a 15 ft depth. The shot point and geophone set ups are illustrated on Fig.2.

8.2 Refraction work

Recording was conducted on two consecutive bases,that is 24 traces. The characteristics of the spread were :

- distance between two consecutive locations of the recording truck: 2,400 metres .

- distance between traces : 200 metres .

- 12 Hall Sears refraction geophones per trace in four lines perpendicular to the traverse. The distance between lines was 3 metres and the geophone spacing 10 metres .

8.3 Special work

8.3.1 Offset spreads : the reflection spread was used with surface shots .

8.3.2 Velocity spreads: the standard reflection spread and shot point pattern were used .

8.3.3. Weathering shots: two cables with twelve take-outs each were laid down. The distance between consecutive take-outs was 5 metres on the first cable and 15 metres on the second one. The total spread length was therefore 225 metres, 5 metres separating the cables . One H.S. Junior Geophone was used per trace. Shots were fired from both ends of the spread at a distance of 5 to 15 metres from the nearest geophone. A charge of 2.5 to 5 lb was used .

8.4. Instrument recording settings

8.4.1 Reflection

Filters	:	1/20 -out	
A.G.C.	:	slow	
Suppression	:	Initial gain	:-27 to -36 db
		delay	: 400 msec
		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.

8.4.2. 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 shots 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 ant the charge of explosives . Values of gain actually used for each shot are shown on the operational diagram . (Pl 8) .

8.4.3. Special recording

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 reflection recording settings . The charge and the shot point pattern were the same as used for the continuous profiling. For longitudinal offsets beyond 1,800 metres, refraction recording settings were used .

Shots were fired on the surface with charges increasing from 80 to 400 lbs with the distance .

Velocity shots

The standard settings for reflection recording were used .

Weathering shots

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

The initial gain was varied 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, at a paper speed of 8" per second.

The magnetic tapes were processed immediately after recording by the field play-back unit on electro-sensitive support, 4" wide at a 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 -1/56 ,all settings were identical to the recording settings. The pen gain was 5,6 or 7 according to the energy level.

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 it was either 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.

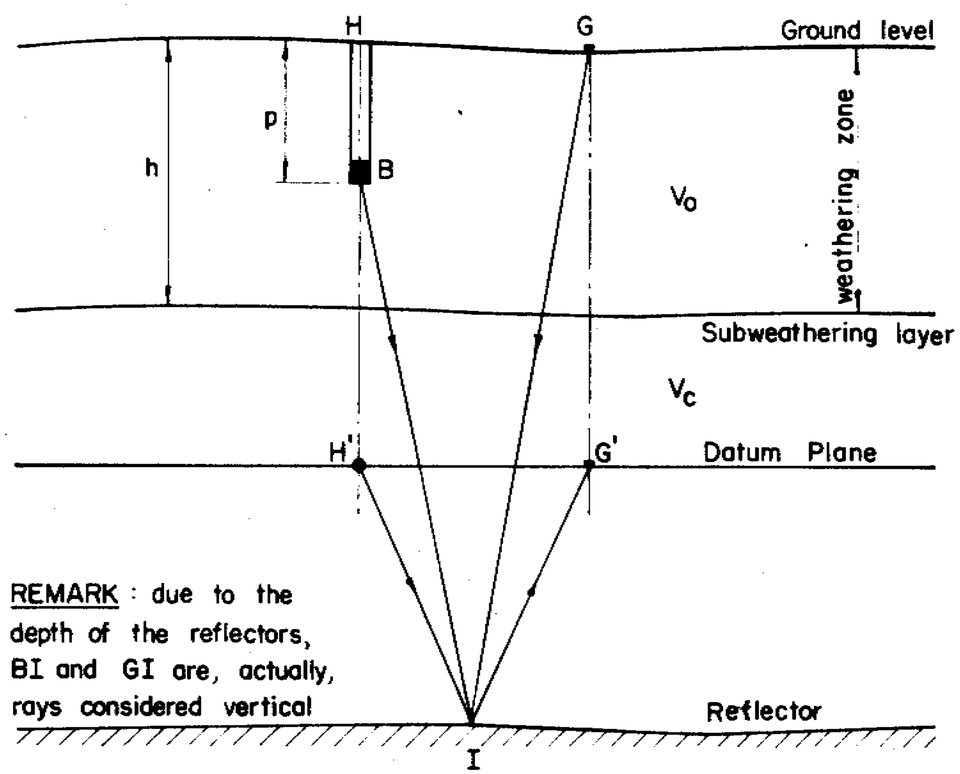
9.3 Special play-backs

The same rules applied to the offset and velocity spreads which, according to the recording settings used, were considered as reflection or refraction records .

FIG. 8

61

REFLECTION CORRECTIONS



REMARK : due to the depth of the reflectors, BI and GI are, actually, rays considered vertical

E_H = Elevation of shot point H
E_G = Elevation of the nearest geophone G
D.P. = Elevation of datum plane
V_0, V_c and h given by the weathering shots

① Partial correction at a point G

$$C = C_{E_G} + C_{wz_G}$$

$$C_{E_G} = \frac{DP - E_G}{V_c} \qquad C_{wz_G} = h\left(\frac{1}{V_c} - \frac{1}{V_0}\right)$$

② Total correction : $\Sigma C = CPE + CS + VT$

CPE = Correction of the wave down-path

CS+VT = Correction of the wave up-path

$$CPE = C_{E_B} + C_{wz_B} = \frac{DP + h - E_H}{V_c} - \frac{h-p}{V_0}$$

$$CS + VT = C_{E_G} + C_{wz_G} = \frac{DP + h - E_G}{V_c} - \frac{h}{V_0}$$

C.G.G. 59

Line : ... Shot point : ... SURVEY : ... Party : ... Client : ...

Tape No. ... Shot No. ... Date ... Geoph./trace ... Offset ... Charge : ... Filter : HS-14-20-28 | 1 | 2 | A.G.C. : slow, med., fast. Expander Gi Po R Suppressor Gi Gf R

Remarks :

PLAYBACK

Playback No. ... Filters L.C. H.C. Pen gain : ... Play gain : ... A.G.C. : O, slow, med., fast

Elev. hole E_H geoph. E_G D.P. D.P. Max. depth Min. a = b = CPE = a/Vc = CS = b/Vc = V calcul. : V adopt. : Remarks :

	CPE	CS + VT	Σ C	CT	ΣCF	Holes
Sup.						
Mid.						
Inf.						

Tie D = d = SP D = Z = D = Z = D = d = Tie

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

TR64/12B

APPENDIX VII

REDUCTION & PRESENTATION OF DATA

1. REFLECTION

1.1 Static corrections

The reference plane was chosen at 100 metres above mean sea level.

Static corrections included weathering and elevation corrections.

The weathering correction consists in replacing the travel time in weathered zone by the theoretical time required to travel through that zone with the velocity of the sub-weathered layer .

The elevation correction consists in transferring geophones and shot points to the datum plane.

The depth 'h' and the velocity 'Vo' of the weathered layer and the velocity 'V_c' of the sub-weathered layer were deduced from the special weathering shots .

The computation method and a heading used for the reflection records are given in Fig 8.

The weathered zone had an average velocity of 700 m/sec and a thickness of 20 to 60 metres. The horizontal velocity of the sub-weathered layer ranged from 1,800 to 2,400 m/sec with an average value of 2,000 m/sec . This value was used for the elevation corrections.

