COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1964/171

GEOPHYSICAL BRANCH SUMMARY OF ACTIVITIES, 1964

RESTRICTED

SUMMARY OF ACTIVITIES

1964

GEOPHYSICAL BRANCH

The following notes summarise the activities of the Geophysical Branch during 1964.

For many surveys, the notes have been prepared before the data have been analysed completely and the conclusions reached are therefore tentative. Use should not be made of the data without first checking as to its validity. Preferably potential users within the Bureau should await the full analysis of the data and the issue of Records.

CONTENTS

OIL SEARCH

1. SEISMIC SURVEYS

SEISMIC PARTY NO.1.

South-East Georgina Basin

Seismic reflection and refraction work was carried out in the south-east Georgina Basin in the area covered by the Springvale and Mount Whelan 1:250,000 sheets. The programme started with refraction and experimental reflection shooting to the east and south east of Herbert Downs on Traverses N, Q, and R. The objectives of this part of the programme were to measure the refraction velocity of the outcropping Ninmaroo Limestone and to develop a reflection technique to be used to record shallow and deep reflections when shooting over outcropping Lower Palaeozoic Formations or when there is a thin cover of Mesozoic, Tertiary or Recent over the Lower Palaeozoic sediments. Continuous refraction profiling on Traverses N and O gave a refraction velocity of 18,500 ft/sec in an east-west direction and 17,500 ft/sec in a north south direction at a very shallow depth. This is an area of outcropping Ninmaroo Formation and a very hard limestone was encountered in the shot holes on Traverse N at depths of 19 ft to 90 ft. An attempt to follow this high speed refractor down dip using continuous refraction profiling failed because of uncertainties in the interpretation due to large velocity changes of between 14,000 ft/sec to 20,000 ft/sec within the first recorded high velocity refractor.

Experimental continuous profiling reflection shooting on Traverses N and O failed to yield any reflected events.

In the second stage of the programme a reflection traverse, connecting Traverses A, B, C, D and Q from the 1963 survey, was shot from Canary Bore No.1 in the east, through Marion Downs, to Traverse Q at Hilary Dam in the west. The objective of this traverse was to attempt a correlation from Canary Bore No.1, where possible Upper Proterozoic sediments were encountered at 500 ft, through the area of outcropping Pre-Cambrian Sylvester Sandstones at Watchie Hut, to the southeastern extension of the Toko Syncline, where the 1963 Seismic Survey indicated a sedimentary thickness in excess of 16,000 ft. Using a double subsurface coverage continuous reflection profiling technique, a section was obtained which gave a fair indication of the structure immediately below the Mesozoic cover, the thickness of which was between 300 ft and 600 ft.

The reflection correlation between Traverse A and Canary Bore No.1 indicates a predominant east dip superimposed on the gentle undulations of the deeper reflections below the relatively flat base Mesozoic reflection which occurs at reflection times of less than 0.2 seconds. The continuity of the deeper reflections is broken at a number of places by disturbed zones and associated diffractions which are indications of faulting. It is not possible from reflection character correlation to indicate the throw of these faults. There is an indication of a very broad anticlinal feature with a culmination in the region of SP7700, east of the crossing of the Hamilton River. A deep shot hole drilled to identify the high velocity refractor encountered on Traverse A entered at 365 ft, a hard limestone which has tentatively been correlated with the Chatsworth Limestone of Upper Cambrian age. If this tentative identification of Chatsworth Limestone and the Upper Proterozoic sediments at 500 ft. in Canary Bore No.1 are assumed to be correct then it is not possible to correlate these two bores using the seismic dip indications without introducing reverse faulting with considerable throw. It is thought that the final correlation will only be solved by a programme of shallow stratigraphic holes (less than 800 ft) along the traverse between Hamilton River and Canary Bore No.1.

The third part of the 1964 programme was designed to obtain more reliable reflection information below the main Ninmaroo Reflection in the south west extension of the Toko Syncline; by the cancellation of possible multiple reflections. Three velocity spreads together with a programme of twelve fold multiple subsurface coverage were shot along parts of Traverse F. A spread length of 7200 ft with the shot point offset up to 900 ft off one end was used to obtain a large

primary-multiple reflection discrimination. The results of this work will be processed in the Central Playback Centre in Melbourne.

For the remainder of the field season and for the whole of the 1965 season Seismic Party No.1 will be engaged in the Tobermory Area of the South Georgina Basin. The programme here will be to develop a seismic technique to obtain reflections on outcropping Palaeozoic limestones and dolomites, and then to carry out an extensive regional reconnaissance survey over the areas of interest which resulted from the recent aeromagnetic, gravity and stratigraphic drilling results.

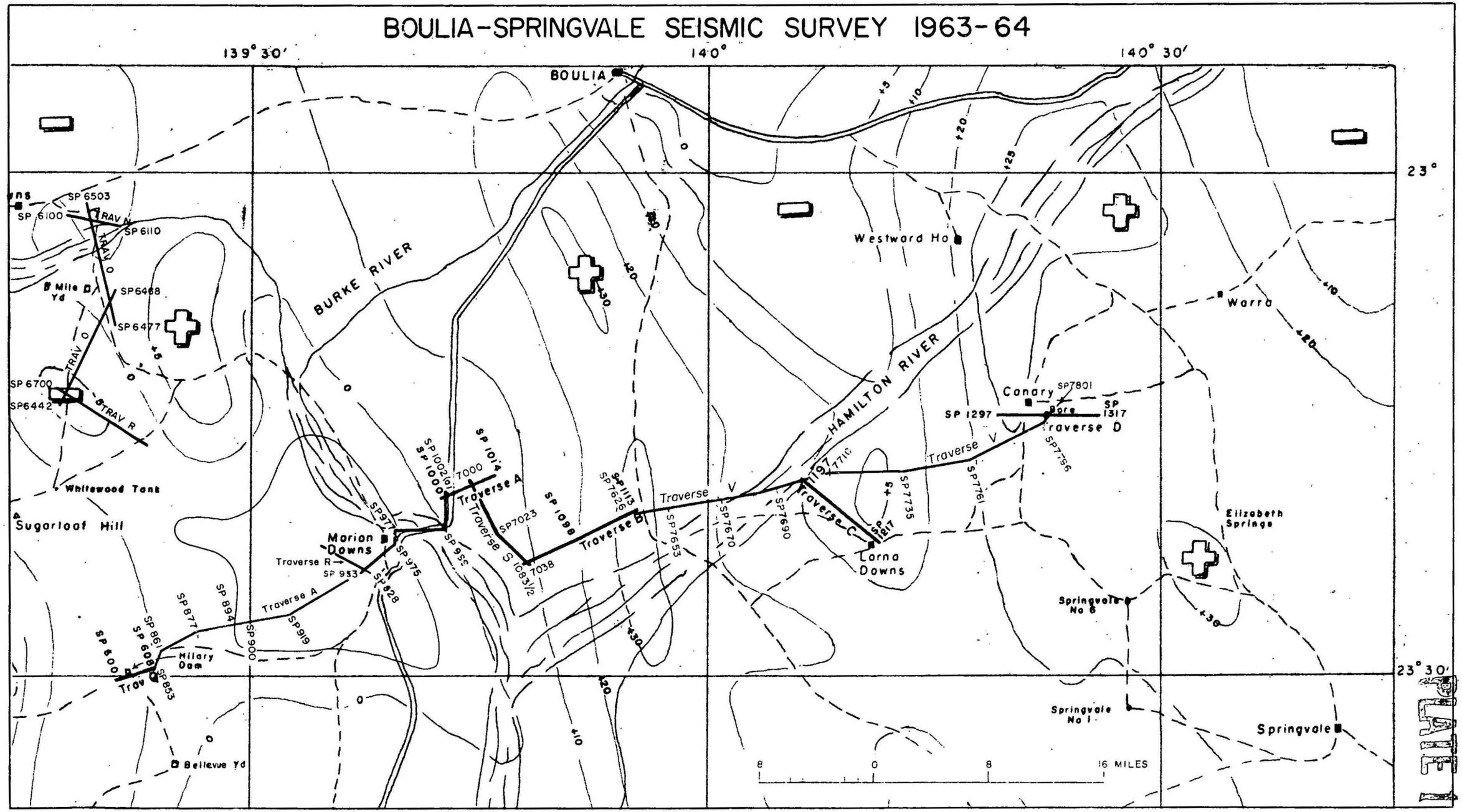
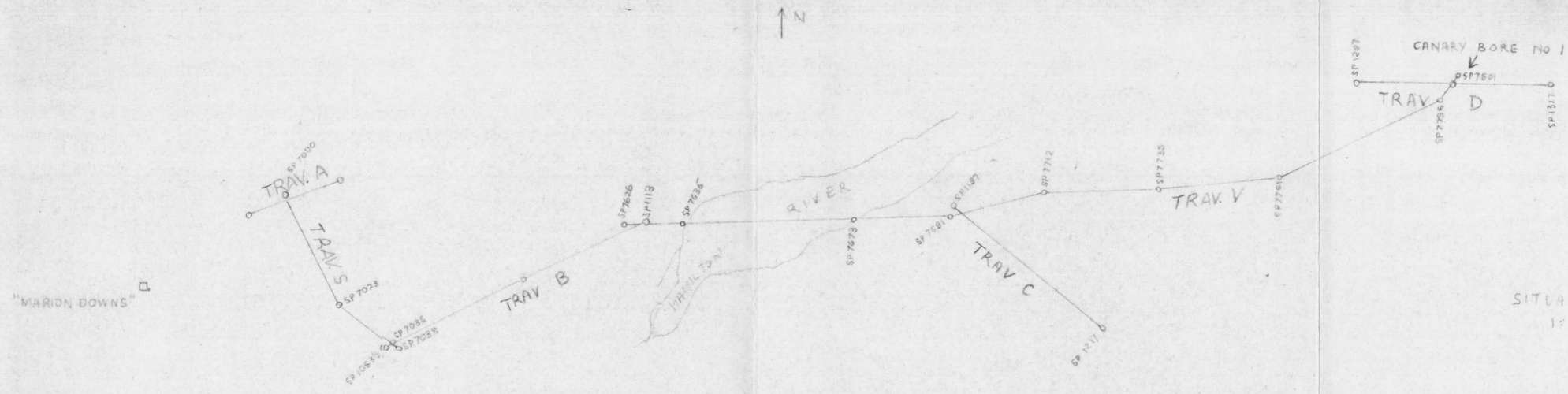
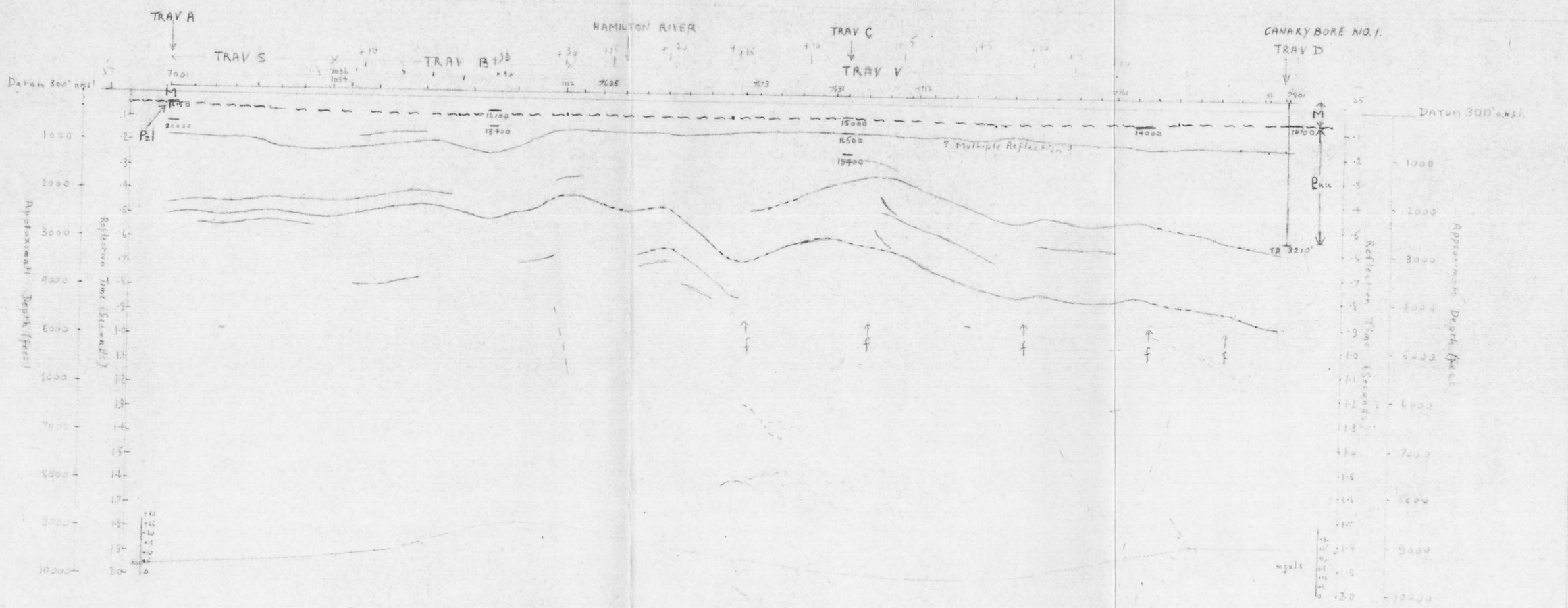

BOULIA-SPRINGVALE SEISMIC SURVEY 1963-64
139° 30'
140°
140° 30'
23°
23° 30'
BOULIA
BURKE RIVER
HAMILTON RIVER
Westward Ho
Warra
Canary
Sugarloaf Hill
Whitewood Tank
Marion Downs
Lorna Downs
Hilary Dam
Springvale No 6
Springvale No 1
Springvale
Elizabeth Springs
Bellevue Yd
8 Mile Dump Yd
Traverse A
Traverse B
Traverse C
Traverse D
Traverse R
Traverse S
Traverse V
SP 6503
SP 6100
SP 6110
SP 6468
SP 6477
SP 6700
SP 6442
SP 7000
SP 7023
SP 7038
SP 7670
SP 7690
SP 7735
SP 7761
SP 7796
SP 7801
SP 1297
SP 1317
SP 1217
SP 953
SP 975
SP 928
SP 900
SP 919
SP 894
SP 877
SP 861
SP 608
SP 853
SP 600
8 0 8 16 MILES

PLATE 2





S.E. GEORGINA BASIN SEISMIC SURVEY 1963-64

PROVISIONAL

SEISMIC CORRELATION

TRAV A MARION DOWNS

– CANARY BORE NO 1

26/10/64

SEISMIC PARTY NO.2.

Perth Basin, W.A. (Bullsbrook Seismic Survey)

During the period mid-March to mid-June 1964 Seismic Party No.2 carried out a seismic reflection survey between the coast and the Darling Range in the Wanneroo - Bullsbrook area, approximately 30 miles north of Perth, Western Australia.

The objectives of the survey were to attempt to derive a suitable shooting technique for obtaining readable results from below the coastal limestone formation, to investigate geological structure across the basin and to supplement hydrological studies being made by the Geological Survey of Western Australia.

Two east west traverses were shot; traverse A, over the Pleistocene coastal limestone formation, and traverse B, to the east of the coastal limestone on a Pleistocene sand formation (see Plate 3). The topography in both areas was flat to undulating but access was difficult because of very rough limestone outcrops on traverse A and dense scrub and many small forms on traverse B. Because of the difficulty of access to the area it was impractical to make traverse B straight and instead it was laid as close as possible to a bitumen road.

The programme consisted of 7 weeks of experimental shooting, of which 4 weeks were spent on the coastal limestone, and 6 weeks of continuous reflection profiling across the basin. Included in the experimental shooting were two attempts to record reflections from depths in the region of the Mohorovicic discontinuity; these attempts yielded inconclusive results.

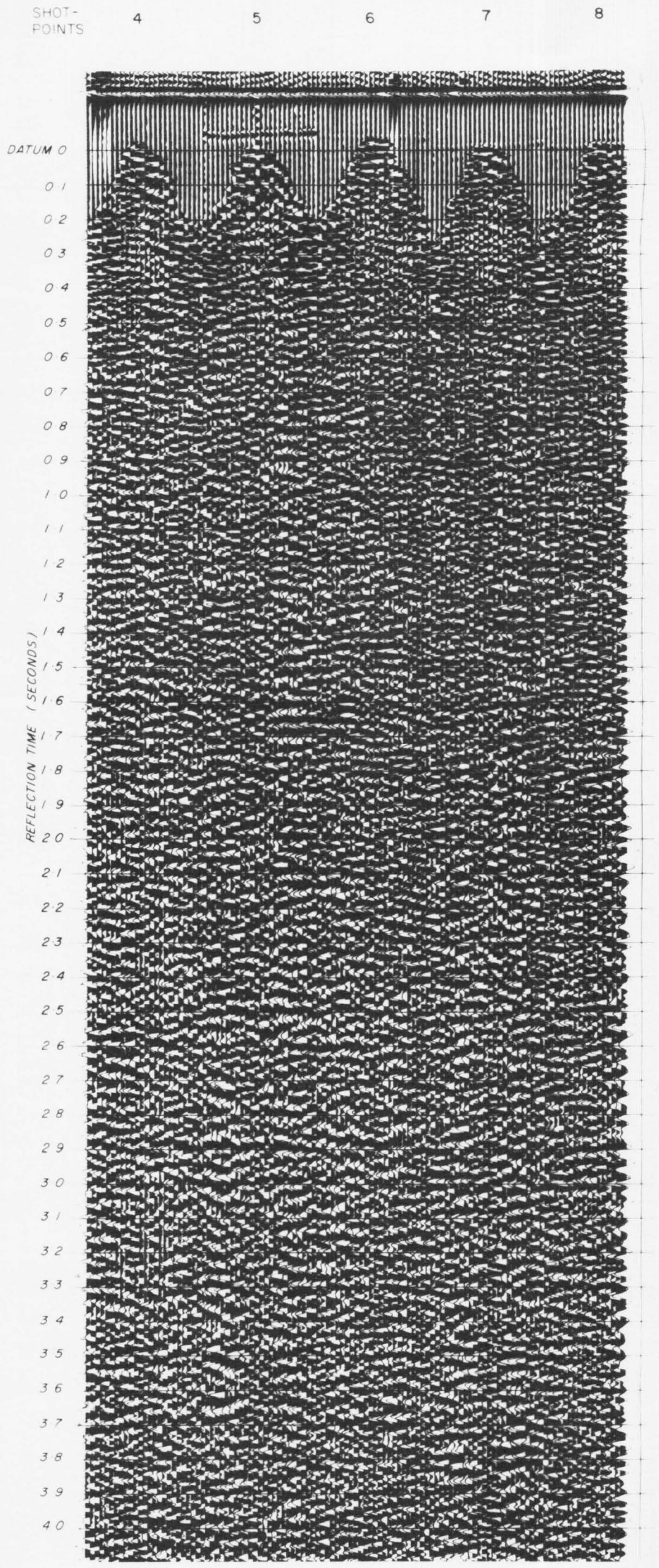
Four noise analyses were shot, three on traverse A and one on traverse B. From these, computed results yielded velocities, frequencies, wave lengths and relative amplitudes of the main seismic noise in the area. These parameters indicated the theoretical best shot hole and geophone arrays to be used for obtaining optimum reflection results. By using this data, and conducting other tests to determine the best charge size and hole depth, and to make any modifications to the pattern size and shape which were shown by experiment to be necessary, a technique for obtaining readable seismic reflection records over the major part of the basin was found. On the coastal limestone formation, however, no reliable reflections were obtained even when the shot hole pattern consisted of 45 holes 30 ft deep and 24 geophones per trace were used.

Record quality was poor to fair in the western half of the basin but improved considerably to the east. A complex geological section in the west gave way to a more conformable, thick synclinal section in the east terminated in the east by the Darling fault. Of interest is an apparent reversal of dip in beds lying deeper than 7000 ft with reversal axis near the centre of the major gravity low of the basin.

PLATE 3

115° 45'
116°
31° 30'
31° 45'
Lake Mackenburra
Barragoon Lake
Lake Nambung
Lake Catambro
Lake Pinjar
Loch Mc Ness
Joondalup Lake
Lake Jandabup
Gnangara Lake
Lennard Brook
Darling Range
Swan
COASTAL LIMESTONE
INDIAN OCEAN
GINGIN
MUCHEA
BULLSBROOK
PEARCE
WANNERU
GNANGARA OBS.
UPPER SWAN
WATERMANS BAY
SCARBOROUGH
MIDLAND JUNCTION
ASHFIELD
PERTH
Uni. B.
S.P. 97
S.P. 101
S.P. 105
S.P. 109
S.P. 114
S.P. 131
"A"
"B"
W.A.
SP 101 Seismic Traverse
+40 BOUGUER ANOMALY (MGALS.)
SCALE IN 8 MILES
PERTH BASIN SEISMIC SURVEY
BULLSBROOK AREA, W.A. 1964

PLATE



CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder : ETL DS7/700

Amplifiers : TIC 8000

Filters : K22-72

A.G.C. : 1/1 125

Gain Initial : -60

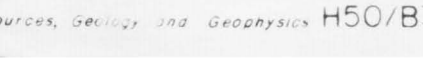
Final : 1-31

Geophones : EVS 2B 20 c/s

Geophone pattern :

24 X 21 ft in line

Shot-hole pattern :



PLAYBACK INFORMATION

Filters : 1/25 1/47

A.G.C. : Super slow

Gain Initial : -50

Final : -30

Trip delay : -2

Compositing : Nil

VELOCITY INFORMATION

$V_a = 6900 + 1420\ t$ (from $T-\Delta t$)

HORIZONTAL SCALE

Spread length = 1800 ft

BULLSBROOK SEISMIC SURVEY 1964

PERTH BASIN W A

TRAVERSE A

RECORDED BY: B M R Seismic Party No 2

SECTION BY: Bureau of Mineral Resources
Playback Centre SIE MS 42

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H50/B3-8

PLATE

CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder : ETL DS7/700

Amplifiers : TIC 8000

Filters : K 22-92

A.G.C. : 1/1 125

Gain Initial : -70

Final : 1-31

Geophones : EVS 2B 20 c/s

Geophone pattern :

24 X 12 1/2 ft in line

Shot-hole pattern :

7 holes in line 45 ft spacing
100 ft deep 20 lbs per hole

PLAYBACK INFORMATION

Filters : 1/25 1/47

A.G.C. : Super slow

Gain Initial : -40 except 147-150-50

Final : -30

Trip delay : -2

Compositing : Nil

VELOCITY INFORMATION

$V_a = 6900 + 1420\ t$ (from $T - \Delta t$)

HORIZONTAL SCALE

Spread length = 1800 ft

BULLSBROOK SEISMIC SURVEY 1964
PERTH BASIN W A
TRAVERSE B

RECORDED BY *B M R Seismic Party No 2*

SECTION BY *Bureau of Mineral Resources*
Playback Centre SIE MS 42

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H 50/ B 3-9

SOUTHERN CARNARVON BASIN, W.A. (Traverse D, Pelican Hill Bore)

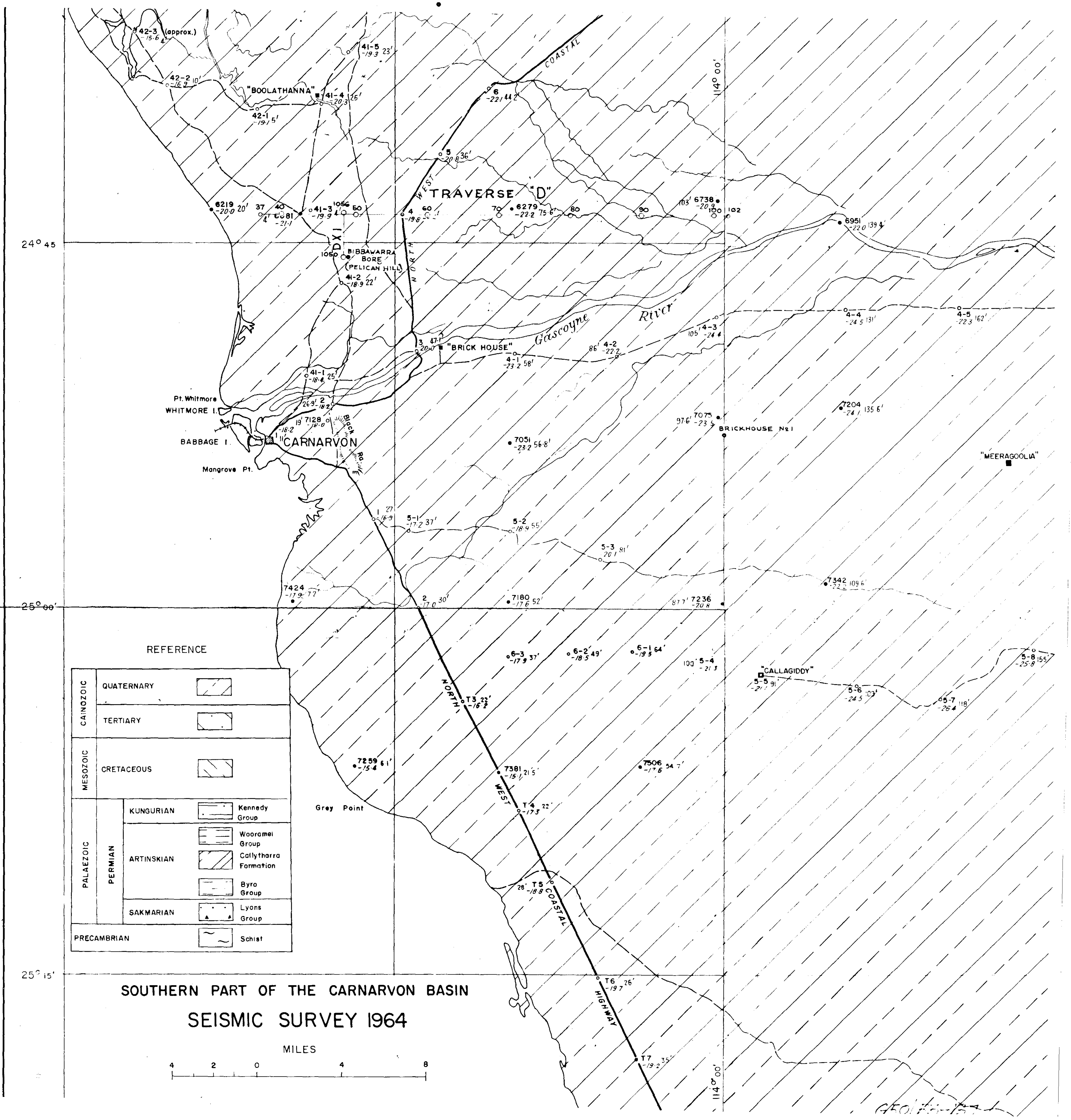
A seismic reconnaissance traverse was surveyed along an east-west line 10 miles north of Carnarvon for a distance of 20 miles eastwards from the coast. Both reflection and refraction techniques were used and results were correlated where possible with the known formations in the Pelican Hill Bore.

Reflections from below the Cretaceous/Palaeozoic unconformity were largely interfered by multiples. Refraction methods recorded four horizons within the Palaeozoic section showing velocities of 14,750; 18,400; 20,280 and 19,100 ft/sec.

Only the 14,750 ft/sec refraction is within the depth range of the Pelican Hill bore and appears to lie near the top of the Gneudna Formation (Devonian). The 20,280 ft/sec refractor, is tentatively correlated with the Dirk Hartog Dolomite (Silurian), is a fairly good marker for structural mapping and shows a mean westerly dip from a depth of about 4,000 ft to 5000 ft along the traverse. The main feature of the profile on this marker is a broad anticlinal reversal with a relief of about 500 feet.

The initial events on two long refraction shots (15 miles) appear to show a refractor having a velocity of 19,100 ft/sec at a depth of 8000 ft. This could be basement but the depth estimate is very tentative.

In an attempt to cancel multiple reflections 5 miles of 12 fold reflection coverage was recorded by the "roll-along" method but stacking is not complete.



SOUTHERN PART OF THE CARNARVON BASIN
SEISMIC SURVEY 1964
MILES
4 2 0 4 8
REFERENCE
CAINOZOIC
QUATERNARY
TERTIARY
MESOZOIC
CRETACEOUS
PALAEZOIC
PERMIAN
KUNGURIAN
Kennedy Group
ARTINSKIAN
Wooramel Group
Callytharra Formation
Byro Group
SAKMARIAN
Lyons Group
PRECAMBRIAN
Schist
24° 45
25° 00'
25° 15'
114° 00'
TRAVERSE "D"
"BOOLATHANNA"
"BRICK HOUSE"
BRICKHOUSE No 1
"MEERAGOOLIA"
"CALLAGIDDY"
BIBBAWARRA BORE
(PELICAN HILL)
CARNARVON
Pt. Whitmore
WHITMORE I.
BABBAGE I.
Mangrove Pt.
Grey Point
Gascoyne River
Black Rd
DX I
NORTH WEST COASTAL HIGHWAY
42-3 (approx.)


Pelican Hill Bore
(known locally as Bibawarra Bore)
2 Miles south of traverse
DATUM MSL
DEPTH IN FEET BELOW DATUM
HORIZON A
HORIZON B
HORIZON C
Gneudna Formation (Devonian)
? Nanyarra Greywacke (Thomas & Dickins 54)
? Tumblagooda S.S. (McWhae et al 1958)
POSSIBLE FAULT
SCALE
HORIZONTAL
VERTICAL
LEGEND
REFLECTION
Reflection time in milliseconds
Reflecting horizon (Unmigrated)
REFRACTION
V_2 = 14750
Refractor velocity in feet per second
SHOTHOLES
CL CLAY
S SAND
SS SANDSTONE
S CL SAND / CLAY
SOUTHERN CARNARVON BASIN 1964
SEISMIC CROSS-SECTION
TRAVERSE D
G50/B3-158

"VIBROSEIS" CONTRACT SURVEY"

An experimental "Vibroseis" survey was carried out by Seismograph Services Ltd of England on behalf of the Bureau from 11th May to 3rd October, 1964. The objectives of the survey were to assess the "Vibroseis" method in respect to quality of results and economy of operation in seismic problem areas within the Otway and Sydney Basins. Areas were selected where difficulties had been experienced in obtaining reliable seismic information from shot-hole methods and a built-up area wnere shot-hole seismic survey methods could not be used.

The test areas and particular factors relevant to their problems were as follows:

Otway Basin

1. Areas covered by Volcanics in Western Victoria - 6 fold common depth point shooting failed to yield good results in previous work, however little experimentation was carried out to select the optimum recording method.

2. Gambier Limestone outcrop areas in the Gambier Sunklands in S.A. The outcrops have been generally avoided due to difficult drilling and anticipated poor results due to poor shooting medium. No experimentation has been carried out.

3. Sand dunes and sheet cover in the Gambier Sunklands in S.A. - poor results from standard shooting on sand cover.

4. Interdunal poor reflection area in the Gambier Sunklands in S.A. - local area where reason for poor quality of results was not known.

Sydney Basin

5. Hawkesbury Sandstone outcrop areas - hard sandstone with difficult drilling and energy penetration problems.

6. Built-up area - City of Maitland - seismic results were good to the east and west of the area but impractical to obtain in the built up area with shot hole methods.

The results of previously obtained shot hole seismic work, with little experimentation, were found generally to be unsuitable for comparison with the Vibroseis results which were obtained after considerable experimentation.

1. Volcanics Project (Plates 8, 9, 10)(Otway Basin)

Experimental work was carried out along 3 traverses designated as Volcanics 1, 2 and 3 over a 6 weeks period in May - June 1964.

Volcanics 1 work was designed as an initial test of the "Vibroseis" method in an area of no basalt cover, near Pretty Hills No.1 bore, where shot hole seismic data had been previously obtained. Recordings were made using a transposed method, (with geophones placed in nests at the normal shot point position and vibrators operating at the stations normally occupied by geophones in shot hole methods), and a 10 fold common depth point method along a 2 mile traverse straddling the bore. Fair to good quality reflections were obtained to 1.8 sec reflection time (approx. 8000 ft) and the Pretty Hills structure was shown on the reflection section. It was considered that the results compared favourably with those obtained from shot-hole work.

1. Volcanics Project (Plates 8, 9, 10) (Otway Basin) (cont'd)

The main experimental traverse Volcanics 2, 6 mile long, was located in an area of thick volcanics cover, near Mt. Napier, where previously conducted common depth point shot hole work had given poor results. Noise tests were recorded and detailed experimentation was carried out with different types of vibrator and geophone patterns and pattern lengths; number of vibrator sweeps, different geophone to vibrator offsets, and various sweep frequencies. Transposed recordings were made over the 6 mile traverse however in-line and common depth point recordings were also made over parts of the line. The results indicated a strong reflection recorded at times ranging from 0.5 to 1.0 sec. along the section. This reflection is probably from basement since it shows good character correlation with the basement reflection obtained on Volcanics 1 at Pretty Hills No.1 bore. The section appears to be thickening slightly to the north.

The same transposed and common depth point recording methods were used, on the Volcanics 3 traverse near Heywood, as for production recording on the Volcanics 2 traverse. The "Vibroseis" results along this traverse were generally fair down to 1.5 sec reflection time but the continuity was intermittent. The deterioration in the continuity may be attributed partly to the high ambient noise level caused by heavy traffic and wind in trees alongside the traverse.

The "Vibroseis" results demonstrate that techniques can be developed to obtain fair quality reliable reflection information in the area of volcanic cover in the Otway Basin in south west Victoria.

2. Gambier Limestone Project (Plates 11, 12) (Otway Basin)

Experimental "Vibroseis" work on the outcropping cavernous Gambier Limestone was undertaken over a 6 week period in June and July.

The main experimental programme was carried out on the Gambier Limestone 2 traverse located approx. 2 miles west of Mt. Schank near Mt. Salt No.1 bore. This traverse is located about 2 miles south of a traverse, previously recorded by a contract party, from which no reflection information was obtained. Noise spreads recorded on the G.L.2 traverse indicated 3 discrete high amplitude interference events with velocities of approx. 2500 ft/sec, 3300 ft/sec and 7200 ft/sec. Transposed recordings were made along 2 miles of traverse in a first attempt to attenuate these low velocity noise events and to record reflections. Fair quality shallow events were recorded at 0.8 to 1 sec. however shallow poorer quality events down to 0.8 sec are partly obscured by noise interference, and deep information was not obtained.

After considerable experimentation designed to attenuate the interference events and increase the signal to noise ratio, 4 miles of traverse were vibrated using a transposed method with minimum vibrator to geophone offset of $\frac{1}{2}$ ml. and geophones in diamond patterns. $1\frac{1}{4}$ miles of common depth point recording was also made. The record quality improved towards the western end of the traverse. Events evident at about 1 sec reflection time are probably reflections from near the top of the Upper Cretaceous Section while those evident at about 2.3 sec. (equivalent depth approx. 12000 ft) may be from reflecting horizons at or near the bottom of the Upper Cretaceous section.

"Vibroseis" recordings were also made on Gambier Limestone outcrops near Glencoe about 15 ml. N.E. of Mt. Gambier to test the applicability of the methods found to be best for recording on the Gambier Limestone 2 traverse. Fair quality events were recorded to 1 sec (approx. 9000 ft) while poorer quality non-continuous events are evident to approx. 2.8 secs. (15000 ft). It was found that the coherent noise level was considerably lower in this area but that penetration for good quality deeper reflections was still a problem. The results along this line were comparable to those obtained by shot hole methods.

3. Sand Dune Project (Plates 11, 13). (Otway Basin)

Initial "Vibroseis" recordings on this project were made along a traverse, designated as Sand Dunes 1 along the highway south of Tarpeena on the Mt. Gambier - Penola Rd. The objective was to determine if reflection information could be obtained easily in this area, just off the sand cover, prior to tackling the problem of getting reflections when recording on the sand cover area. Fair quality reflections showing slight south dip were obtained to a reflection time of approx. 1 sec (4000 ft) over 1 ml. of traverse. Poorer quality reflections are evident with reflection times to about 2 sec. The results were of similar quality to previous shot hole results.

A noise test was recorded on the sand cover. From the results of the noise test a transposed technique was established for recording on the Sand Dunes 2 Traverse. This technique differed only slightly from that used off the sand cover, however 20 sweeps per trace were necessary, instead of 10 sweeps, to obtain penetration into the section below the sand. Fair to poor quality reflections were recorded to at least 1.8 sec. reflection time with consistent southerly dip.

The transposed method which gave fair results on the Sand Dunes 2 Traverse was found to be inapplicable to recording on a short dune traverse in the western part of the basin. Only poor reflections were recorded on this Sand Dunes 3 Traverse. It was concluded that no standard "Vibroseis" technique can be used in areas of sand cover but that a new technique should be developed for work in each area.

4. Interdunal Poor Reflection Area Project (Plates 11, 14) (Otway Basin)

Recordings were made along a traverse located in the interdunal area north east of Beachport. The traverse was originally surveyed using shot-hole methods by the S.A. Mines Department. The results from the shot-hole work were poor in the area over which Vibroseis recordings were made.

A noise test was initially recorded. This revealed principle interference events with velocities of 7400 ft/sec and 220 ft/sec. A technique similar to that used on the Sand Dunes 2 Traverse was then used for recording along this traverse. Fair to poor quality reflections were obtained to approx. 2 sec. reflection time. There is evidence of faulting in the southern part of the section; this faulting may be the reason for the deterioration in the quality of the deep reflections in the section towards the south.