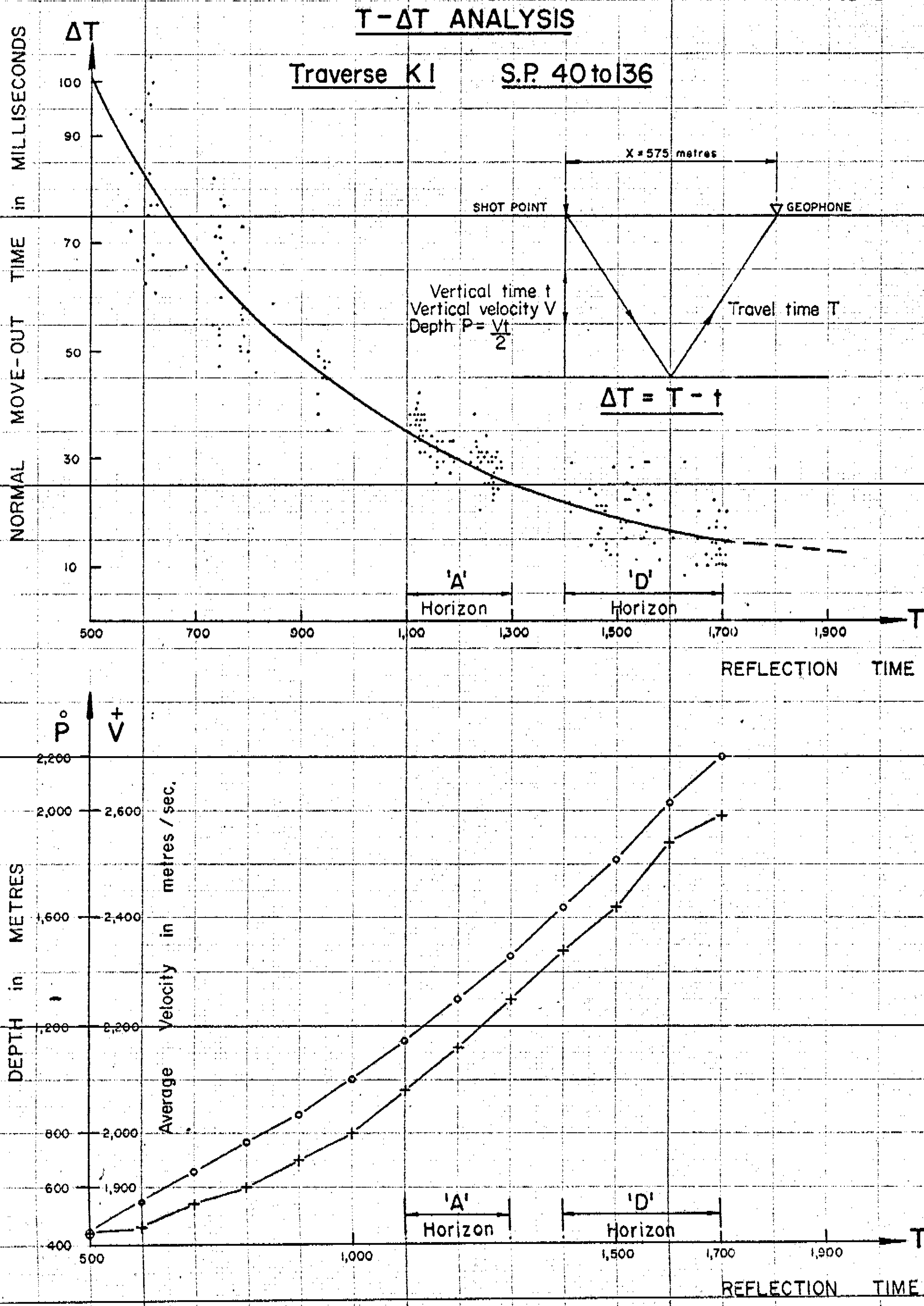
Static corrections were determined for each recorded station using a method based on the comparison of templates recorded on a spread shot from two adjacent shotpoints. It is derived from the " Plus minus method of interpretation seismic refraction sections" Hagedoorn (Geophysical prospecting Vol 7 no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

1.2 Dynamic corrections (Fig 9-10)

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 9 and 10.

The C.G.G. designed " MTD Corrector " allows corrections up to

FIG. 9


T-ΔT ANALYSIS
Traverse K I
S.P. 40 to 136
ΔT
NORMAL MOVE-OUT TIME in MILLISECONDS
X = 575 metres
SHOT POINT
GEOPHONE
Vertical time t
Vertical velocity V
Depth P = Vt/2
Travel time T
ΔT = T - t
'A' Horizon
'D' Horizon
REFLECTION TIME
T
P°
V+
DEPTH in METRES
Average Velocity in metres / sec.
500
700
900
1,100
1,300
1,500
1,700
1,900
1,000
10
30
50
70
90
100
400
600
800
1,200
1,600
2,000
2,200
1,900
2,000
2,200
2,400
2,600

200 milliseconds with any desired steps . The move-out values are applied in one millisecond units according to the T - delta T curve.

1.3 Interpretation documents

The magnetic tapes were processed at the camp and assembled in variable are 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).

In refraction ,corrections are not vertical times but partial delay times.

2.2 Interpretation documents

The following documents concerning the refraction probe SK 1 are included in the report .

- Operational diagram (Pl 8)
- Interpretation diagram (Pl 9)
- Time-distance curves (Pl 10)
- Interpretation plate (Pl 11)

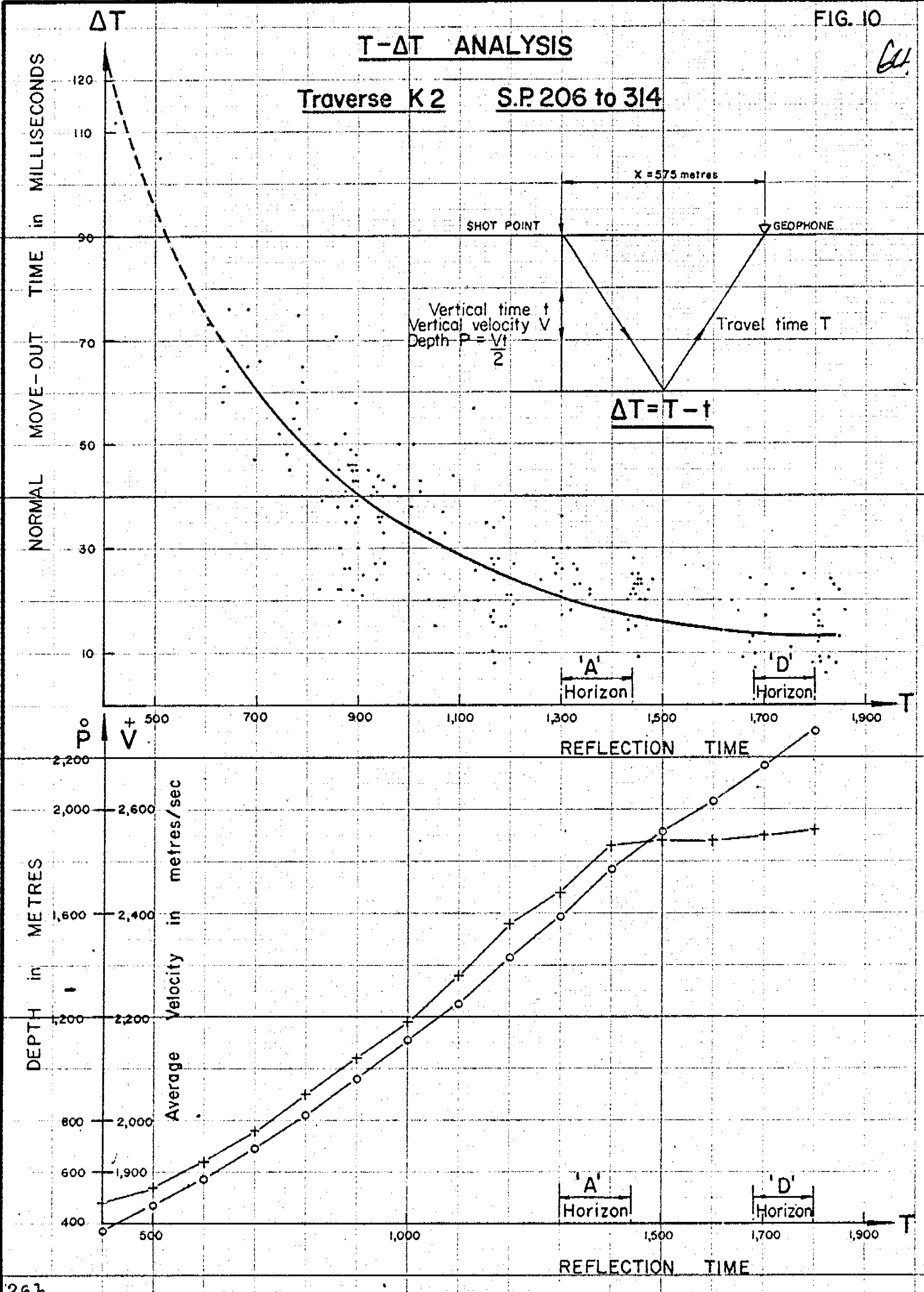
These plates are self explanatory and it should be noted that on the diagrams ,in order to represent both direct and reverse spreads ,two slanting lines are drawn on which are shown the actual bases shot .

3. DEPTH CROSS-SECTIONS

3.1 Velocity surveys

3.1.1 Traverse K1 -SP 34-37: reflections corresponding to the 'A' horizon only were good enough to be studied by the Gardner method (" Geophysics April 1947 "). The calculations gave an overburden vertical velocity of 2,100 m/sec ± 20 m/sec. The Dix method gave 2,100 m/sec. (Fig. 4b).

FIG. 10



T-ΔT ANALYSIS
Traverse K 2
S.P. 206 to 314
ΔT
NORMAL MOVE-OUT TIME in MILLISECONDS
120
110
90
70
50
30
10
X = 575 metres
SHOT POINT
GEOPHONE
Vertical time t
Vertical velocity V
Depth P = Vt/2
Travel time T
ΔT = T − t
'A' Horizon
'D' Horizon
T
500
700
900
1,100
1,300
1,500
1,700
1,900
REFLECTION TIME
P
V
DEPTH in METRES
Average Velocity in metres/sec
2,200
2,000
1,600
1,200
800
600
400
2,600
2,400
2,200
2,000
1,900
500
1,000
1,500
1,700
1,900
'A' Horizon
'D' Horizon
T
REFLECTION TIME

26b

3.1.2 Traverse K2-SP 247-250

The above mentionned Gardner method was applied to reflections corresponding to the 'A' and 'D' horizons. The following values were found: 2,300±25 m/sec. for the 'A' and 2,550±30 m/sec. for the 'D'. Results of the Dix method are similar for the first horizon. The determination is questionable for the 'D' as shown on Fig. 4b.

3.2 T -Delta T analysis

The interpretation of T-delta T graphs presented on Fig 9 and 10, provides also some velocity information useful for a time-depth computation.

Fig. 9 shows an increase of the overburden velocity with depth along traverse K1. The extreme values are 2,100 and 2,250 m/sec. for the 'A' horizon, corresponding to depths of 1,100 and 1,300 metres. The corresponding velocity values for the 'D', are 2,350 and 2,600 m/sec..

Results are not so good along traverse K 2, with very scattered delta T values (Fig 10). It is probably that the values calculated and shown on the V-T graph are higher than the actual ones, especially those concerning the 'A'. For this horizon, the vertical velocity would exceed 2,400 m/sec., which is not in accordance with the 2,300 m/sec. deduced from the velocity spreads (3-1-2).

3.3 Reflection

For the time-depth conversion of the 'A' horizon, a constant overburden velocity of 2,100 m/sec. was adopted. It is probable that to the south the calculated depths are approximately 10% less than the actual ones, because of the increasing overburden velocity. The survey was a reconnaissance one and the velocity determinations were too scattered to allow a precise and definite study. In these conditions, it was considered more realistic to choose a constant velocity, the same one used for the adjacent " Northern Simpson Desert " Survey in OP 64/1 lease.

The average vertical velocity down to the 'D' horizon appeared to vary between 2,350 and 2,550 m/sec. For the reasons given hereabove, a constant velocity of 2,500 m/sec. was adopted.

3.4 Refraction

The offset spreads on traverse K1 (SP 34) proved that the 6,000 m/sec. refractor and the 'D' originate from the same formation. Thus, the same overburden vertical velocity of 2,500 m/sec. was used for the marker's depth computation.

The formula used was :

Depth = Delay x V / cos θ

with sin θ = overburden velocity / marker velocity.

Application : overburden velocity = 2,500 m/sec.

V = 6,000 m/sec.

Therefore, sin = 0.417 , cos = 0.909 , and depth = 2,78 delay .

Since the delays were calculated with a + 100 metres a.m.s.l. datum plane, 100 metres has to be subtracted from the above values , in order to obtain the depths b.m.s.l. shown on plates 16 to 19 .

COMPAGNIE GÉNÉRALE DE GÉOPHYSIQUE

LIST OF PERMANENT MARKERS

Line	Shot Point	Longitude	Latitude	Elevation
K1	10	522,696	1,726,233	96,41
	20	525,283	1,720,810	88,20
	30	527,871	1,715,389	80,12
	40	530,436	1,709,950	80,46
	50	532,943	1,704,478	79,63
	60	535,367	1,698,981	84,99
	70	537,832	1,693,504	69,10
	80	540,321	1,688,023	67,28
	90	542,790	1,682,545	61,76
	100	545,235	1,677,058	69,18
	110	547,275	1,671,424	51,50
	120	549,239	1,665,730	46,63
	130	551,181	1,660,028	49,43
	140	553,142	1,654,314	39,56
	150	555,096	1,648,560	35,53
	160	557,018	1,642,856	37,47
	170	558,978	1,637,190	27,66
	180	560,904	1,631,523	24,88
	190	562,828	1,625,847	19,27
	200	564,719	1,620,161	25,74
K 2	210	552,952	1,647,528	44,42
	220	547,055	1,646,478	58,78
	230	541,170	1,645,378	46,61
	240	535,425	1,644,303	42,63
	250	529,535	1,643,233	62,71
	260	523,802	1,642,120	58,84
	270	518,206	1,641,054	52,66
	280	512,300	1,639,994	75,24
	290	506,552	1,638,908	57,58
	300	500,801	1,637,835	67,63
	310	495,059	1,636,762	62,29
K3	320	528,395	1,652,271	64,02
	330	530,386	1,646,647	55,45
	340	532,362	1,640,989	44,71
	350	534,379	1,635,335	68,24
	360	536,381	1,629,685	47,07
Tellurometric Station of Poeppel's Corner		566,032	1,616,967	23,50

Note :

Transverse Mercator projection system . Australian Belt Zone 5 . Poeppel's Corners tellurometric station is the origin for elevation and co-ordinates calculated in the metric system. Elevations are given in metres above mean sea level .

DO NOT REMOVE FROM SEPIA TUBE

PR NUMBER	PR 1964-0012
SURVEY NAME	Kilpattha Seismic Survey

LINE NUMBER	SP / VP INTERVAL	BARCODE	TUBE NUMBER	RACK NUMBER	VERSION
K1	34	S05332			Offset Shots
Location Map		S05333			Location Map
Refraction Probe SK1		S05334			Time Distance Curves
Refraction Line-SK1		S05335			Interpretation Plate
Refraction Probe SK1		S05336			Interpretation Diagram
Refraction Probe SK1		S05337			Operation Diagram
Geophysical Data		S05338			Geophysical Data
Elevation		S05339			Misclosures
Latitude and Longitude		S05340			Misclosures
Accessibility map		S05341			Accessibility map
Location Map		S05342			Location Map
Location Map		S05343			Location Map
K2	248	S05344			Offset Shots
Traverse K1		S05345			Traverse K1
Probe SK1		S05346			Example of Refraction Records
Traverse K2		S05347			Depth Cross Section
Traverse K3		S05348			Depth Cross Section
'A' Horizon		S05349			Schematic Contour map
Traverse K1		S05350			Depth Cross Section

AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd. **PL.1**
O.P. 36

[redacted]