5. Hawkesbury Sandstone Project (Plates 15, 16, 17) (Sydney Basin)

Experimental "Vibroseis" work was conducted in Hawkesbury Sandstone outcrop areas in the Kulnura and Grassy Hills areas of the Sydney Basin during a 6 weeks period in August to October. Hawkesbury Sandstone outcrop areas have been generally avoided in shot hole seismic work in the Sydney Basin because of the difficulty in drilling holes, and the general poor quality of the seismic results when recording on the outcrops.

A noise test was recorded on the Hawkesbury Sandstone 1 Traverse about 3 miles south of the Kulnura No.1 bore. The results indicated that the principle interference event was the high velocity, high amplitude, first break event. Initial recordings were made over the 3 ml. traverse with a $\frac{1}{4}$ ml. offset, 600 ft. patterns, sweep frequency of 10-40 cps and 10 sweeps per trace. In addition experiments were carried out with different offsets, sweep frequencies and number of sweeps in attempts to increase the signal to noise ratio for deep low amplitude events. The results indicated that shallow reflection information to 1 sec. could be obtained by simple Vibroseis transposed recording techniques in the area south of Kulnura, however deeper information to approx. 1.7 sec (12500 ft) could be recorded only at the expense of attenuating the shallow reflections.

5. Hawkesbury Sandstone Project (Plates 15, 16, 17) (Sydney Basin) (cont'd)

The technique found to be applicable for recording south of Kulnura was used for recording on the Hawkesbury Sandstone 2 Traverse along a twisting road which passed the Kulnura Bore. On this traverse fair quality reflections are evident to approx. 1.4 sec. reflection time (10,500 ft). It is evident that the Kulnura anticlinal structure extends in low relief through the section. A test was made of the applicability of the best recording methods, used at Kulnura, to the Grassy Hills area on outcropping Hawkesbury Sandstone. Fair quality reflections were obtained to approx. 1 sec. reflection time indicating probably about 6,500 ft. of section, however poor quality reflections are evident to 1.6 sec (12,000 ft). The reflection quality was poorest in the vicinity of deep, steep gorges on either side of the traverse at its eastern end.

It has been shown that reflection information can be successfully obtained when recording with "Vibroseis" methods on Hawkesbury Sandstone outcrops in the Sydney Basin. The results obtained in the Kulnura area are much superior to those obtained by conventional methods.

6. Built-up area Project (Plates 15, 18, and 19) (Sydney Basin).

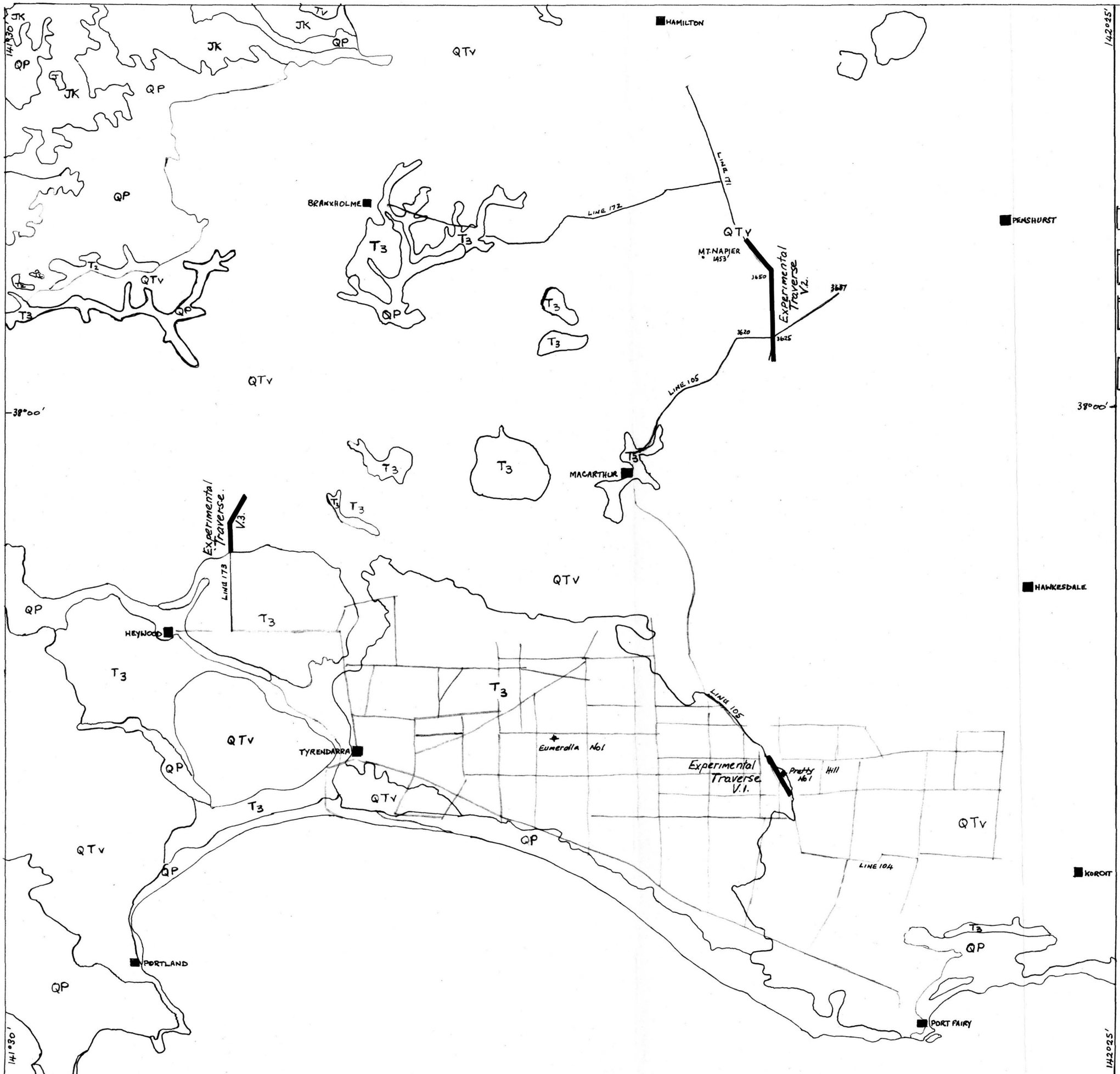
Shot-hole seismic traverses surveyed during a recent survey in the Maitland area could not be tied through the built-up, highly populated areas. Faulting is evident in this gap "Vibroseis" recordings were made through the City of Maitland in a one week period with the objectives of assessing the method in the built up area and of obtaining information on the fault.

After initial experimentation using the standard in-line recording method along the roadway, with vibrator force levels at 25% maximum, a high effort transposed recording technique was adopted. Vibrators with maximum force level operated along the bitumen roadways but geophones were laid in nests as far from the roadway and power lines as possible in order to reduce random noise from traffic and 50 cps. interference.

A high amplitude, high velocity, near surface wave masks reflection information down to approx. 0.5 sec. reflection time and it limits the amplitude of recording for the deeper information. However, a good continuous reflection was recorded at approx. 0.7 to 0.8 sec (approx. depth 4500-6000 ft). This reflector which indicates approx. 3° east dip can probably be associated with the Greta Coal Measures. Other poorer quality events are evident to approx. 1.2 sec. reflection time (8500 ft).

The fault is fairly well defined at the eastern end of the traverse. It appears to be almost vertical. The Greta CoalMeasures are evident in surface outcrop to the west of the fault thus it is estimated that it is downthrown approx. 4500 ft. to the east. Reflections showing east dip are evident on the west of the fault.

It has been shown that the "Vibroseis" method can be used successfully for obtaining reflection information in a built-up, highly populated area, however, it may not be possible to attain an optimum recording technique due to the limitations imposed on choice of recording parameters.



PLATE

QP	Post Miocene sands and gravels
QTv	Newer Volcanics, basalts and tuffs
T4/T3	Heytesbury (Glenelg) Group.
Tv	Older Volcanics
T2/T1	Wangerrip (Knight) Group.
JK	Mesozoic terrestrial-littoral dep.

Note: Geology after FROME BROKEN HILL CO. PTY LTD.

——— Existing traverses Locations approximate.

▬▬ Proposed Experimental Traverses - Volcanics Problem

SCALE: 1 INCH = 4 MILES

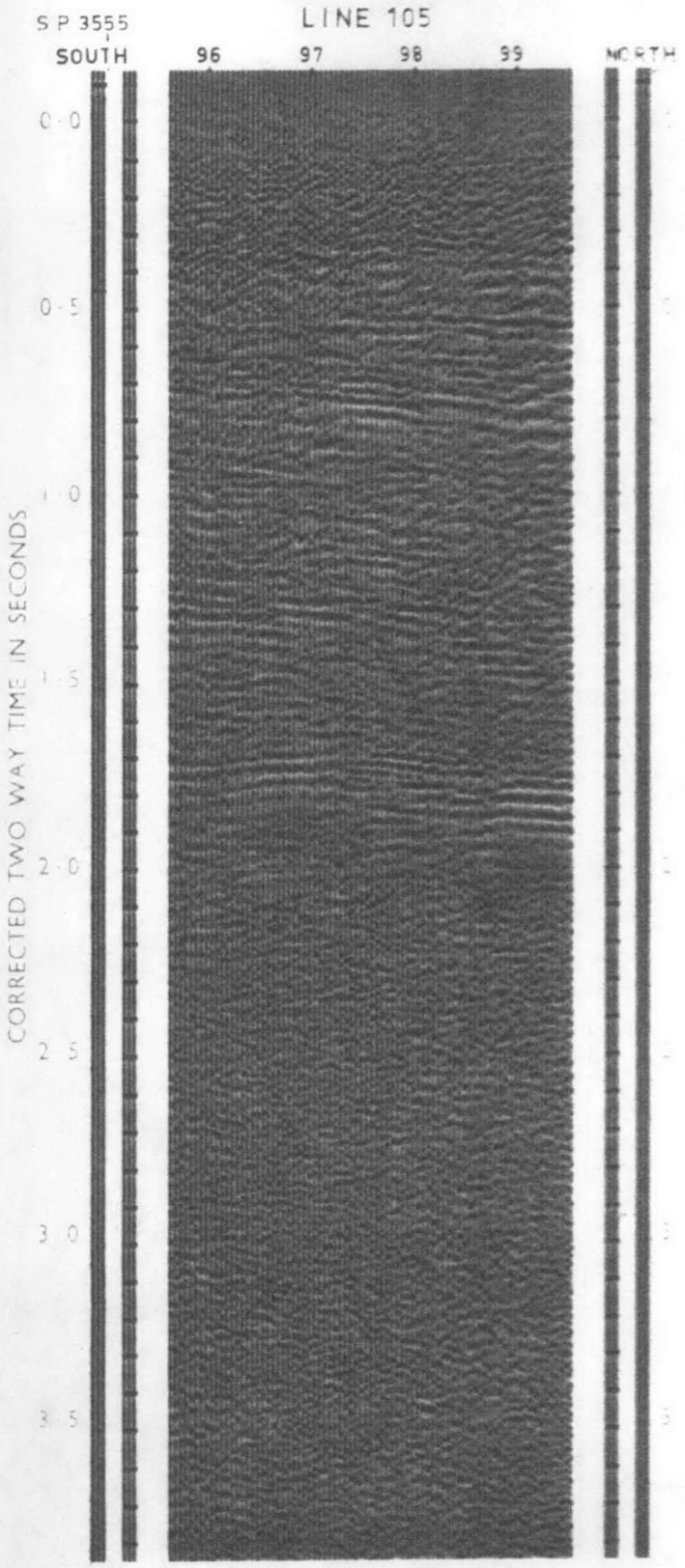
4 2 0 4

OTWAY BASIN
S.W. VICTORIA

VIBROSEIS EXPERIMENTAL TRAVERSES

G 438-7

PLATE 9



SEISMOGRAPH SERVICE LIMITED
LONDON ENGLAND

VARIABLE AREA CROSS-SECTION
VIBROSEIS®
FOR BUREAU OF MINERAL RESOURCES

VOLCANICS 1

LINE 105 S.P.'S. 96 – 99

VELOCITY DISTRIBUTION	PRETTY HILLS No 1
WEATHERING VELOCITY (V_w)	2000 F/SEC
HORIZONTAL VELOCITY (V_h)	—
ELEVATION VELOCITY (V_e)	6000 F/SEC
WEATHERING METHOD	—
HORIZONTAL SCALE 1" : 2400'	DATUM M.S.L.
TYPE OF PROFILING	10 FOLD C.D.P.
TRACE INTERVAL	132'
OFFSET DISTANCE	1386' – 3894'
No. AND TYPE OF VIBRATORS	3 – 2
SWEEP FREQUENCY 14 – 57	No OF SWEEPS 10
PLAYBACK FILTER	14 – 60
MIXING	NIL

VIBRATOR PATTERN:

264' X 100'

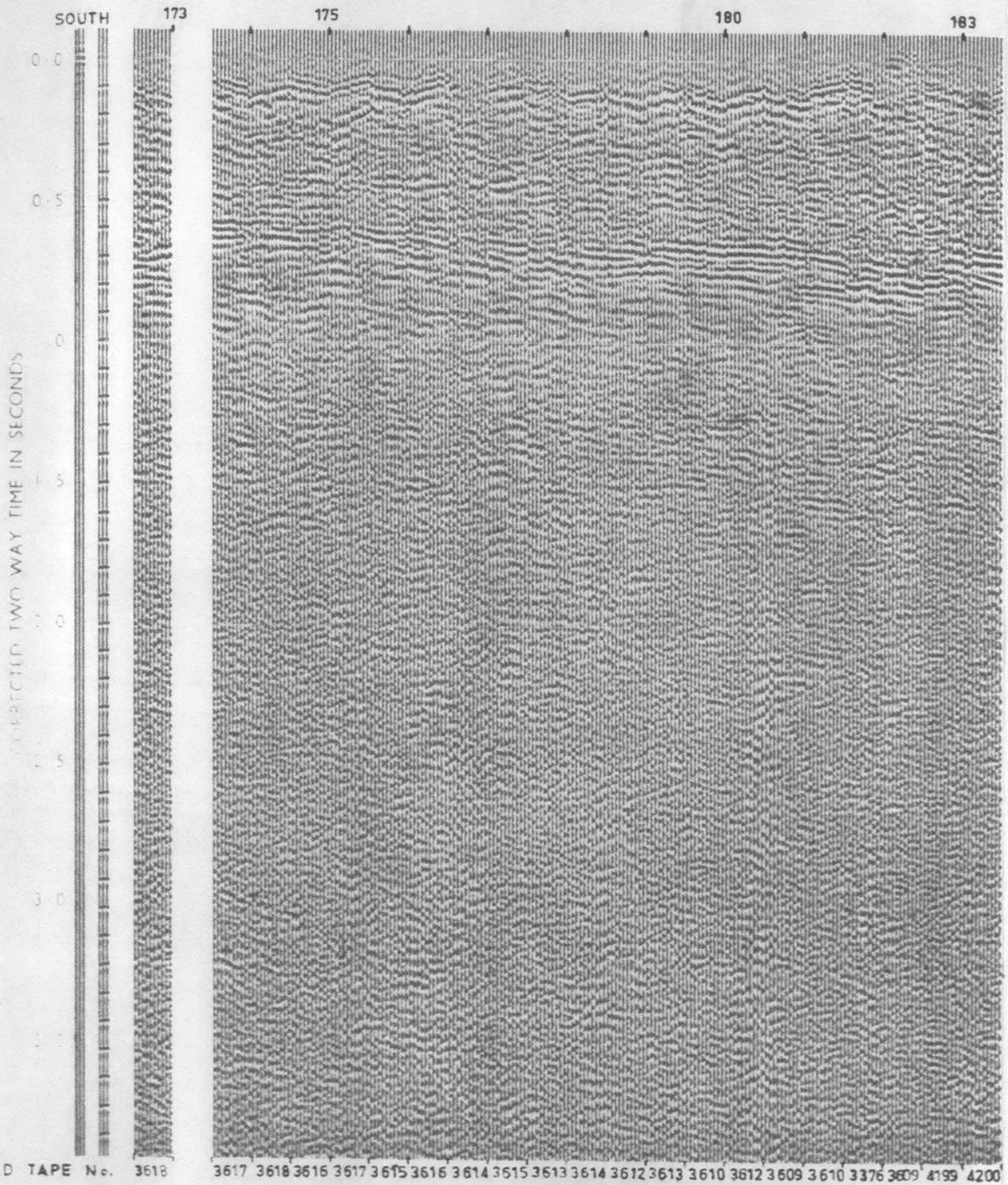
GEOPHONE PATTERN:

264' ALONG LINE WITH 40 GEOPHONES PER TRACE

PARTY 243	DATE MAY-1964
ENCLOSURE 2	PROGRESS REPORT 1

SSL 94A. ® TRADE MARK CONTINENTAL OIL CO.