KILPATTHA SURVEY
1964

LOCATION MAP

SCALE-1/250,000

LEGEND

Reflection Traverse and Shot Point (numbered every 10th S.P.) — 250 240

Refraction Line and Base Numbers — 10 11 12

Offset and Velocity Spreads

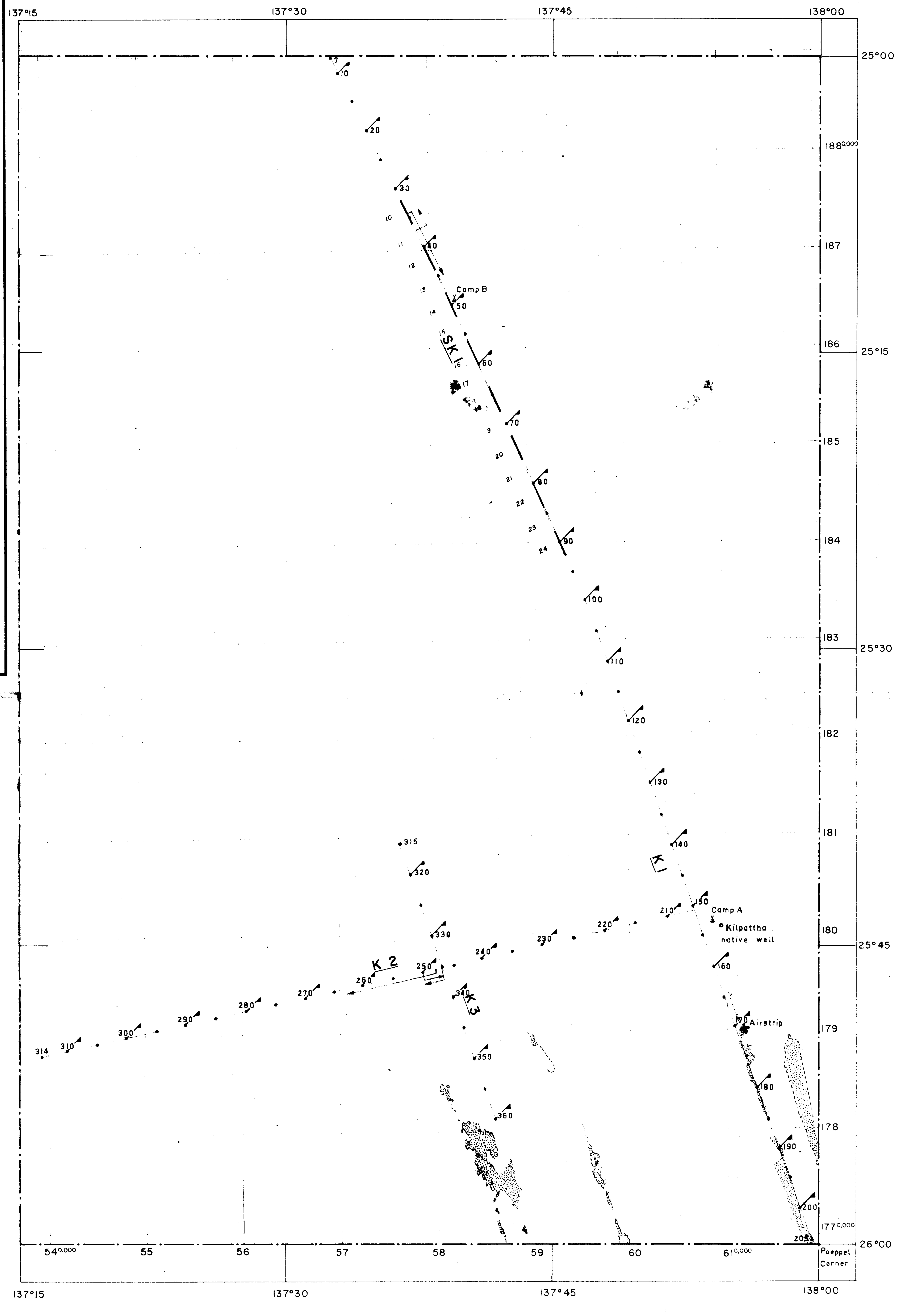
Permanent Marker

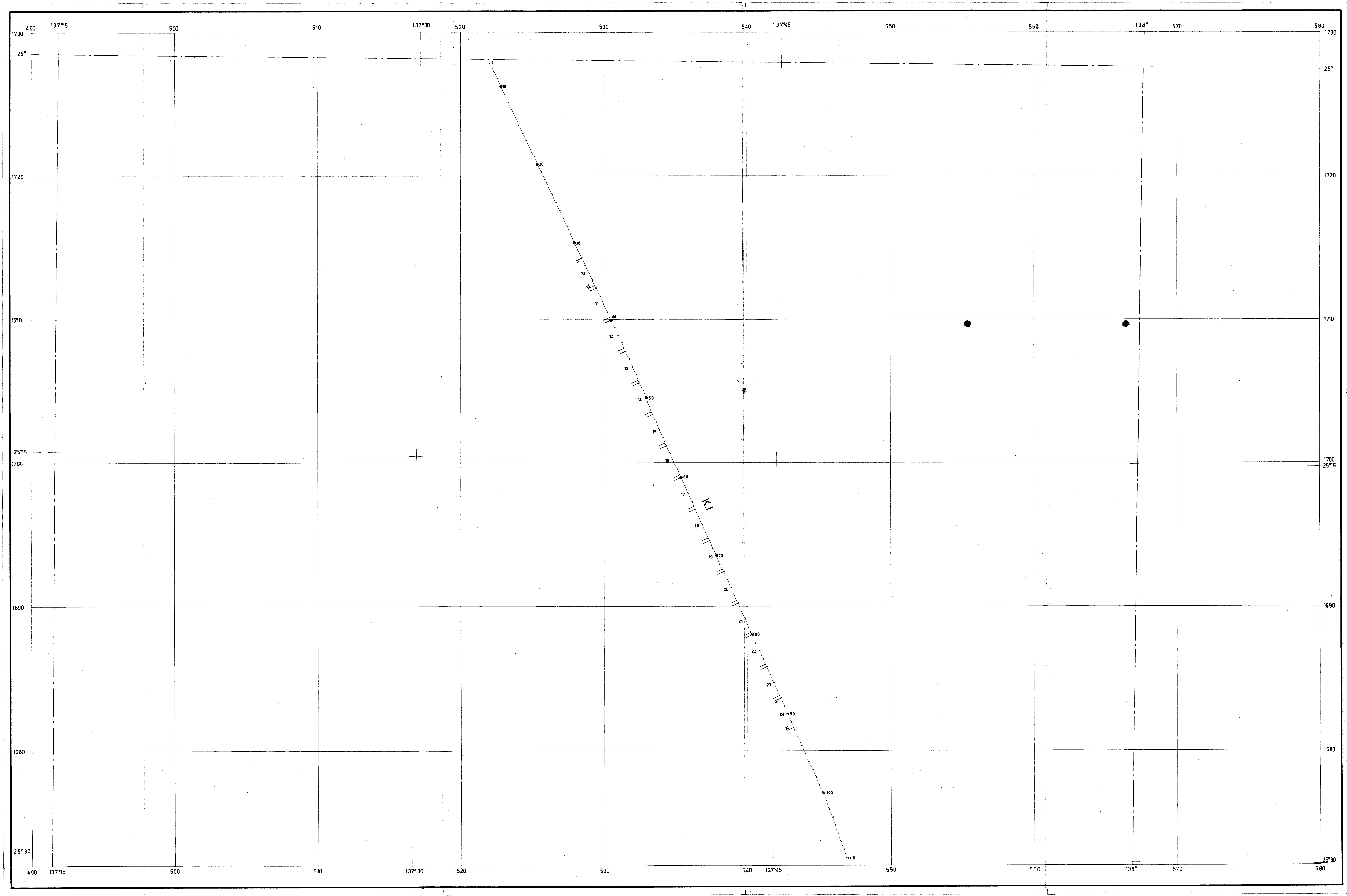
O.P. 36 Boundary

NORTHERN TERRITORY
GEOLOGICAL SURVEY

S.6509
COMPAGNIE GENERALE DE GEOPHYSIQUE

TRANSVERSE MERCATOR PROJECTION
10,000 Yard Grid
ZONE 5 (Australia Series)





AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd. **PL. 2**

O.P. 36

[redacted]

KILPATTHA SURVEY

1964

LOCATION MAP

SCALE 1/100,000

LEGEND

C.G.G. Seismic Traverse

Reflection Shot Point and Number 170

Refraction Base, Traces 1 and 12 Location

Permanent marker

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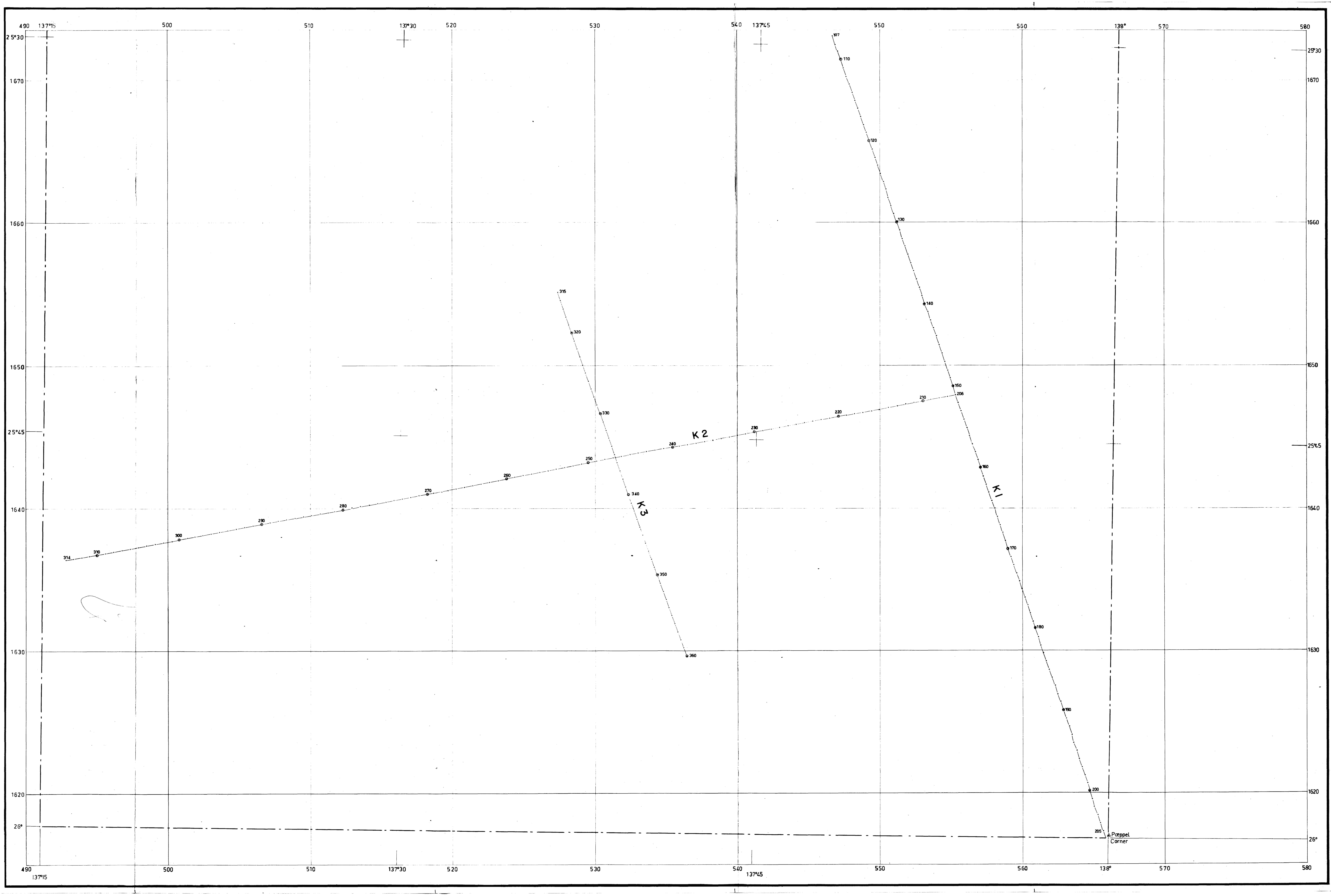
COMPAGNIE GENERALE DE GEOPHYSIQUE PR64/12

TRANSVERSE MERCATOR PROJECTION

10,000 metre grid

Zone 5 (Australia series)



AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd. PL. 3
O.P. 36

KILPATTHA SURVEY
1964

LOCATION MAP

SCALE. 1 100,000

LEGEND

C.G.G. Seismic Traverse

Reflection Shot Point and Number 170

Refraction Base, Traces 1 and 12 Location

Permanent marker

NORTHERN TERRITORY
GEOLOGICAL SURVEY

[redacted]

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COMPAGNIE GENERALE DE GEOPHYSIQUE PR64/12

TRANSVERSE MERCATOR PROJECTION
10,000 metre grid
Zone 5 (Australia series)

PR64/120

AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd. **PL. 4**

O.P. 36

ACCESSIBILITY MAP

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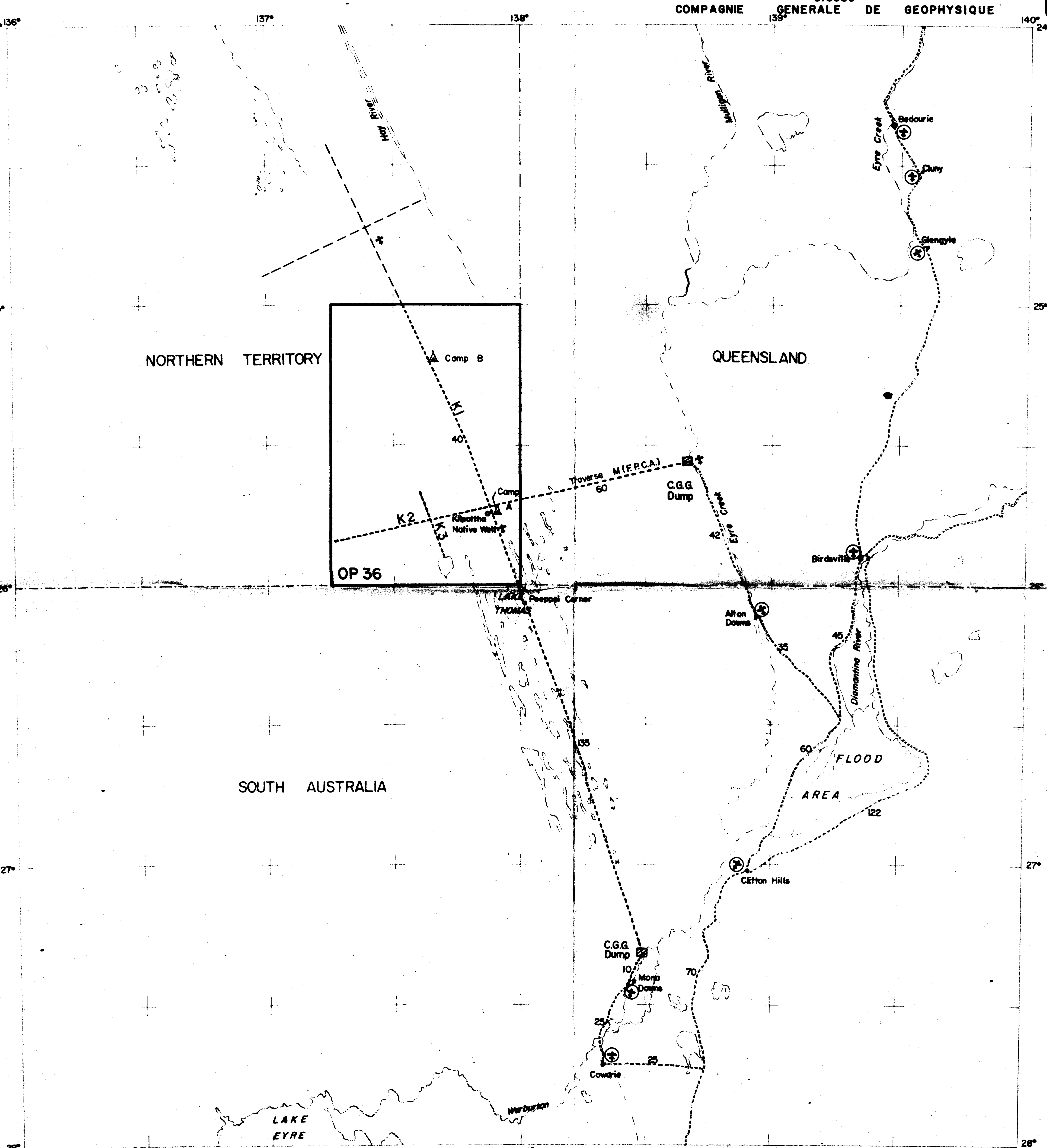
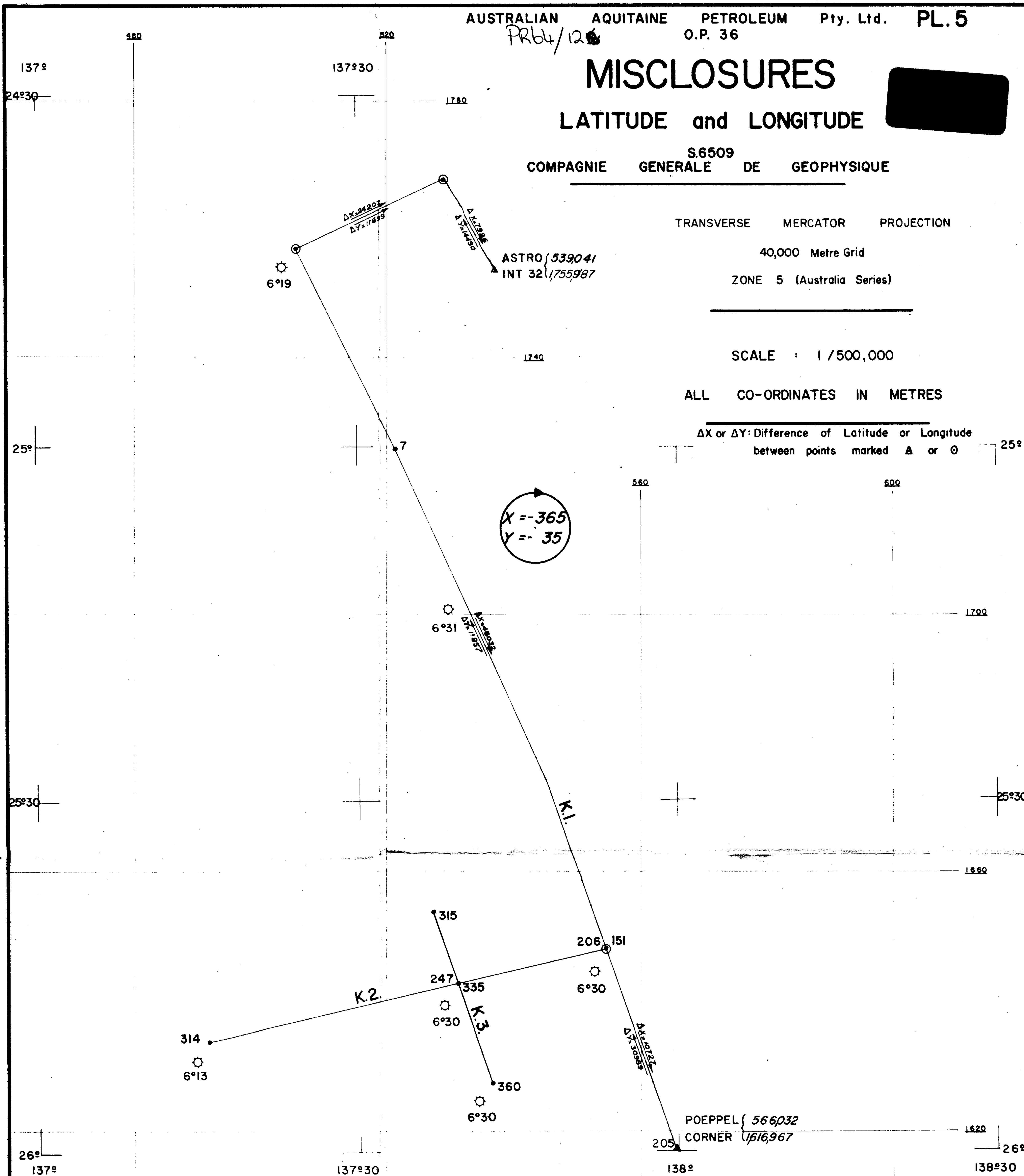
COMPAGNIE GENERALE DE GEOPHYSIQUE