LINE 171



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VARIABLE AREA CROSS-SECTION
FOR BUREAU OF MINERAL RESOURCES

VOLCANICS 2

LINE 171 S.P.'S. 173 — 183

VELOCITY DISTRIBUTION	PRETTY HILLS No1
WEATHERING VELOCITY (Vw)	2000 FT. SEC.
HORIZONTAL VELOCITY (Vh)	—
ELEVATION VELOCITY (Ve)	6000 FT. SEC.
WEATHERING METHOD	—
DATUM M.S.L. + 500'	TRACE INTERVAL 88'
HORIZONTAL SCALE	1" = 1600'
OFFSET DISTANCE	880'
PLAYBACK FILTER	20 - 60
MIXING UNMIXED	No. OF SWEEPS 10
No. OF VIBRATORS	3
SWEEP FREQUENCY	20 - 57
TYPE OF PROFILING	TRANSPOSED

VIBRATOR PATTERN :

400' IN LINE WITH 133' SPACING

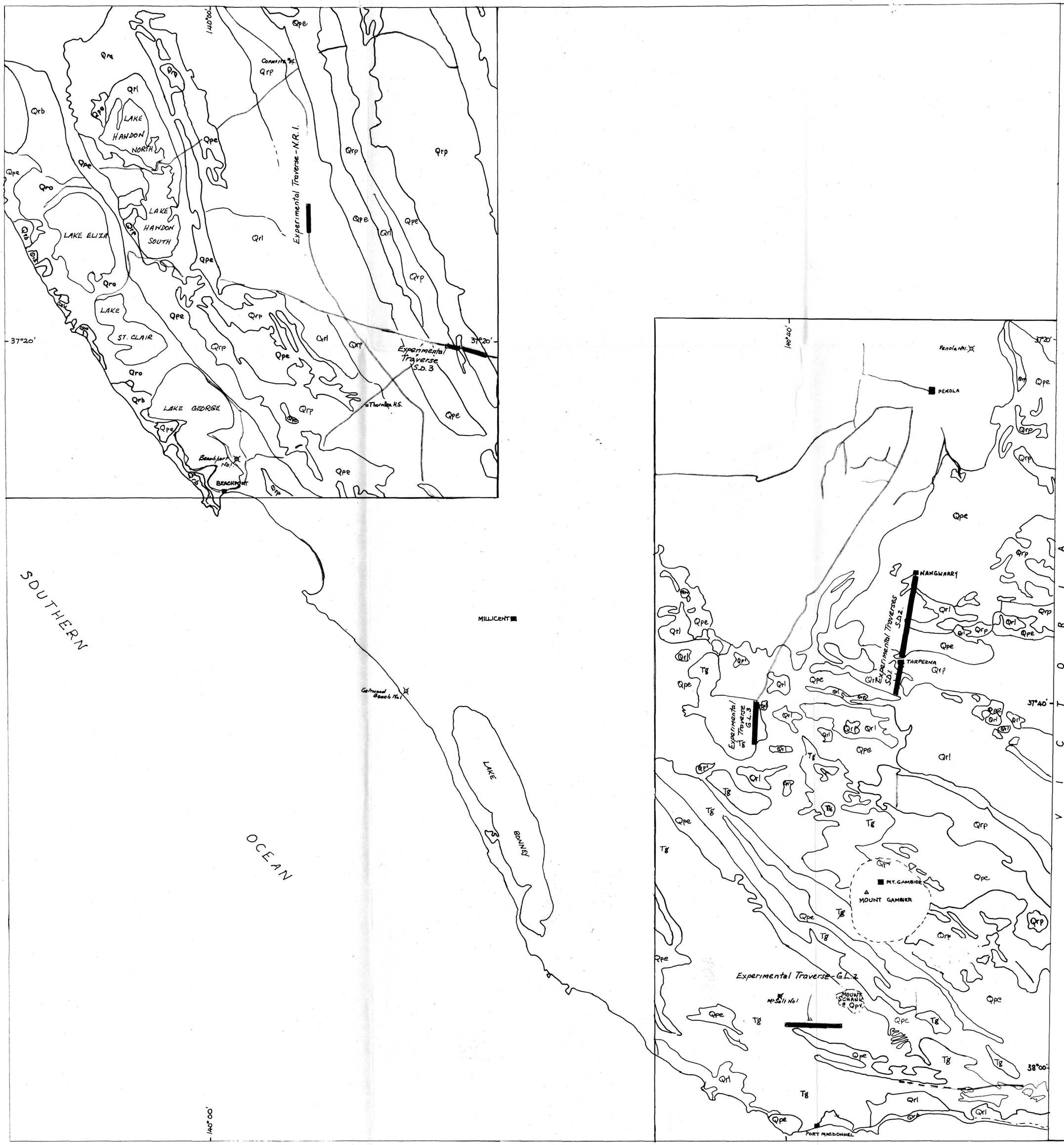
GEOPHONE PATTERN

400' x 200' RECTANGLE WITH

400 GEOPHONES PER TRACE

PARTY	243	DATE	10 - 6 - 64
ENCLOSURE	3	PROGRESS REPORT	3

PLATE



PLEISTOCENE

RECENT

- Qrl — Swamp marsh, lunette and lake marls clays and peats
- Qrp — Deep flat lying sands and sand sheets meadow podzols
- Qrb — Back shore beach ridged calcareous and siliceous dune sands
- Qro — Osborne high sea level marine deposits
- Qra — Anadarra high sea level marine deposits
- Qpe — Aeolianite consolidated beach sands and included Thawerthinous horizons
- Qpb — Sea beach and sea floor deposits of the Aeolianite systems
- Qpf — Basalts, olivine basalts and scoria
- Qpv — Ash lapilla and volcanic bombs

UNCONFORMITY

LOWER TERTIARY

- GAMBIER LIMESTONE — Tg — Fossiliferous limestones bryozoal limestones marls, dolomites and flint beds
- KNIGHT CLAYS — Tk — White and lightly coloured sands and clays with lignite horizons also thin marine sandy glauconitic and bryozoal beds.

Note: Geology after GEOLOGICAL SURVEY of SOUTH AUSTRALIA PENOLA - Sheet J54-6 & 10

- Existing traverses Locations approximate
- Proposed Experimental Traverses.

SCALE: 1 INCH = 4 MILES.

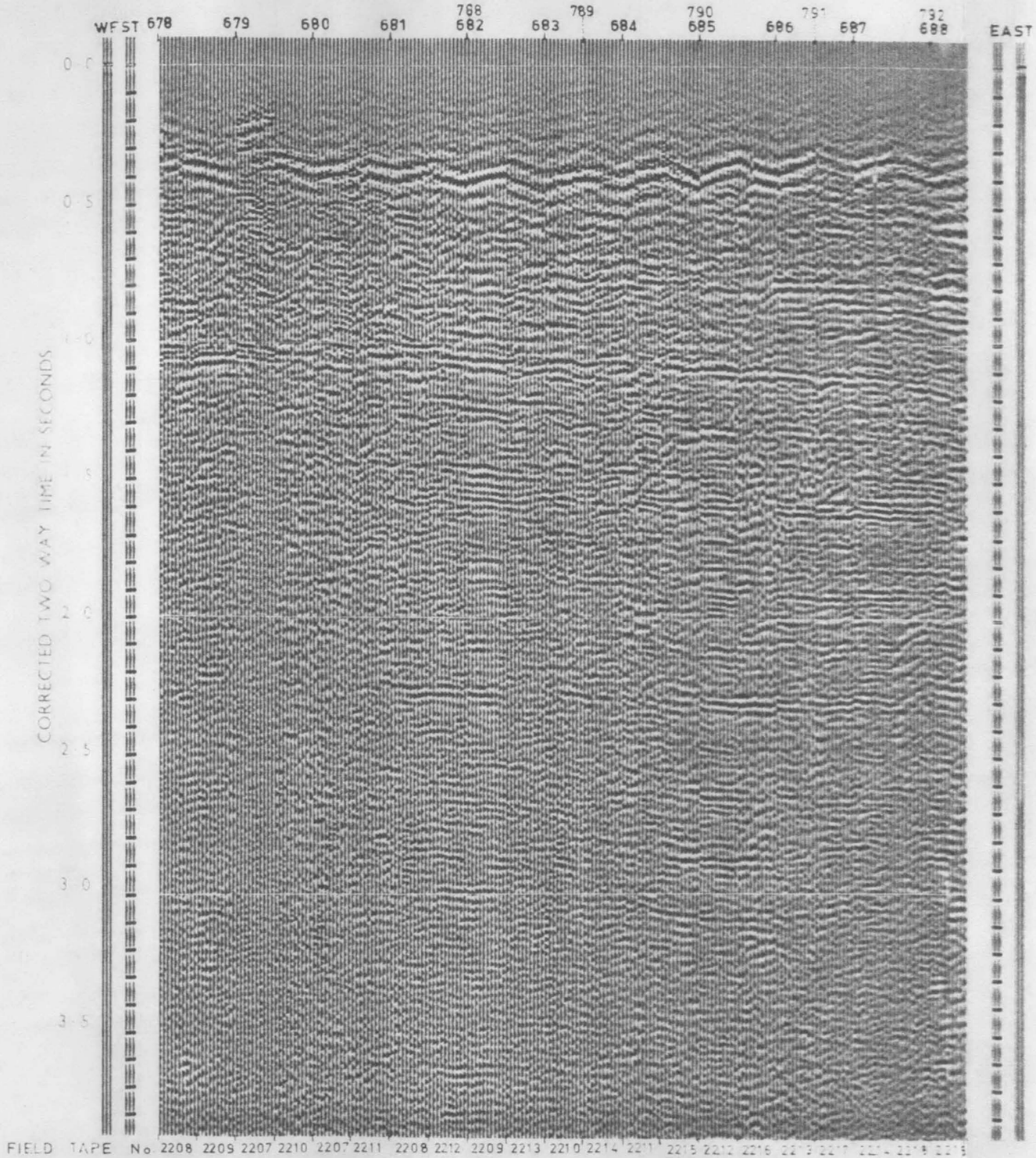
4 2 0 4

OTWAY BASIN
S:E. SOUTH AUSTRALIA

VIBROSEIS EXPERIMENTAL TRAVERSES

G 438-8

LINE 1



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VARIABLE AREA CROSS-SECTION
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GAMBIER LIMESTONE 2

LINE 1 S.P.'S. 678 – 688

VELOCITY DISTRIBUTION	GELTWOOD BEACH
WEATHERING VELOCITY (V_w)	–
HORIZONTAL VELOCITY (V_h)	–
ELEVATION VELOCITY (V_e)	7000 F/SEC.
WEATHERING METHOD	–
HORIZONTAL SCALE 1" : 1600'	DATUM M.S.L.
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	88'
OFFSET DISTANCE	SEE TABLE
No AND TYPE OF VIBRATORS	3
SWEEP FREQUENCY 14 – 57	No OF SWEEPS 20
PLAYBACK FILTER	14 – 60
MIXING	–

VIBRATOR PATTERN:

200' IN LINE

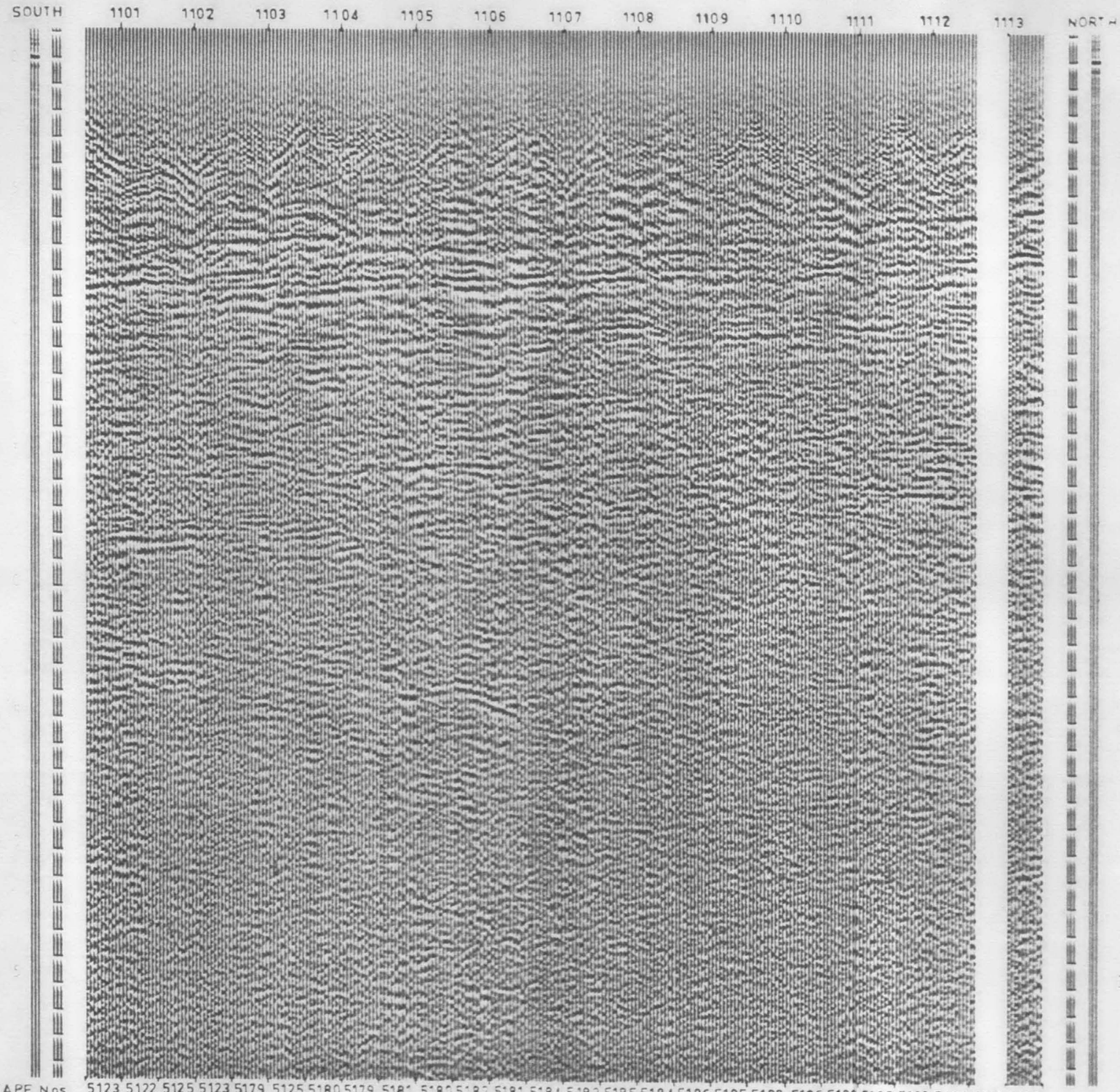
GEOPHONE PATTERN:

400' x 400' DIAMOND OF 400 GEOPHONES

PARTY 243	DATE 27-7-1954
ENCLOSURE 3	REPORT P.R. 6

SSL 94A. ®A TRADE MARK CONTINENTAL OIL CO.

LINE S D 2



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SAND DUNES 2

LINE S.D. 2 S.P.'S. 1101 - 1113

VELOCITY DISTRIBUTION	BEACHPORT No.1
WEATHERING VELOCITY (V_w)	-
HORIZONTAL VELOCITY (V_h)	-
ELEVATION VELOCITY (V_e)	7000 FT/SEC
WEATHERING METHOD	-
HORIZONTAL SCALE 1": 2400'	DATUM M.S.L.
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	1386' - 2574'
No AND TYPE OF VIBRATORS	3
SWEEP FREQUENCY 14 - 57	No OF SWEEPS 20,40
PLAYBACK FILTER	14 - 60
MIXING	-

VIBRATOR PATTERN:

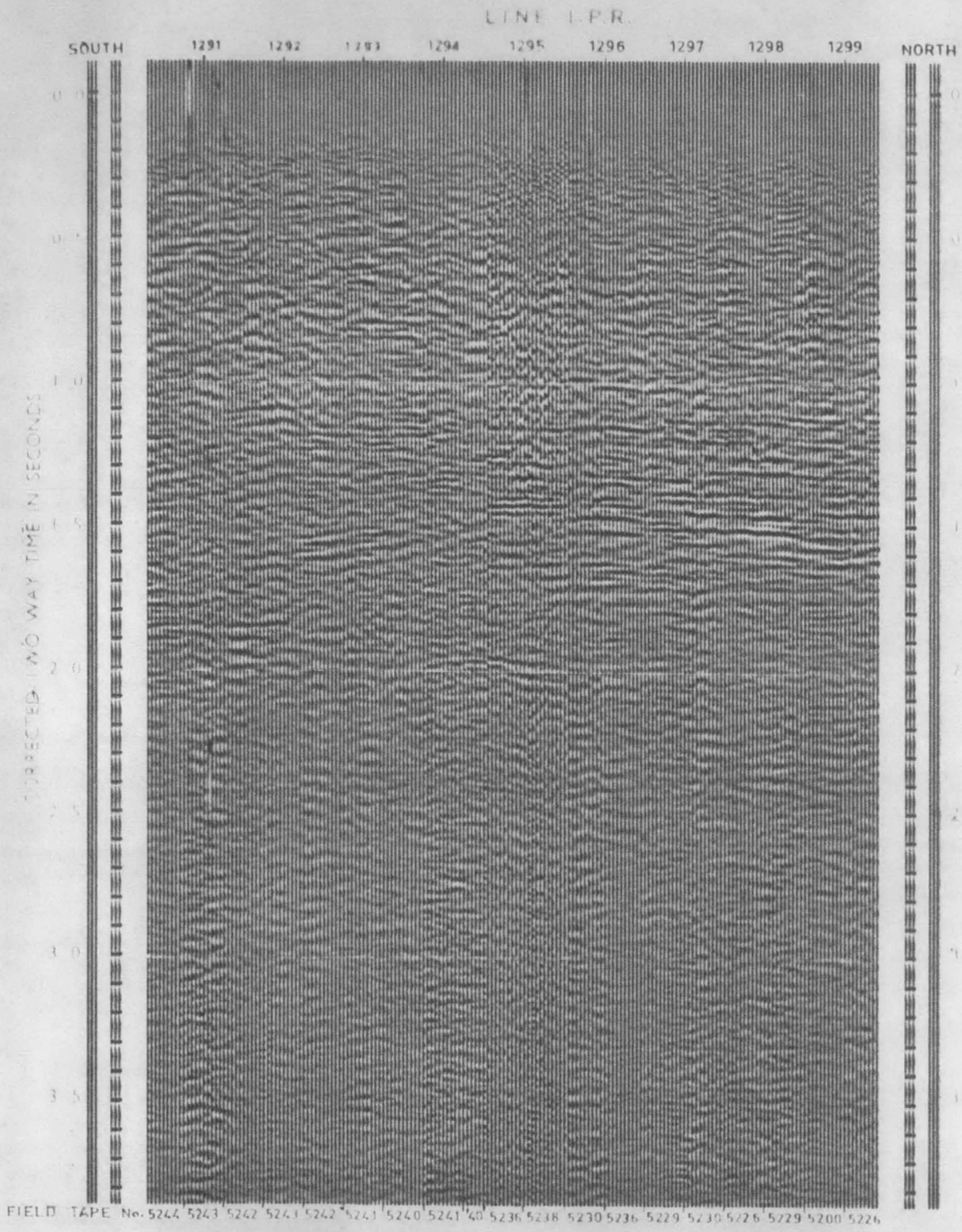
400' IN LINE

GEOPHONE PATTERN:

400' X 180' RECTANGLE OF 400 GEOPHONES

PARTY 243	DATE AUGUST - 1964
ENCLOSURE No 9	REPORT P.R. 7

S.S.L. 94A. ®A TRADE MARK CONTINENTAL OIL CO



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VARIABLE AREA CROSS SECTION
VIBROSEIS®
FOR BUREAU OF MINERAL RESOURCES

INTERDUNAL POOR REFLECTION

LINE I.P.R. S.P.'S 1291 – 1299

VELOCITY DISTRIBUTION	BEACHPORT No.1
WEATHERING VELOCITY (V_w)	–
HORIZONTAL VELOCITY (V_h)	–
ELEVATION VELOCITY (V_e)	7000 F/SEC.
WEATHERING METHOD	–
HORIZONTAL SCALE 1" : 2400'	DATUM M.S.L.
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	726' – 1254' & 1386' – 2574'
No. AND TYPE OF VIBRATORS	3
SWEEP FREQUENCY 14 – 57	No. OF SWEEPS 10
PLAYBACK FILTER	14 – 60
MIXING	3/2 COMPOSITED

VIBRATOR PATTERN:

400' IN LINE

GEOPHONE PATTERN:

400' X 180' RECTANGLE OF 400 GEOPHONES

PARTY 243	DATE 26-8-1964
ENCLOSURE No.2	PROGRESS REPORT 8

SL 94A. ®A TRADE MARK CONTINENTAL OIL CO.

PLATE 8.

P.E.L. 88 (PLANET).