LEGEND

- • Homestead
- • Town
- —·— State Boundary
- 122 Distance in miles
- ---- Road
- ---- Bulldozed Track
- Airstrip – Existing
- Airstrip – C.G.G.

SCALE : 1/1,000,000


AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd.
PL. 5
PR64/12
O.P. 36
MISCLOSURES
LATITUDE and LONGITUDE
[redacted]
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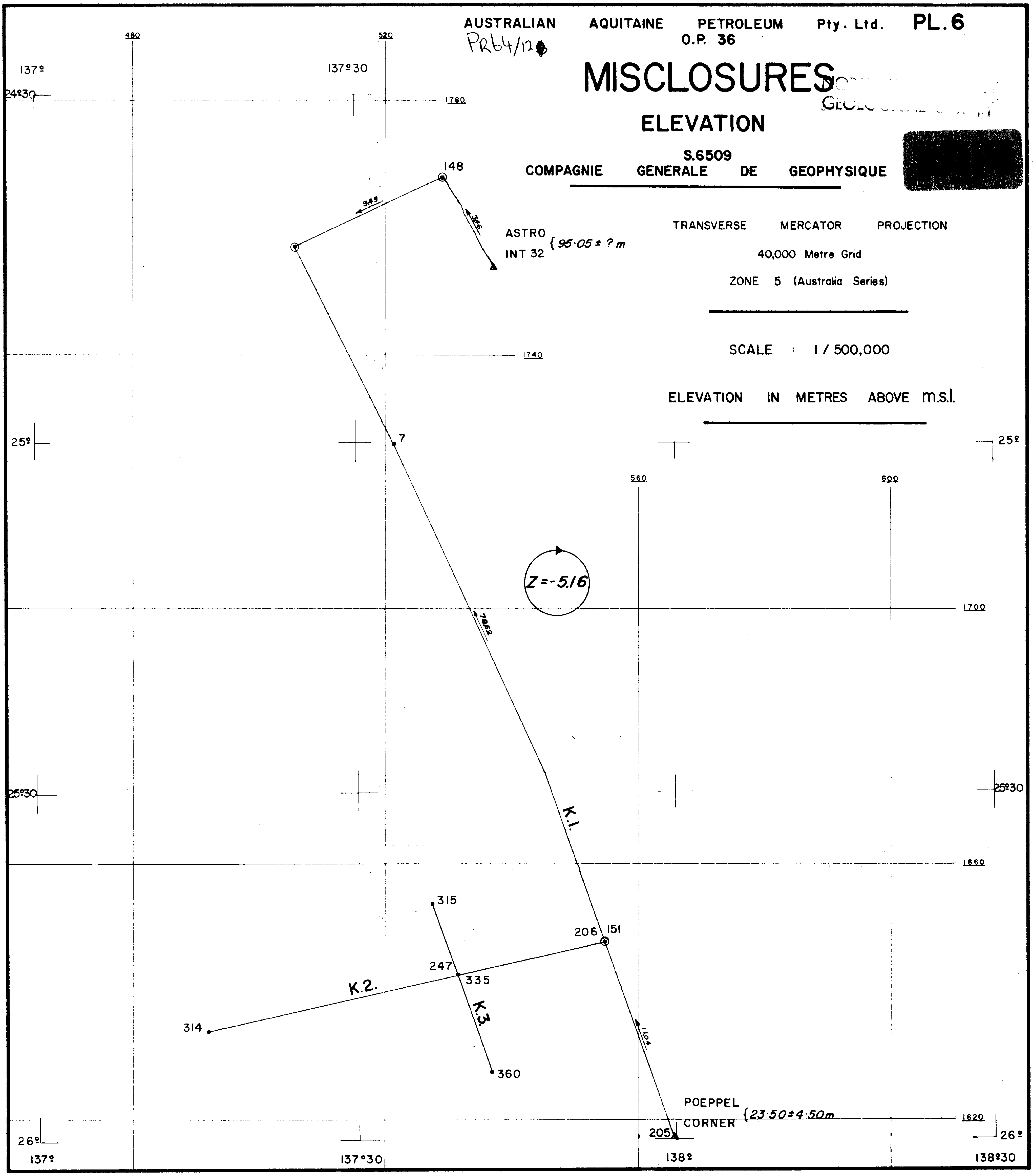
COMPAGNIE GENERALE DE GEOPHYSIQUE
TRANSVERSE MERCATOR PROJECTION
40,000 Metre Grid
ZONE 5 (Australia Series)
SCALE : 1 /500,000
ALL CO-ORDINATES IN METRES
ΔX or ΔY: Difference of Latitude or Longitude between points marked Δ or ⊙
137º
137º30
24º30
25º
25º30
26º
138º
138º30
480
520
560
600
1780
1740
1700
1660
1620
ΔX=24207
ΔY=11699
ΔX=17986
ΔY=14490
ASTRO { 539,041
INT 32 { 1755,987
6º19
7
X =-365
Y =- 35
6º31
ΔX=48032
ΔY=11857
K.1.
315
206
151
6º30
247
335
K.2.
K.3.
6º30
314
6º13
360
6º30
ΔX=10727
ΔY=30989
POEPPEL { 566,032
CORNER { 1616,967
205


AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd.
PL. 6
O.P. 36
PR64/120
MISCLOSURES
ELEVATION
S.6509
COMPAGNIE GENERALE DE GEOPHYSIQUE
[redacted]
TRANSVERSE MERCATOR PROJECTION
40,000 Metre Grid
ZONE 5 (Australia Series)
SCALE : 1 / 500,000
ELEVATION IN METRES ABOVE m.s.l.
137º
137º30
24º30
25º
25º30
26º
138º
138º30
480
520
560
600
1780
1740
1700
1660
1620
148
ASTRO
INT 32
{95·05 ± ? m
7
Z = -5.16
K.1.
K.2.
K.3.
315
206
151
247
335
314
360
POEPPEL
CORNER
{23·50 ± 4·50m
205

PR64/12

AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd. **PL. 7**

O.P. 36

KILPATTHA SURVEY

1964

GEOLOGICAL SURVEY

GEOPHYSICAL DATA

SCALE : 1 / 250,000

LEGEND

Magnetic Basement Depth Curve (Depth Below M.S.L.)	-1 km.
Magnetic High Axis	
Magnetic Fault	
Magnetic basement estimated depth (in km.b.m.s.l.)	(-2·1)
Bouguer Anomaly Curve Curve Spacing : 5 milligals Density : 1·9 g/cm³	-10
'High' Anomaly	
'Low' Anomaly	

[redacted]

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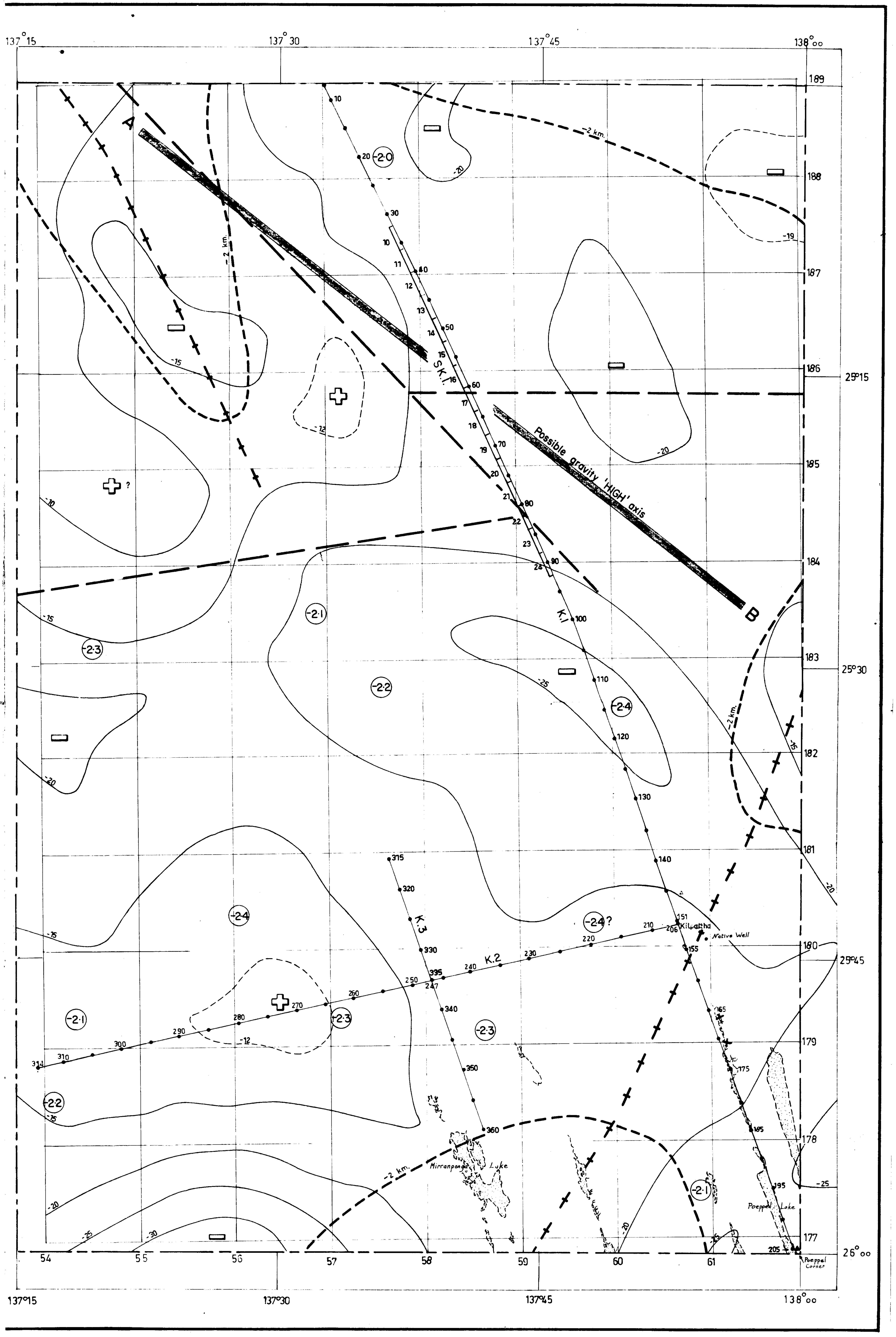
COMPAGNIE GENERALE DE GEOPHYSIQUE

ORIGIN of INFORMATION

GRAVITY : Mines Administration Pty. Ltd. coverage 1961

MAGNETIC : B.M.R. Aeromagnetic coverage 1962 (C.G.G. reinterpretation)



PR64/12

AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd. **PL.8**

O.P. 36

KILPATTHA SURVEY

1964

GEOLOGICAL SURVE

OPERATIONAL DIAGRAM

REFRACTION PROBE SK I

SCALE

Horizontal : 1 / 80,000

Vertical : 1 / 240,000

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COMPAGNIE GENERALE DE GEOPHYSIQUE

AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd.

O.P. 36

PL.9

PR64/128

KILPATTHA SURVEY

1964

GEOLOGICAL SURVEY

INTERPRETATION DIAGRAM

REFRACTION PROBE SK I

SCALE

Horizontal : 1 / 80,000

Vertical : 1 / 240,000

[redacted]

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COMPAGNIE GENERALE DE GEOPHYSIQUE

PR64/126

AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd. **PL. 10**

O.P. 36

KILPATTHA SURVEY

1964

NORTHERN TERRITORY
GEOLOGICAL SURVEY

TIME - DISTANCE CURVES

REFRACTION PROBE SK I

SCALE

Horizontal : 1cm. = 400 metres

Vertical : 1cm. = 200 milliseconds

LEGEND

Corrected Time

Velocity in Metres per Second

D.P. = 100 Metres a.m.s.l.

[redacted]

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COMPAGNIE GENERALE DE GEOPHYSIQUE

PR64/12 AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd. **PL.11**

O.P. 36

KILPATTHA SURVEY

1964

NORTHERN TERRITORY
GEOLOGICAL SURVEY

INTERPRETATION PLATE

REFRACTION LINE – SK I

SCALES

Horizontal : 1 cm. to 400 metres
Vertical : 1 cm. to 50 milliseconds

LEGEND

Corrected Time

Offset : 1,800 metres

Intercepts calculated with V=6,000m/sec.

Datum Plane : 100 metres

[redacted]

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COMPAGNIE GENERALE DE GEOPHYSIQUE

1 – Intercept curves were integrated with the following shot points chosen as origin:
 - SP 10/7 for the direct shots,
 - SP 15/7 for the reverse shots.

2 – The integration constants "c" are indicated below the corresponding shot points.
The relation between intercepts I_s and $I_{10/7}$ calculated for a geophone location recorded with shot points S and 10/7 is as follows: $I_{10/7} = I_s + c_s$
The same applies to shot point 15/7.

3 – Delays corresponding to direct shot points are written above the delay curve and delays corresponding to reverse shot points are written below this curve.

3-1 Calculation of a "direct shot point" delay:

I_d

$\text{Delay} = (I_d - c_d) \cdot \frac{1}{2}$

offset

SP: constant: c_d

3-2 Calculation of a "reverse shot point" delay:

$\text{Delay} = \frac{1}{2}(I_r - c_r)$

offset

SP: constant: c_r

I_r

4 – The delay-scale determined for the 6,000 m/sec. marker was also used for the short 5,450 m/sec (?) marker.

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O.P. 36

PL.12

KILPATTHA SURVEY
1964

OFFSET SHOTS

LINE K1
S.P. 34

FILTERS : 20-40

Velocities in metres per second

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AUSTRALIAN AQUITAINE PETROLEUM PTY. LTD. PL.13
O. P. 36

KILPATTHA SURVEY
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OFFSET SHOTS

LINE K2
S.P. 248

FILTERS 20-40

Velocities in metres per second

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COMPAGNIE GENERALE DE GEOPHYSIQUE

REMARKS

The 5,580 m/s arrival is easily pickable on the monitor records. It is very weak on these Play-backs because of the low gain setting

PLAY-BACK SETTINGS

Filters 1/20–1/56 – A.G.C. : Slow — Unmixed.