PLATE 15

151° 00'

33° 00'

Experimental Traverse 8 U

MAITLAND

East Maitland No.1. (Dunsyth)

CESSNOCK

NEWCASTLE

SINGLETON AREA

& LOCHINVAR AREAS

KULNURA, MORISSET

PUTTY

OCEAN

SOUTH PACIFIC

LAKE MACQUARIE

SWANSEA

TUGGERAH LAKE

WYONG

KULNURA AREA

Experimental Traverse HS2

Kulnura Bore 6293'

Experimental Traverse HS1

Experimental Traverses

HS3 HS4

GRASSY HILLS AREA

P.E.L. 10.

P.E.L. 13

Existing traverses Locations approximate

Experimental Traverses

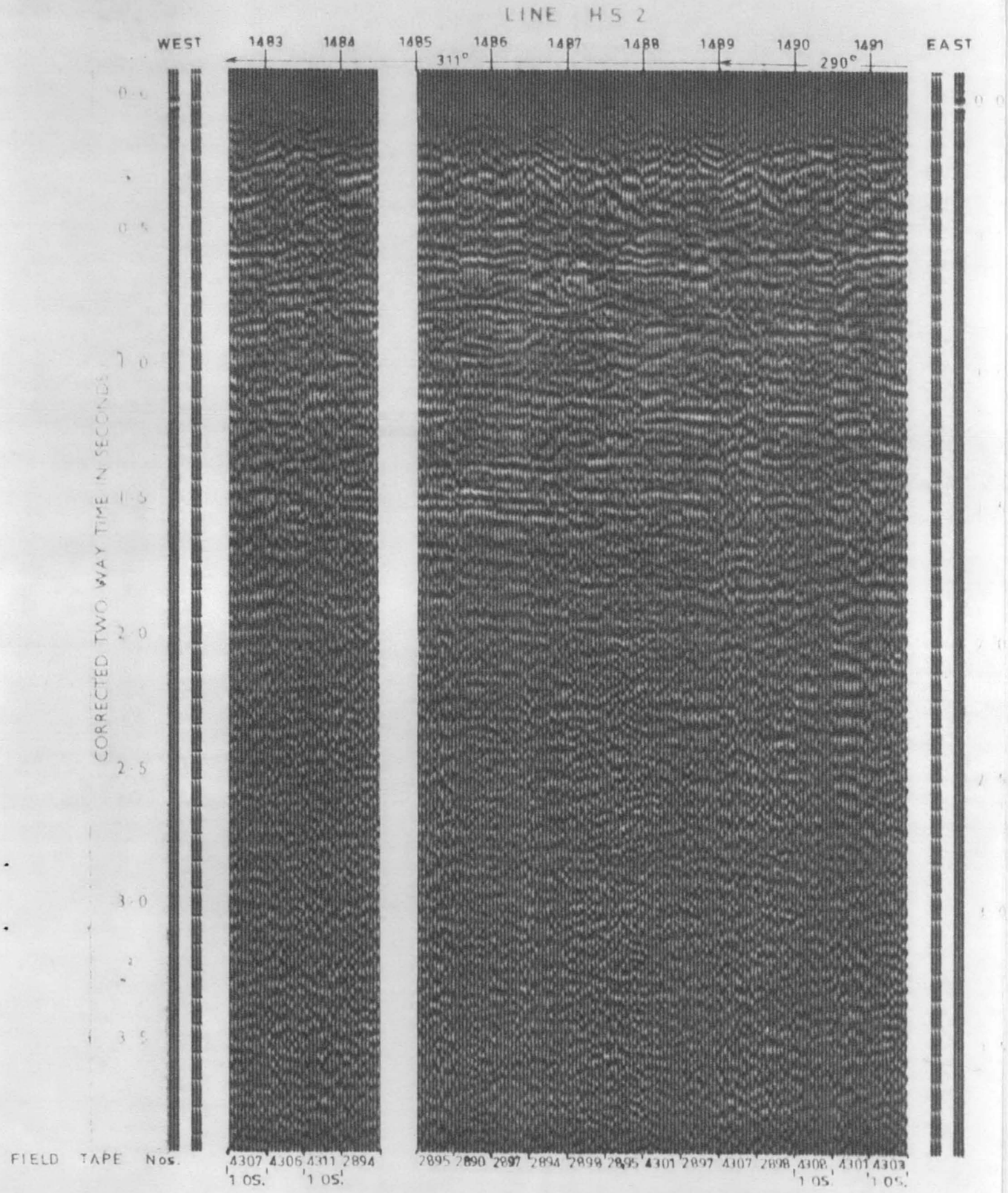
SCALE: 1 INCH = 2 MILES

4 2 0 4

SYDNEY BASIN N.S.W

VIBROSEIS EXPERIMENTAL TRAVERSES

G438-9



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VARIABLE AREA CROSS SECTION
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HAWKESBURY SANDSTONE 2

LINE H S 2 S.P.'S 1483 - 1491

VELOCITY DISTRIBUTION	Vi=12000+ 6 z
WEATHERING VELOCITY (Vw)	3000 F/SEC
HORIZONTAL VELOCITY (Vh)	-
ELEVATION VELOCITY (V_e)	10000 F/SEC
WEATHERING METHOD	-
HORIZONTAL SCALE 1" 2400'	DATUM M.S.L.+800'
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	2706' - 3894'
No. AND TYPE OF VIBRATORS	2 & 3
SWEEP FREQUENCY 10-40	No OF SWEEPS 10:20
PLAYBACK FILTER	OUT-42
MIXING	-

VIBRATOR PATTERN:

1000' IN LINE

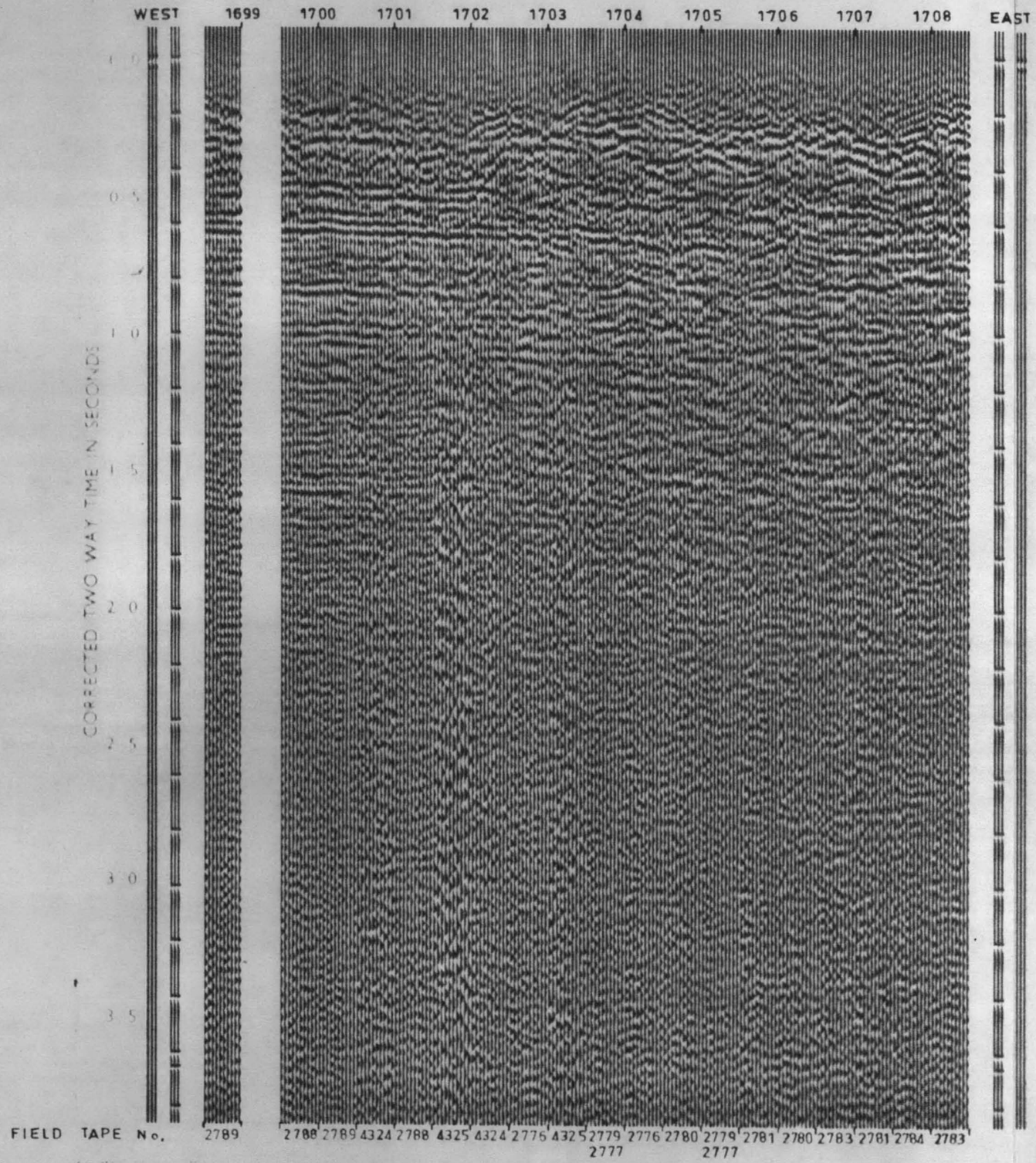
GEOPHONE PATTERN:

1000'X200' RECTANGLE OF 360 GEOPHONES

PARTY 243	DATE 23-9-1964
ENCLOSURE 3	REPORT P.R. 10

SSL 943A. ®A TRADE MARK CONTINENTAL OIL CO.

LINE H.S. 4



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VARIABLE AREA CROSS SECTION
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HAWKESBURY SANDSTONE 4

LINE H.S. 4 S.P.'S 1699 - 1708

VELOCITY DISTRIBUTION	Vi = 12000 - 6z
WEATHERING VELOCITY (Vw)	3000 F/SEC.
HORIZONTAL VELOCITY (V_h)	-
ELEVATION VELOCITY (V_e)	10000 F/SEC.
WEATHERING METHOD	-
HORIZONTAL SCALE 1" : 2400'	DATUM M.S.L.+1000
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	1386' - 2574'
No. AND TYPE OF VIBRATORS	2 & 3
SWEEP FREQUENCY 10 - 40	No. OF SWEEPS 10-20
PLAYBACK FILTER	OUT - 42
MIXING	-

VIBRATOR PATTERN:

600' IN LINE

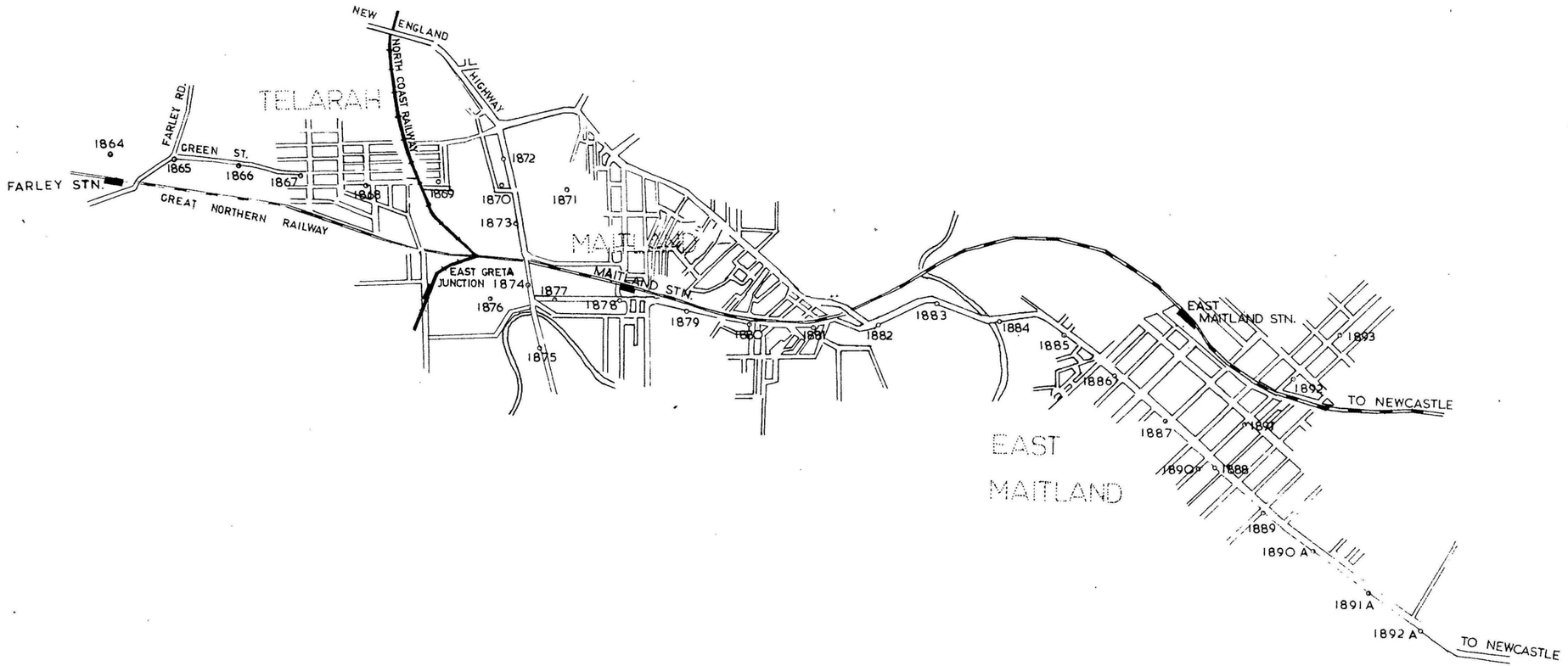
GEOPHONE PATTERN:

600' X 200' RECTANGLE OF 360 GEOPHONES

PARTY 243	DATE 29-9-
ENCLOSURE 2	REPORT P.R. 10

SSL 94A. ®A TRADE MARK CONTINENTAL OIL CO

PLATE 10



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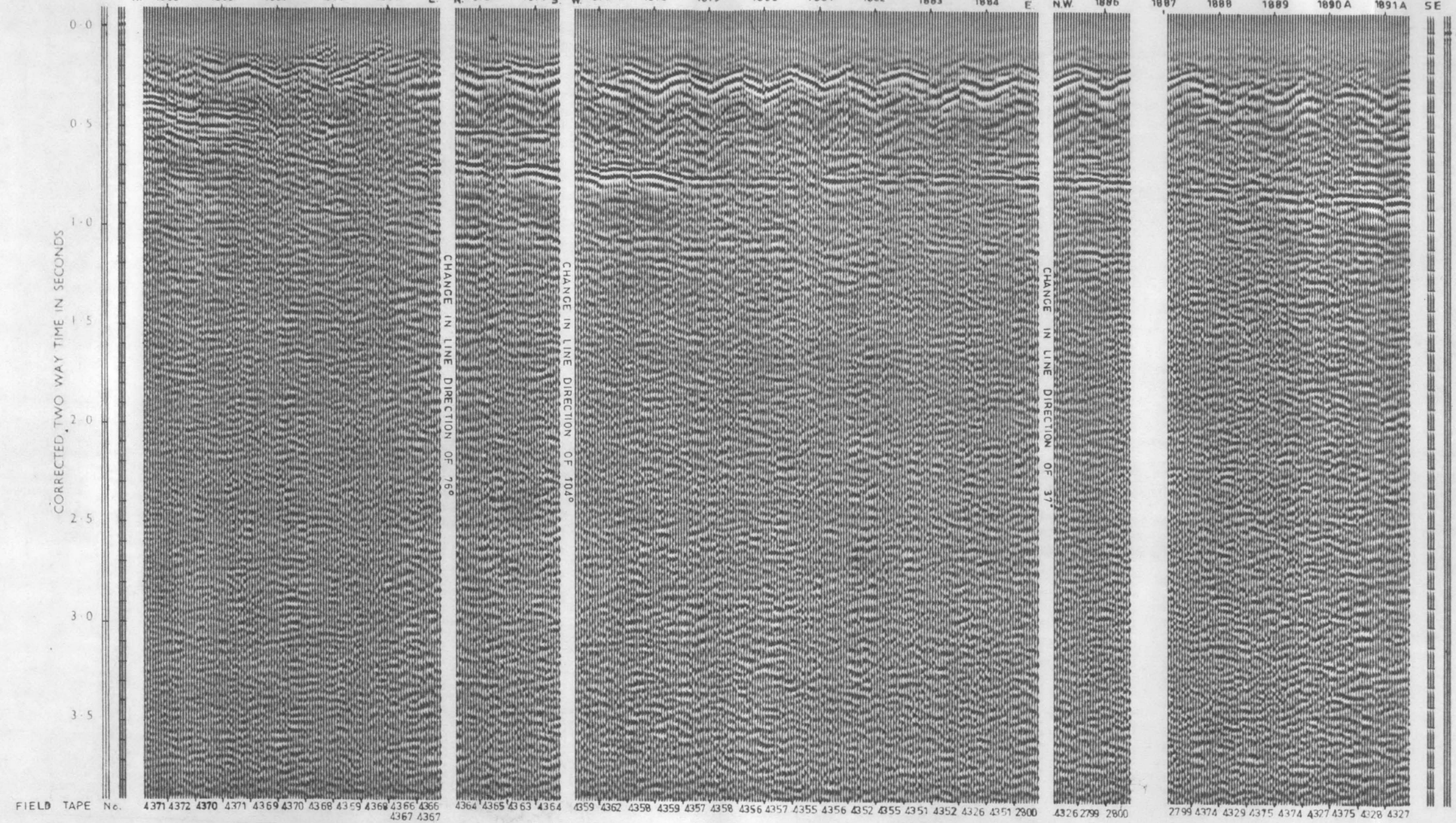
FOR BUREAU OF MINERAL RESOURCES

MAP SHOWING
SEISMIC LINE
LOCATION IN BUILT-UP AREA

LOCATION	MAITLAND
SCALE	25 INCHES TO 1 MILE
PARTY CHIEF	T. L. KENDALL
PARTY 243	DATE SEPTEMBER - 1964
ENCLOSURE No. 8	PROGRES REPORT 10

LINE B U



SEISMOGRAPH SERVICE LIMITED
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VARIABLE AREA CROSS-SECTION
VIBROSEIS®
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BUILT-UP AREA

LINE B.U. SP'S. 1865 - 1891A	
VELOCITY DISTRIBUTION	$V_i = 12000 + 6z$
WEATHERING VELOCITY (V_w)	-
HORIZONTAL VELOCITY (V_h)	-
ELEVATION VELOCITY (V_e)	10000 F/SEC.
WEATHERING METHOD	-
HORIZONTAL SCALE 1" : 2400'	DATUM M.S.L.
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	1386'-2574' & 2706'-3894'
No. AND TYPE OF VIBRATORS	3
SWEEP FREQUENCY 14-40	No. OF SWEEPS 10
PLAYBACK FILTER	OUT - 42
MIXING	3/2 COMPOSITED

VIBRATOR PATTERN:

1888W – 1891A W 396' IN LINE
1865W – 1877E 132' IN LINE

GEOPHONE PATTERN:

RECTANGULAR

PARTY 243	DATE SEPTEMBER-64
ENCLOSURE No. 7	PR. REPORT 10

SSL 94A. ®A TRADE MARK CONTINENTAL OIL CO.

2. PLAYBACK CENTRE

The S.I.E. Geodata MS42 playback centre equipment was delivered to the Bureau in February 1964. Since the equipment was installed considerable time has been spent in testing its functions and in personnel becoming acquainted with operating procedures.

Standard corrected playback sections have been made in either variable area or variable density form for surveys as follows:

Thargomindah 1963
Byro 1963
Bullsbrook 1964
Canary 1964 (Two fold stacked section in addition to standard section)

Full scale or reduced sections are available for the above. Transfer tapes have been prepared for much of the above work in preparation for further experimental compositing.

In addition to the above work, sections will be prepared during 1964 for the following surveys:

Carnarvon Basin 1964 - 12 fold stacked and standard sections.
Giles Carnegie 1962 - standard mixed section.
Bullsbrook 1964 - standard mixed section.
S.E. Georgina Basin 1964 - 12 fold stacked sections.

3. AEROMAGNETIC SURVEYS (VH-MIN)

Georgina Basin 1964

The aeromagnetic survey of the Georgina Basin, which commenced in 1963 was completed in 1964. The object was to determine the thickness of the Lower Palaeozoic sedimentary sequence.

The Mt. Drummond, Lawn Hill, Ranken, Camooweal, Frew River, Avon Downs, Huckitta, Mt. Whelan, and part of the Wallhallow and Alroy 1:250,000 areas were surveyed along east-west flight lines spaced at intervals of two miles. The northern half of Illogwa Creek and Hay River 1:250,000 areas were also surveyed at a flight line interval of four miles to establish continuity with the Simpson Desert survey flown in 1962.

In the southern part of the basin (plate 20) the major structures delineated by the survey are the Dulcie syncline within the Huckitta 1:250,000 area and the Toko syncline which diagonally crosses the Mt. Whelan 1:250,000 area. Depths to magnetic basement of over 8000 ft. are estimated along the axis of the Dulcie syncline. Depths of 16,000 to possibly 20,000 ft. within the Toko syncline are in agreement with seismic results. A magnetically disturbed region south west of the Toko syncline is considered to be associated with a granite body intruded by basic rocks.

In the northern half of the basin, magnetic basement is above sea level over all of the Wallhallow 1:250,000 area. Deep magnetic basement extends west from the northerly trending Mt. Isa Structural High, on the eastern boundary of the survey area to a basement scarp which trends south east through the centre of Ranken and Avon Downs 1:250,000 areas. This implies a large thickness of overlying sediments.

The major part of the sedimentary sequence is believed to be Proterozoic because rocks of this age outcrop extensively in the northern part of this deep region. Bore hole information supports the interpretation that the Palaeozoic sequence in this part of the basin is relatively thin.

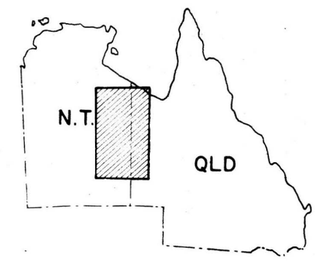
West of basement scarp which crosses Ranken and Avon Downs, magnetic basement is generally less than 2000 ft. below sea level. The magnetic pattern suggests that it consists of Lower Proterozoic metamorphic rocks.

PLATE 20

AEROMAGNETIC SURVEY, GEORGINA BASIN, NT-QLD, 1963-64

MAGNETIC BASEMENT CONTOURS

LOCATION DIAGRAM



LEGEND

Probable fault

Boundary of 1963 surveys

MILES 10 0 10 20 30 40 50 MILES

KILOMETRES 10 0 10 20 30 40 50 60 70 KILOMETRES

(CONTOUR VALUES IN FEET BELOW SEA LEVEL)

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics F 53/B1-37

4. GRAVITY SURVEYS

Southern Queensland

The 1964 helicopter contract gravity survey is still in progress. Preliminary results on the following 1:250,000 sheets have been completed; Barrolka, Jundah, Windorah, Eromanga, Blackall, Adavale, Quilpie, Tambo, Augathella, Charleville, Springsure, Eddystone, Mitchell, Baralaba, Taroom, Roma, Surat, Monto, Mundubbera, Chinchilla, Dalby, Bundaberg, Maryborough, Gympie, Ipswich, Wide Bay, and Brisbane.

A network of road traverses was first surveyed by the contractor which incorporated Department of the Interior bench marks and previous B.M.R. regional gravity stations. This survey has been tied to B.M.R. primary stations, and B.M.R. secondary stations established in 1964 by the regional gravity group. This network served as a basis for the helicopter survey.

All previous reliable gravity stations established in the area will be integrated with the present survey. Seven private company surveys occur in the area, and integration of this work is a major problem due to the variety of base maps, elevation data, gravity data, and densities used in these surveys. Some 15,500 gravity stations are involved in these surveys all of which have to be recomputed.

The following statistics apply to phase 1 of the helicopter survey:-

New readings (helicopter)	3503
New stations (")	2618
New stations (ground control)	1157
Photo-identifications (previous ground control)	434

In phase 2 of the survey, at present in progress, all apparent misreadings will be checked, some readings will be taken at selected boreholes, and the survey will be extended to cover three more 1:250,000 sheets viz., Toompine, Wyandra, and Bulloo. It is anticipated that final maps will be available in late January 1965.

The accompanying gravity map of Queensland (Plate 21) includes the preliminary results of the current survey which indicate several major gravity units in Queensland.

In the 1964 survey area the correlation between gravity and structural geology is generally good.

The Nebine Gravity Ridge separates the Thomson Regional Gravity Low in the west from the Surat Regional Gravity Low in the east. This ridge corresponds to the geologist's concept of a basement ridge separating the Eromanga and Surat Basins. It is a continuation of the Anakie Gravity High and mapping on Wyandra should show its relation to the Eulo Shelf.

The Thomson Regional Gravity Low is an extensive feature containing three north-east trending gravity depressions separated by similarly trending gravity ridges. All three depressions probably correlate with low-density pre-Mesozoic sediments and/or thickening Mesozoic section. This relationship is known to exist in the Adavale Basin.

The Surat Regional Gravity Low reflects the geological structure of the Surat Basin. The extent of the granite known in bore holes around Roma is clearly defined by a large negative anomaly. A north-south trending gravity ridge occurs over the Meandarra Trough resulting in reverse correlation in this area between the Bouguer anomalies and the sedimentary thickness.

Southern Queensland (cont'd)

In the Coastal Gravity Complex structural highs correspond to gravity 'highs'. Many gravity 'lows' in this region correspond to granites. A regional increase of gravity over the eastern coast of northern Queensland is consistent with a rise in the Moho of 5 to 6 km from land to ocean (Dooley 1963). This steep gradient has also been mapped around Brisbane.

Gravity Readings along Seismic Traverses

The survey is being conducted, under contract to the B.M.R., by Compagnie Generale de Geophysique along Phillips Petroleum Company seismic traverses in the Adavale-Charleville area.

The objectives of the survey are:-

1. To establish a semi-detailed gravity network within the regional network established during the 1964 helicopter gravity survey.

2. The regional gravity pattern showed good general correlation with the broad configuration of the Adavale Basin, as delineated by the seismic results. The semi-detailed gravity survey is planned to give more detail and to investigate the correlation between Bouguer anomaly and the smaller structures within the Adavale Basin.

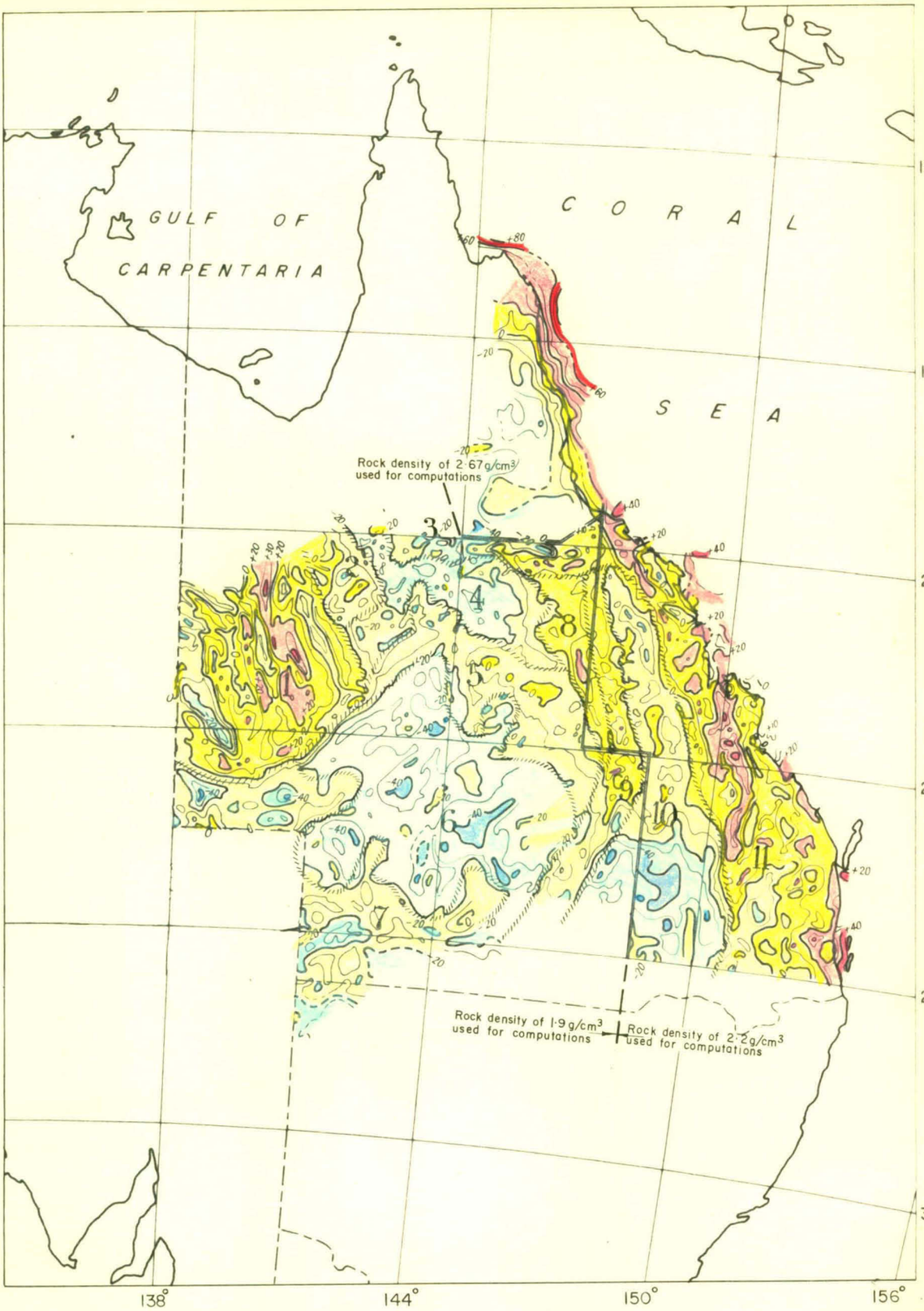
3. There is good depth control throughout the area (from seismic and bore hole information) and it is intended to carry out a detailed interpretation.

4. On the basis of this interpretation it may be possible to assess the further use of gravity surveys in other parts of the basin as a relatively rapid and inexpensive means of outlining structures warranting further investigation.

The survey commenced on 17th August, 1964, and by the 13th September, 1964, 327 1 mile stations and 72 1/3 mile stations had been read.

It is expected that the survey will be completed by the middle of December, 1964.

PLATE 21



1. Cloncurry Regional Gravity High
2. Julia Creek Gravity Shelf
3. Charters Towers Gravity Plateau
4. Flinders Regional Gravity Low
5. Muttaburra Gravity Ridge
6. Thomson Regional Gravity Low
7. Eulo Gravity Platform
8. Drummond Gravity Shelf
9. Anakie - Nebine Gravity Ridge
10. Bowen - Surat Regional Gravity Low
11. Coastal Gravity Complex

Gravity Feature Boundary

QUEENSLAND

BOUGUER ANOMALIES

100 0 100 200 300 400 500 MILES

CONTOUR INTERVAL 10 MILLIGALS

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS Q/B2-1-1

(BASED ON A/BO-1)

5. WELL LOGGING

In June and July the Widco 10,000 ft. winch with the Failing logmaster recorder were used for the gamma ray logging of existing water bores in the Queensland section of the Great Artesian Basin. The twenty bores logged are in the Julia Creek, Richmond area. The principal marker bed, the Toolebuc Member, shows out clearly on most of the logs.

The work was interrupted at the end of July when a gamma ray probe was lost in a bore and the winch was damaged while trying to free the probe. The winch was repaired but another persistent fault in the hydraulic drive to the winch had not been rectified by October.

The 2000 ft. Widco logger is to be loaned to Alliance Oil Development late in October for use in Eastern N.S.W.

The C.V.L. equipment and Birdwell winch were field tested in March in a water bore drilled by the Victorian Mines Department. The results were not satisfactory because noise interfered with the pulses being measured. Further laboratory testing was delayed for about four months while other logging equipment was prepared for field work.

A high temperature gamma ray probe has recently been delivered and is being tested in the laboratory before being sent to Queensland for the water bore logging programme.

A Record on the 1962 gamma ray logging programme and another describing the logging of BMR.11 in the Georgina Basin were completed.

METALS SEARCH

1. GROUND METALLIFEROUS SURVEYS

Dobbyn, Q'land. (Copper), (Plate 22)

The survey using E.M. & I.P. methods was continued during 1964. An area of about 25,000 feet in length has now been covered, with traverses about 500 feet apart. Several E.M. anomalies were observed, but most of them were not confirmed by the I.P. method. However, one anomaly obtained by both methods persists for practically the full length of the layout, and may represent a mineralised zone of major importance. The layout of traverses and position of anomalies is shown on the attached sketch.

Dobbyn & Mt. Isa, Q'land., Gravity Surveys, (Copper)

Brief gravity surveys were made at Dobbyn and Mt. Isa. The purpose of the surveys was to obtain extra information necessary to complete interpretation of earlier gravity surveys in these areas. The results will be incorporated in the reports on the earlier surveys.

Herberton, Q'land. (Tin)

A geophysical survey using E.M., S.P., and I.P. methods was commenced at Herberton, and is still proceeding. The purpose of the survey is to extend the area covered by the survey previously made by A.G.G.S.N.A. around the United North Australian mine and to provide targets for a drilling campaign to test the economic possibilities of the Herberton district. The work so far done has confirmed the anomalies obtained on the previous survey, but results suggest that these anomalies are due to flatly dipping conductors. Other anomalies have been obtained in areas not previously surveyed, but their significance cannot be assessed as yet.

Queenstown, Tas. (Copper)

Surveys using E.M., I.P., and S.P. methods were made over two areas near Queenstown. One was an area of about 3000 feet by 1200 feet at Gormanstown, adjacent to the Blow open cut. Weak anomalies were obtained, but it is not considered that they are due to sulphide bodies. No testing was recommended.

The other area is at Comstock, a little to the east of the area already surveyed in 1957. The area was much more difficult than had been supposed, and observations were possible over two traverses only. An E.M. and I.P. anomaly of only moderate strength was observed. It is proposed to extend the survey to cover an area of about 6000 feet by 5000 feet during 1965.

Oonah, Tas. (Copper and Tin)

A brief survey using E.M., I.P., and S.P. methods was made at the Oonah mine, near Zeehan. The purpose of the survey was to fill in the gap between layouts of the survey made in 1963. It was impossible to complete the programme envisaged, as the central part of the area was covered by a lease taken up by other mining interests. The work was confined to extending the traverses of the previous survey as far as possible. The anomalies discovered by the previous survey were confirmed, and in some cases extended, but no new anomalies were discovered.

Derby, Tas. (Tin)

A gravity survey was made over an area about 3 miles by 2 miles surrounding Derby to test if the gravity method could be used to follow the course of the Cascade lead. This lead, which was extremely rich, was mined by the Briseis Co., until it entered under a thick cover of basalt. It was hoped that the gravity method could trace the course of the lead under the basalt cover.

Derby, Tas. (Tin)(cont'd)

The results have not yet been completely interpreted, but appear to be inconclusive, as the country is too rough for gravity work. Terrain corrections must be applied, which are often several times as great as the anomaly to be expected from the lead. The amount of surveying necessary to apply these corrections to sufficient accuracy over the whole area would be prohibitive.

Beaconsfield, Tas. (Gold)

A gravity survey was made over the Beaconsfield goldfield, at the request of the Tasmanian Department of Mines, to discover if the gravity method could be used to follow the course of the alluvial lead, which was mined in the early days. Seven traverses were surveyed. Near the old workings, the survey results agree closely with the geological section as known from mining operations. Other traverses located to cross possible extensions of the course of the lead did not give definite indications.