CORRECTIONS

Static corrections with 2,000 m/s vertical velocity

Move-out corrections after T–ΔT statistics

Reference plane : +100 metres a.m.s.l.

C.G.G. 59 RECORDING UNIT

Seismic Spread : 12 + 12 traces
50 metres between traces
600 metres between S.P.
36 H.S. junior geophones per trace in 3 lines parallel to the traverse

Shot Point : 24 holes in 4 lines parallel to the traverse
5 lbs. per hole
Depth : 15 ft.

Pab4/12

AUSTRALIAN AQUITAINE PETROLEUM PTY. LTD. PL.14

KILPATTHA SURVEY

S 115 TRAVERSE K I 86 N

SCALE — Distance : 1·5"/600 metres
Times : 3·75"/1 sec two-way time

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AUSTRALIAN AQUITAINE PETROLEUM PTY. LTD.

PL. 15

P264/124

O.P. 36

KILPATTHA SURVEY

1964

EXAMPLE OF REFRACTION RECORDS

PROBE SK I

[redacted]

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REFRACTION PROBE S.K. I

DIRECT SHOTS

S.P. 10/7 Bases 10 to 21

Not corrected times

Velocities in metres per second

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AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd.

O.P. 36

PL. 16

KILPATTHA SURVEY 1964

GEOLOGICAL SURVEY

DEPTH CROSS SECTION TRAVERSE K.1

SCALES

Horizontal : 1cm. to 1,000 metres
Vertical : 1cm. to 200 metres

DEPTH CALCULATION

Average vertical velocity from D.P. = 100m. down to A horizon : 2,100m/s
Average vertical velocity from D.P. = 100m. down to D horizon : 2,500m/s

All depths are relative to the mean sea level

LEGEND

Continuous REFLECTION horizon
Continuous REFRACTION horizon
Probable or extrapolated horizon
'Phantom' horizon
Probable fault
Estimated depth of the magnetic basement

[redacted]

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COMPAGNIE GENERALE DE GEOPHYSIQUE

PR64/128

AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd.
O.P. 36

PL.17

KILPATTHA SURVEY
1964

DEPTH CROSS SECTION
TRAVERSE K.2

SCALES

Horizontal : 1cm. to 1,000 metres
Vertical : 1cm. to 200 metres

DEPTH CALCULATION

Average vertical velocity from D.P. = 100m. down to A horizon : 2,100 m/s
Average vertical velocity from D.P. = 100m. down to D horizon : 2,500 m/s

All depths are relative to the mean sea level

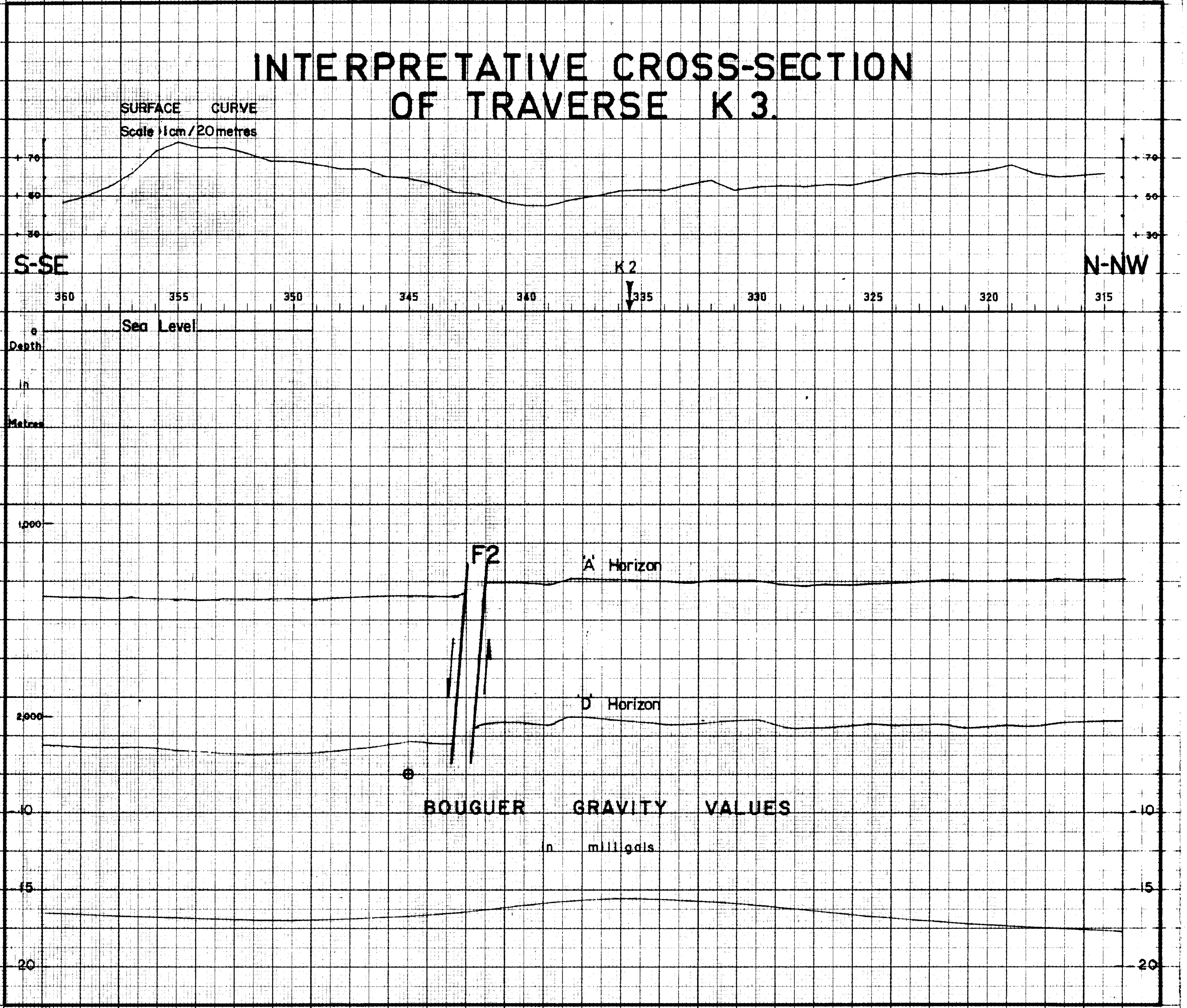
LEGEND

Continuous REFLECTION horizon
Continuous REFRACTION horizon
Probable or extrapolated horizon
'Phantom' horizon
Probable fault
Estimated depth of the magnetic basement ⊕

[redacted]

S.6509

COMPAGNIE GENERALE DE GEOPHYSIQUE



PR64/12

AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd. **PL.18**

O.P. 36

KILPATTHA SURVEY

1964

DEPTH CROSS SECTION

TRAVERSE K.3

SCALES

Horizontal : 1cm. to 1,000 metres
Vertical : 1cm. to 200 metres

DEPTH CALCULATION

Average vertical velocity from D.P. = 100m. down to A horizon : 2,100m/s
Average vertical velocity from D.P. = 100m. down to D horizon : 2,500m/s

All depths are relative to the mean sea level

LEGEND

- Continuous REFLECTION horizon
- Continuous REFRACTION horizon
- Probable or extrapolated horizon
- 'Phantom' horizon
- Probable fault
- **Estimated depth of the magnetic basement** ⊕

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COMPAGNIE GENERALE DE GEOPHYSIQUE

PR64/12…

AUSTRALIAN AQUITAINE PETROLEUM Pty. Ltd. **PL. 19**

O.P. 36

KILPATTHA SURVEY
1964

SCHEMATIC CONTOUR MAP

'A' HORIZON

SCALE-1/250,000

LEGEND

Average Vertical Velocity from D.P. = +100m down to A Horizon : 2,100 m/sec

Contour interval : 20 metres

Questionable axis — HIGH

Offset Spreads

All depths are relative to the mean sea level.

[redacted]

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COMPAGNIE GENERALE DE GEOPHYSIQUE

TRANSVERSE MERCATOR PROJECTION

10,000 Yard Grid

ZONE 5 (Australia Series)