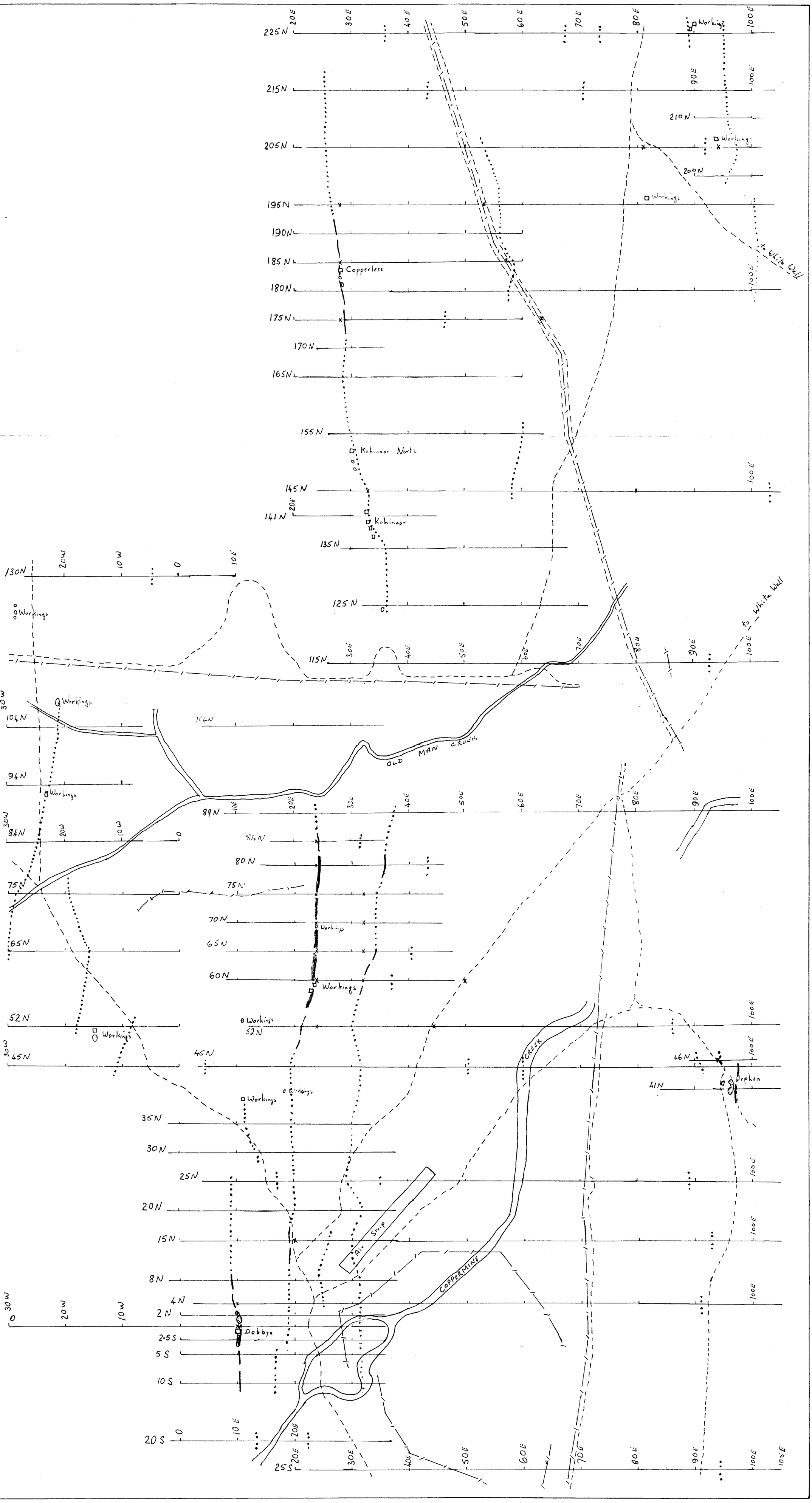
Pilbara, W.A. (Manganese)

A test survey was made by the W.A. Mines Department at the request of the Bureau, to see if geophysical methods could be of any assistance in prospecting manganese deposits in the Pilbara area. It was considered that the only possibility was the use of the gravity method, to distinguish between small outcropping deposits, and deposits containing significant tonnages. A gravity meter was made available by the Bureau for the tests.

Preliminary reports indicate that the test was successful, in that a well defined gravity anomaly was obtained over an outcropping deposit containing about 100,000 tons of ore.

Rum Jungle, N.T. (Copper and Uranium) (Plate 23)

Reconnaissance E.M. Surveys were made over two areas near Rum Jungle, one known as the Rum Jungle Triangle area, to the west of the areas previously surveyed west of the areas of known mineralisation, and the other, known as the Rum Jungle East area, to the east of the Rum Jungle granite. The areas are shown on the sketch map attached. In the Rum Jungle Triangle area, the survey area can be divided into two zones, one containing no anomalies, and the other containing weak E.M. anomalies, generally best defined in the imaginary component. The only anomalies indicating good conductors occurred towards the northern end, and are extensions of anomalies already detected in previous surveys. They persist for lengths of about ½ mile. In the Rum Jungle East area, the northern part shows practically no anomalies. Proceeding south, a zone of anomalies gradually appears (shown as Zone C on the sketch). The anomalies are weak at first, but increase in strength going south, reaching extraordinary strength near the Batchelor Road junction. Detailed Turam surveys have been made over selected areas (shown on the sketch) and further detailed surveys will be made before the end of the season.


Workings
Copperless
Kohinoor North
Kohinoor
White Well
OLD MAN CREEK
Air Strip
COPPERMINE CREEK
Dobbyn
Orphan
DOBBYN AREA, Q
PLAN OF GRID
3000W TO 10,500E
SHOWING I.P. ANOMALIES
5°50'
TN
M.N.
FEET
1000 0 1000 2000
LEGEND
creek
road or track
fence
shaft
open cut
workings
steel peg in concrete
traverse done with I.P.
I.P. anomaly:
weak
medium
strong

2. AIRBORNE METALLIFEROUS SURVEYS

Menzies, Leonora, W.A. (VH-MIN)

The original programme consisted of an airborne magnetic and radiometric survey at 1-mile line spacing of the Menzies, Leonora and Edjudina 1:250,000 areas. The survey commenced early in October and is still in progress. It is unlikely that the time now available will allow surveying of more than two of these areas viz. Menzies and Leonora.

The survey was requested by the West Australian Mines Department. The object of the survey is to provide data to assist regional mapping. It is expected that the magnetic data will broadly delineate the greenstone and acidic type Precambrian rocks, indicate magnetic lineations within the greenstone areas and generally give information on regional folding. The results will be used as a basis for planning the detailed aeromagnetic survey in the region of Menzies and Leonora townships, requested by Western Mining Corporation and proposed for inclusion in the 1965 Cessna programme.

The preliminary results of the survey show that the intense magnetic anomalies previously recorded in the north of the Kalgoorlie sheet extend into the Menzies sheet. Well defined magnetic trends are shown. The anomaly forms are predominantly symmetrical indicative of sources with near-vertical dip. The towed bird scintillometer has detected about twenty point source radiometric anomalies some of which appear to be caused by salt pans.

The VH-MIN party will continue field operations in the region until early December.

Renison Bell, Tasmania (VH-GEO) (Plate 24)

The survey originated from a request by Renison Associated Tin Mines for a geophysical investigation to

(a) look for a faulted continuation to the south of the Federal orebody, and

(b) elucidate the structure and trace the lode occurrences of the Dalcoath workings.

A ground party was not available for this work and a detailed aeromagnetic survey with Cessna aircraft was programmed as a substitute. The airborne survey was planned to cover a much larger area than that of the Company's localised problems. The original aim was to survey a total area of about 30 square miles around Renison Bell, but owing to the late start only a few flying days were available and the survey was limited to the Renison Bell area extended to the east and north-east and to part of the Cuni district. A small amount of ground magnetic surveying was carried out concurrently.

In the Renison Bell tinfield cassiterite is found in massive sulphide orebodies containing a high percentage of pyrrhotite and previous geophysical work had shown that the lodes are well suited to investigation by the magnetic method.

The results of the airborne survey in the form of magnetic contours are shown in the accompanying map (Plate 24). Numbers on the map refer to the magnetic features discussed below. The largest anomalies (1) are associated with a known pyroxenite sill outcropping mainly to the east of the Ring River. North of the sill and separated from it by a magnetic low is a large double anomaly (2), which may be due to a second

ultrabasic sill. The possibility that it is due to pyrrhotite mineralisation cannot be excluded and further investigation of the anomaly by geological and geophysical work or by a test drill hole seems warranted.

No extension of the Federal lode to the south was detected. A magnetic high (3) north and east of the Battery Mine could be accounted for by the Battery orebody but is stronger than expected from a sill type lode. It may indicate an additional fissure lode parallel to the Federal lode or that this lode has been thrown west by cross faulting.

A large anomaly (4) was detected north-west of the Federal lode, just north of the area covered by earlier ground surveys and roughly coinciding with Dreadnought Hill. To check on the possibility that the anomaly arises from a known basalt dyke, the aeromagnetic work was followed up by ground magnetic traverses. Over the area of basalt outcrop these showed intense negative anomalies, rapid changes from negative to positive values and on the northern traverses evidence of a magnetic source with limited depth extent. These anomalies were superimposed on a broad anomaly from a deeper source, apparently the anomaly shown by the airborne results. It is considered likely therefore that the aeromagnetic anomaly at Dreadnought Hill is due mainly to pyrrhotite mineralisation and the possibility of a repetition of the Federal orebody is suggested. The ground work was not sufficient to provide drilling targets but it is expected that the area of the Dreadnought anomaly will be drilled systematically as part of the normal development of the Federal lode.

East of the Dalcoath workings an anomaly (5) was detected striking a few degrees north of east indicating a steeply dipping body. The anomaly is thought to be due to pyrrhotite mineralisation but this should be confirmed by geological work and other geophysical methods before further magnetic surveying is undertaken. In the Dalcoath area flying was restricted by difficult terrain and unsatisfactory aerial photography and the workings were only just included in the aeromagnetic survey. A broad ill-defined anomaly striking approximately north was recorded just east of the workings but in general little useful information was obtained in the area from the airborne survey. Some ground magnetic traverses were read in the Dalcoath area. These resulted in very disturbed profiles due apparently to large boulders of pyrrhotite. No clear magnetic pattern emerged. Further ground magnetic surveying to the north and self-potential coverage of the whole grid seem desirable.

Comparison of the aeromagnetic results with those of the Bureau's ground surveys done between 1950 and 1952 in the area between the Battery Mine and Renison Bell township, showed that the main magnetic features have been detected from the air but some of the minor detail has been lost. The numerous ground magnetic anomalies over the Blow Lode are not resolved by the airborne survey and appear as a single large anomaly (6), the magnitude of which suggests that the mineralisation is more extensive than estimated at present.

Small high grade copper-nickel deposits have been mined in the Cuni district. Previous investigations have shown that magnetic segregations carrying nickel occur in the pyroxenite sill east of Cuni. The aim of the aeromagnetic survey was to attempt to detect such magnetite bodies. Only one survey flight was made in the Cuni areas. Owing to extensive turbulence, the coverage was limited and the results inconclusive. However further detailed aeromagnetic work would probably be justified.

Ground magnetic work was also carried out on five traverses east of the Federal open cut but no anomalies of interest were detected.

In general the airborne survey showed that useful detailed aeromagnetic data can be obtained over rugged terrain of the type at Renison Bell. However, there are definite limitations to flying over the most rugged type of terrain and flying in this region should be confined to the summer months.

Kalgoorlie WA (VH-GEO) (Plate 25)

The survey was made at the request of New Consolidated Gold Fields Pty Ltd. The area programmed for survey covered 48 square miles and lay immediately north-north-west of the Golden Mile. This area was extended to the east and south during the course of the survey. The Company held Temporary Reserves over much of this area and were carrying out auger drilling for geological and geochemical investigations, concurrently with the aeromagnetic survey. The purpose of the survey was to aid the geological mapping of an area which was largely covered by soil.

The magnetic data clearly show the positions of the sub-alluvial geological contacts between beds of contrasting magnetic susceptibility. The geological identification of these beds has been suggested (Plate 25). Possibly the most important result of the survey is that it appears to have delineated the beds of Younger Greenstone, which are the beds that contain the major gold deposits of the Golden Mile.

No mineralisation was detected by the survey, but the possibility of a drag gold in the structure of Zone 3 warrants further investigation as such a structure might be very favourable for mineralisation.

Based on the results of the 1964 survey, further work could profitably be programmed for the area immediately north and north-west of the 1964 survey area and contained by Arrow Lake, Paddington and Broad Arrow townships, Mount Ellis, Lady Bountiful mine and Black Flag homestead. Paddington, Broad Arrow and Lady Bountiful are the sites of former gold fields while just south of Mount Ellis there is a minor copper deposit which has been worked from Credo mine.

Norseman W.A. (VH-GEO) (Plate 26)

During the first half of August, an area of 18 square miles was surveyed, 9 miles to the north-north-east of Norseman. The purpose of this survey was to assist geological mapping of the area being undertaken by New Consolidated Gold Fields Pty Ltd. The company held Temporary Reserves over nearly all the surveyed area and were carrying out a programme of auger drilling to assist geological mapping and to provide samples for a geochemical investigation.

The original request was for aeromagnetic surveying over an area of 40 square miles but this had to be reduced to surveying over the area of Temporary Reserves due to equipment problems causing a loss of available survey time.

The magnetic data from the survey was presented as a contour map of the intensity of the total maguetic field (see Plate 26) but detailed interpretation of the results has not been completed.

Two main features are evident from a preliminary inspection of the contour map :-

(1) A zone of high magnetic field intensities in the south-west corner of the survey area, which corresponds to the known outcrop of part of the norite dyke, a prominent feature traversing the Norseman field with strike slightly north of east.

(2) Another zone of high intensity, which occurs along the southern boundary of the survey area and corresponds to known outcrop of banded iron formation. This appears to be a continuation of the bed of banded iron formation, which occurs to the east of the township.

Comparison of the Cessna with the DC3 results show that the two contour maps are basically the same and the Cessna survey may not have given much more information than was previously available. In order to complete the interpretation a detailed examination of the Cessna magnetometer records is being made in conjunction with a study of the DC3 profiles over adjacent areas.

Tennant Creek, N.T. (VH-GEO) (Plate 27)

The survey was made in conjunction with geological and geochemical work, to assist in the location of bodies of economic mineralisation, either by direct detection or indirectly by providing new information on the geological structure. The survey was carried out during September, 1964, and covered three separate areas, Aeromagnetic Ridge, Northern Star and Gigantic. The resulting magnetic contours on the Aeromagnetic Ridge area are shown in accompanying plan.

The 'aeromagnetic ridge', an east-west elongated magnetic high to the east of the Tennant Creek township, appears as a more pronounced feature in the Cessna results than in the earlier DC3 work. It is terminated abruptly at the eastern end by a strong north-easterly lineation (shown more clearly on the DC3 map) running close to Nobles Nob and Golden Forty, the magnetic pattern east of the lineation having apparently been shifted south about one mile. A smaller shift of the magnetic pattern in a similar sense is associated with the Peko shear. There is little or no geological evidence of lateral movement in the Warramunga sediments along the Golden Forty lineation but there is a definite quartz filled zone. This suggests that the movement is mainly a basement feature, but that there was some activity in the zone after deposition of the Warramunga sediments.

Although some of the smaller anomalies along the 'ridge' may be due to ironstone bodies, it seems unlikely that they alone could produce such an extensive and continuous feature. The ridge feature is considered to be mainly due to an up-faulted block of pre-Warramunga (? Archaean) rocks similar to the magnetite-rich metamorphic rocks intersected in drill holes in B.M.R. No.3 area to the west-south-west of Tennant Creek. Depths to magnetic sources along the 'ridge' are estimated to range from 1300 ft. to 700 ft below the surface.

North-east of Peko, within and close to the shear zone, there are several small circular anomalies. These are near high copper concentrations detected by the geochemical party and further investigation may be justified. The largest of these anomalies, centred at 20,000E, 2000N (geochemical grid co-ordinates), appears to be due to a body about 500 ft below surface, and as it is close to both the Peko shear and to small geochemical anomalies, would represent a suitable target for a drilling test. A limited amount of ground magnetic work would first be

required to accurately locate the peak of the anomaly. At the eastern end of the 'ridge', two anomalies, one centred about half a mile north-east of the Golden Kangaroo and the other a little less than a mile further north, are thought to indicate ironstone bodies of possible economic importance and further investigation, initially by geochemical methods, appears warranted.

In the south-west of the survey area, the dominant magnetic feature is a broad complex anomaly with two major peaks. The main source is estimated to be less than 400 ft. below the surface and the western source slightly nearer the surface. Comparison with similar anomalies elsewhere in the field suggests that this anomaly is due to porphyry rocks rather than to ironstone bodies.

The Cessna survey in the North Star area showed the North Star anomaly to be more complex than indicated by the DC3 map. The DC3 anomaly was resolved into a main anomaly over the North Star and Northern Star mines and a minor anomaly to the north-east. The results give a more complete picture of the main anomaly than obtained by the A.G.G.S.N.A. ground survey, in which profiles near the peak of the anomaly were too disturbed to allow contouring. The main aeromagnetic anomaly indicates a body at depth of between 300 and 500 ft., dipping fairly steeply to the north.

The anomalies are located on the steepest part of a north-east striking magnetic slope, which possibly indicates a fault contact in the Warramunga sediments or in the underlying basement rocks. The geochemical sampling programme, unfortunately stopped south and east of the peak of the main aeromagnetic anomaly, which is near the Northern Star open cut. The highest copper concentrations were obtained in holes drilled in the ironstone outcrop south-east of the open cut. The eastern end of the main aeromagnetic anomaly, which is a distinct anomaly in the A.G.G.S.N.A. work, has been prospected by diamond drilling which intersected gold ore and copper ore. In view of the previous results in this area, further work on the main aeromagnetic anomaly appears justified. This anomaly has not been tested at depth. Extension of the geochemical survey to include the anomaly would be desirable before attempting to select targets for deep drilling.

The DC3 anomaly near the Gigantic mine was resolved by the Cessna survey into two major anomalies, which are located on a gentle magnetic slope rising to the south-east. Estimated depths of the sources of these anomalies are unusually shallow for the Tennant Creek field, being 100-150 ft below surface. Quartz-hematite-magnetite outcrops in the area and is probably the source of the anomalies. The aeromagnetic contour map shows a slight disturbance of the contour pattern which may be due to the extension of the Peko shear.

The survey showed that the detailed aeromagnetic method is applicable to the Tennant Creek field and that major type anomalies can be detected and delineated. A small amount of ground follow-up work would be necessary in most cases prior to selecting sites for drill holes.

Darwin-Pine Creek N.T. (VH-GLO)

Three areas, Mt. Bundey, Frances Creek and Mt. Harris were selected for detailed surveying with the Cessna aircraft from the results of the 1963 Contract aeromagnetic survey of the Darwin-Pine Creek area. The first two areas were also proposed for detailed survey by the Senior Resident Geologist, Northern Territory.

The aims of the survey are as follows :-

(1) Mt. Bundey - Location of possible extensions to known deposits and possible new deposits. Iron deposits, in the form of magnetite, appear to have been detected by the contract survey.

(2) Frances Creek - Location of iron ore deposits either directly or through the detection of marker beds. Haematite deposits were surveyed in 1961 using a ground magnetometer but the results were inconclusive in determining whether an airborne survey was justified.

(3) Mt. Harris - This area includes most of the Mt. Harris tinfield. The object of the survey here was to provide information to assist the search for tin in the area.

The survey commenced early in October. It is unlikely that all three areas will be surveyed in 1964, and provision is made for completion of the work in the 1965 programme.

MacArthur River Aeromagnetic Survey N.T.

The survey covered part of the Bauhinia Downs 1:250,000 area and was flown under contract by Adastra Hunting Geophysics Pty.Ltd. in October-November, 1963. It formed part of the Special Mineral Survey Programme in the Northern Territory. Analysis of the results of the survey was carried out during 1964, by the Geophysical Branch airborne group.

The magnetic data show sources of magnetic disturbances on a regional and local scale. The outstanding features of the regional magnetic field are intrabasement susceptibility contrasts located at depths between 6000 and 8000 feet below ground level which trend N20°W. These contrasts indicate that the magnetic basement controlled the Tawallah and Emu faults. It also appears that post Lower Proterozoic structure does not make a significant contribution to the regional magnetic anomalies.

A number of isolated magnetic anomalies arising from shallow sources can be correlated with outcrops of either Scrutton Volcanics or rocks of the overlying Tawallah Group. Another series of magnetic anomalies, also produced by shallow sources, are characterised by pronounced elongation and low amplitude. These anomalies rarely show any relationship to mapped geology although on occasion can be correlated with faults. The most probable interpretation for all of these elongated anomalies is mineralisation along fault planes.

The most important result obtained from the survey data is the delineation of magnetic lows in the immediate vicinity of the McArthur River homestead. It is most likely that these lows are associated with small sedimentary basins containing lead-zinc mineralization and therefore indicate specific targets for future exploration.

PLATE 23

RUM JUNGLE AREA, N.T.
LOCALITY MAP
GEOPHYSICAL SURVEYS TO 1964

Scale 0 1 2 MILES

North

131°01' 131°05' 131°10'

12°55'

13°01'

13°05'

To Darwin

NORTH AUSTRALIA RAILWAY

Rum Jungle Granite

Reference to Australia Standard Map Series

DARWIN

DINE CREEK

12° 13° 14°

Kanyaka Siding

Giant's Reef Fault

T.E.P. Embayment Area

Dyson's

White's

White's Extended

Brown's

Rum Jungle Granite

Rum Jungle Creek

Area 55

Rum Jungle Siding

BATCHELOR

Airfield

Coomalie Airfield

STUART HIGHWAY

Zone A

Zone B

Zone C

Zone D

Zone P

Zone Q

Rum Jungle Triangle

Bureau of Mineral Resources, Geology and Geophysics, Darwin, N.T.

Based on Rum Jungle Special Geological Map Scale 1" = 1mile.

Rum Jungle East Area

INSET MAP

Axes of Turam ratio anomalies

Anomalies greater than 1:30

Scale: 1 inch = 2000 ft.

Zone of low Slingram real component values

Axis of Magnetic anomaly

Slingram anomalies associated ? with Giants Reef Fault.

Zone boundaries

Radioactivity greater than 2 X background.

Axes of strong Slingram Real Component anomalies

Geophysical survey areas to 1963.

1964

PLATE 24

145°22'30"

145°30'

41°46'

41°49'30"

41°52'

145°26'

PIEMAN

HUSKISSON RIVER

Success Creek

RING RIVER

Crimson Creek

Tramway

Almora Creek

RIVER

Renison Bell

Isaacson Creek

Dreadnought Hill

ARGENT

Stebbins Hill

Renison Bell Hill

Dolcoath Creek

Colebrook Hill

Exe

Colebrook

Creek

RIVER

Commonwealth Hill

Pine Hill

HENTY RIVER

LITTLE HENTY RIVER

Cuni

Sligo Creek

Serpentine Hill

Creek

Melba

Nevada

Tramway

Black Hill

Creek

DETAILED AEROMAGNETIC SURVEY, 1964
TASMANIA

RENISON BELL AREA

TOTAL MAGNETIC INTENSITY CONTOURS

SCALE

1 0 1 MILES

GEOPHYSICAL LEGEND

2,000
1,000
Aeromagnetic contours with flight line intersections

GEOLOGICAL LEGEND

Basalt dyke

DEVONIAN
Quartz porphyry

CAMBRIAN
Serpentinite and pyroxenite

Gabbro, norite and dolerite

12°10'
TRUE NORTH
MAGNETIC NORTH

CONTOUR INTERVAL

RENISON BELL:- 100 GAMMAS

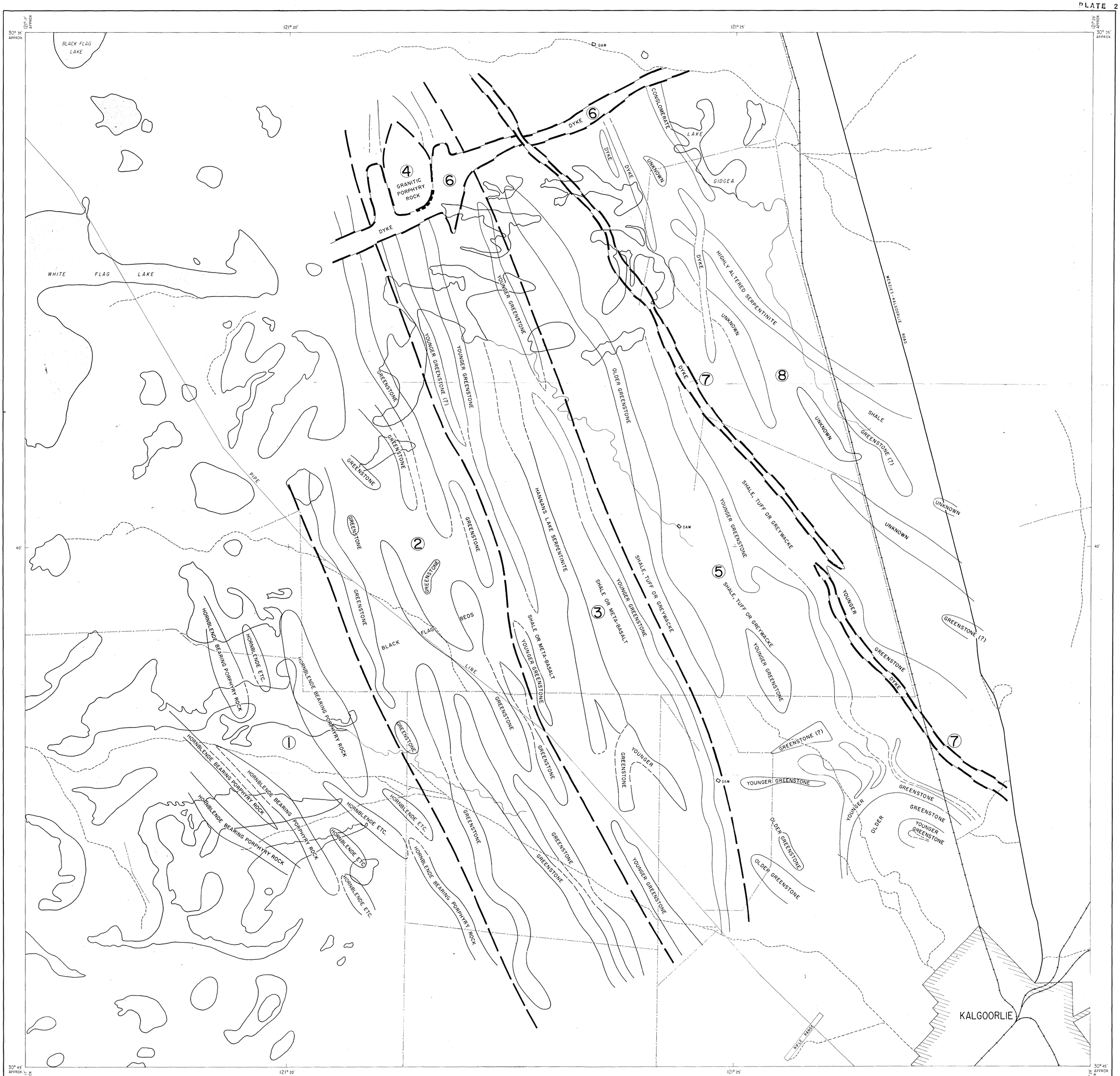
CUNI:- 20 GAMMAS

TOPOGRAPHICAL LEGEND

River or creek
Main road
Road or track
Railway
Hill feature
Open cut

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

K55/BI-19



DETAILED AEROMAGNETIC SURVEY, 1964

KALGOORLIE

WESTERN AUSTRALIA

GEOPHYSICAL INTERPRETATION

MILES 1 0 1 MILES

KILOMETRES 1 0 1 KILOMETRES

9°20'

True North
Mag. North

GEOPHYSICAL LEGEND

- Zone boundary
- ⑥ Zone number
- Boundary of magnetic feature
- Inferred boundary of magnetic feature

TOPOGRAPHICAL LEGEND

- River or creek
- Highway or main road
- Road or track
- Railway
- Fence

NOTE:- This map was compiled by direct plotting from uncontrolled aerial photographs.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H51/BI-31

To Accompany Record No.

PLATE 2

121° 48'
32° 09' 45"
121° 57'
32° 09' 45"

L A K E

C O W A N

PRINCESS ROYAL

CLAYPAN

CLAYPAN

CLAYPAN

CLAYPAN

EYRE HIGHWAY

D U N D A S H I L L S

32° 08' 30"
121° 48'
32° 08' 30"
121° 57'

True North
Mag. North

DETAILED AEROMAGNETIC SURVEY, 1964

NORSEMAN

WESTERN AUSTRALIA

TOTAL MAGNETIC INTENSITY CONTOURS

MILES 1 0 1 MILES

KILOMETRES 1 0 1 KILOMETRES

MAGNETIC CONTOUR INTERVAL 10 GAMMAS

GEOPHYSICAL LEGEND

Magnetic contours

Magnetic "Low"

NOTE :- The magnetic data have not been corrected for the regional magnetic gradient.

TOPOGRAPHICAL LEGEND

- River or creek
- Highway or main road
- Road or track
- Fence
- Hill feature
- Mine
- Dam
- Hut

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. I 51/E1-20

To Accompany Record No

PLATE 3

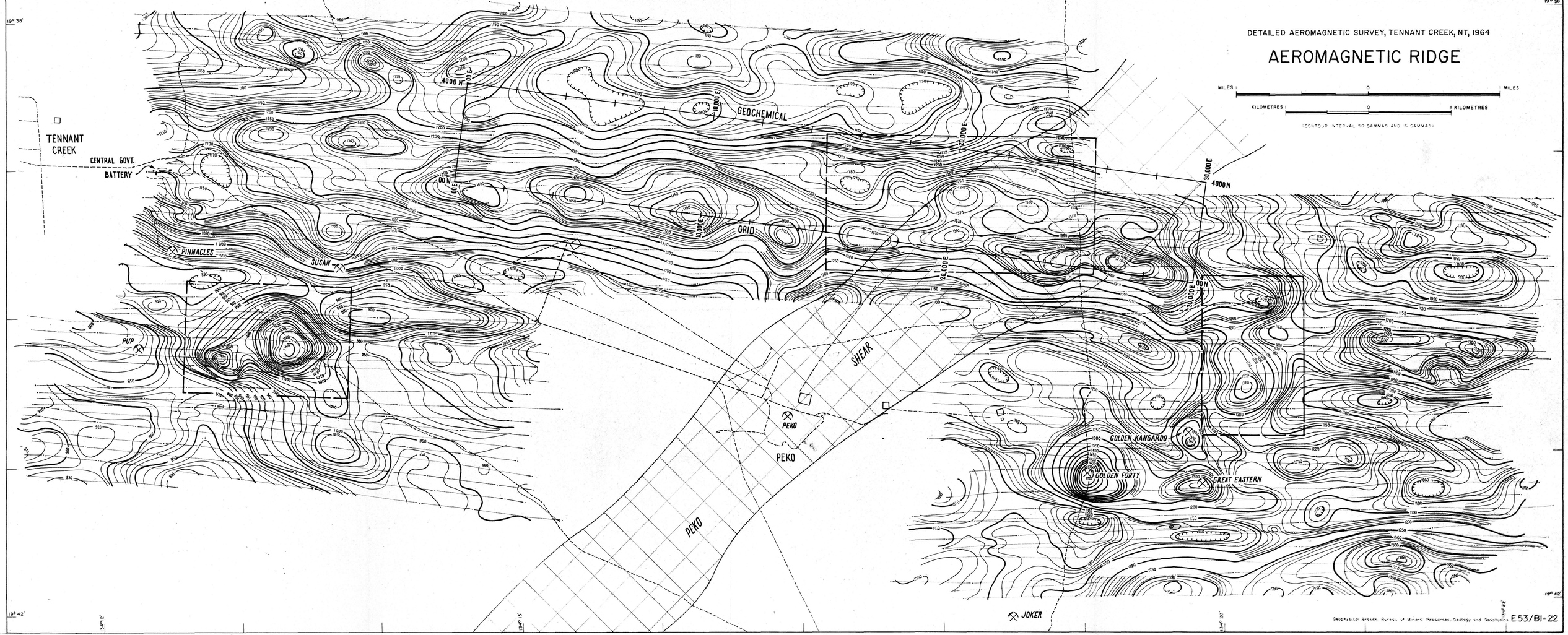
DETAILED AEROMAGNETIC SURVEY, TENNANT CREEK, NT, 1964

AEROMAGNETIC RIDGE

MILES 1 0 1 MILES

KILOMETRES 1 0 1 KILOMETRES

(CONTOUR INTERVAL 50 GAMMAS AND 10 GAMMAS)



Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics E53/81-22

3. AIRBORNE METALLIFEROUS CONTRACT SURVEY

Darwin-Pine Creek Aeromagnetic Survey, N.T.

The 1 mile map areas of Mt. Bundey and Burrundie, and parts of the areas of Batchelor, Marrakai, Ban Ban and Woolwonga were covered by the survey, which was flown by Adastra Hunting Geophysics Pty. Ltd. in September 1963, under contract to the Bureau and formed part of the Northern Territory Special Mineral Survey Programme. Analysis of the results of the survey by the Airborne Section of the Geophysical Branch is at present under way.

Several outstanding features are evident on the magnetic contour maps. Striking across the Marrakai, Batchelor, Mt. Bundey and Woolwonga areas in a general north-westerly direction are two pairs of lines of anomalies, one pair positive and the other negative, which appear to be due to new surface sources although no geological cause is evident.

In the Mt. Bundey area a very disturbed region associated with the Mt. Bundey Granite and Mt. Goyder Syenite was recorded. One of the most intense anomalies in this region is believed to be due to the known magnetite deposit and the region is being covered in detail by a light aircraft aeromagnetic survey.

Large granite masses in the Ban Ban and Burrundie areas are revealed as being almost non-magnetic. However, the adjacent rocks, the Mt. Masson Formation and Golden Dyke Formation are generally disturbed, possibly due in part to associated intermediate or basic intrusives. The known iron deposits in the Mt. Masson Formation at Frances Creek are not clearly associated with the magnetic pattern. The Mt. Harris Tinfield deposits, which also occur in the Mt. Masson Formation, are also not clearly related to the magnetic results but a more detailed evaluation of the data should add to the knowledge of structure in this region.

ENGINEERING AND HYDROLOGY

Lake George, N.S.W.

A seismic refraction survey was carried out to obtain information about the thickness of alluvium and lake deposits and to investigate the structure of the bedrock in the basin. The survey indicated that the basin is probably a graben with axis in north-south direction. The existence of faults was indicated on both sides of the graben. The bedrock is very uneven, the maximum recorded depth to bedrock being about 450 ft. In general the seismic work and the gravity survey completed in 1962 suggests the same structure of the basin.

Ginninderra Farm, A.C.T.

A seismic refraction survey was carried out to determine the thickness of the overburden and the nature of the overburden and the bedrock. The results show that the depth to bedrock ranges from about 28 ft. to 48 ft. Seismic velocities in the unweathered bedrock ranging from 14,000 to 17,000 ft/sec indicate a very low porosity.

Cotter E. dam site. A.C.T.

Seismic refraction, supplemented by resistivity and magnetic traversing, was used to determine the depth and nature of the bedrock at the site of a proposed dam in the Upper Cotter valley. Two borrow areas were also investigated to collect information about the quantity of clay present which could be used in the construction of an earth dam. The results showed that the overburden is relatively thin, generally less than 50 ft. Seismic velocities of the bedrock range from 7000 ft/sec to 19,000 ft/sec. The low velocity suggests the presence of a shear zone. Dynamic properties of the rocks were measured on several sample cores from the dam site.

The seismic results indicate that the borrow pit in the Red Hill area is the more promising for development.

No work was requested by the Geological Branch on the Bendora pipe-line.

Burdekin Delta, Q'land.

A short extension of the resistivity survey was carried out to determine variation of salt water level where intrusion has previously been observed and to check on marginal areas previously unaffected. Preliminary results suggest a general increase in the intrusion of salt water.

North Stradbroke Island, Q'land.

To assess the ground water resources of the island, seismic, resistivity, and gravity methods were used to determine the thickness of water saturated sand and the shape of the bedrock. Preliminary results show that the depth to bedrock ranges from 8 ft. to about 850 ft. The bedrock velocity is 8500 ft/sec to 16000 ft/sec and the velocity of the overburden beneath the water table is about 4800 ft/sec to 7500 ft/sec. In most of the North part of the island the overburden is below present sea level.

Experimental resistivity depth probing using different electrode configurations were used on several seismic traverses. A change of resistivity probably caused by the tide was observed for a system of electrodes placed high on the beach. An estimate of the water flow rate at several localities was obtained by dosing an electrode system with salt water and measuring the temporal variation of resistivity at a second electrode system 10 ft. away. A flow of 10 ft. per day was measured at one location.

North Stradbroke Island, Q'land. (cont'd)

Salinity measurements taken on 200 water samples show the water is fresh.

Gravity work was tried in conjunction with the seismic work to test whether it would give information on the bedrock configuration. The preliminary results suggest that some valuable data can be obtained from the gravity results, but a high regional gradient may make interpretation difficult.

Kerang (Murray Valley), Vic.

A resistivity survey was carried out on a 70 square mile area of the Kerang irrigation district to determine whether resistivity methods could be used to detect shallow aquifers and if so indicate their extent in the trial area. Resistivity depth probing and a small amount of traversing were used. The resistivity work was supplemented by drilling and a water sampling programme. Several holes were logged with the Widco 500 ft. gamma ray logging equipment but this technique was discontinued when the equipment proved unreliable in operation.

In several areas the presence of shallow aquifers interpreted from the resistivity programme has been verified by drilling. In other areas the resistivity method has been interpreted to indicate clays to a depth of about 50 ft. A limited number of drill holes in these areas verify the resistivity interpretation. Probably the resistivity interpretation is substantially correct for the whole area and shallow aquifers are confined to a zone close to Pyramid Creek.

Markham Valley, N.G.

Resistivity surveys to determine the extent of ground water in three parts of the valley were carried out using the depth probe technique with both alternating and direct current. The existence of a considerable amount of drilling information has made it possible to advance a hypothesis for the difference between the results obtained by using A.C. and D.C. instruments. The initial investigation suggests that the difference is related to the clay and moisture content of the ground.

VIBRATION TESTS

Victoria

Melbourne

The Engineering Section acted as consultants for some vibration tests carried out by the Victorian Railways in connection with the proposed location of an underground railway system beneath the Commonwealth Office block, Melbourne, Victoria.

Vibrations produced by rail traffic and the detonation of small explosive charges were measured by staff of the Victorian Railways. The tests showed that the effect of vibration on the structure would be negligible.

Reservoir

A vibration test was carried out to determine the effect of vibrations produced by a compressor on adjoining properties at the Gas and Fuel Corporation's pumping station, Reservoir, Victoria. The tests showed that the vibration produced was negligible compared with that produced by natural causes, such as people walking on the floors.

ROCK TESTING

Seismic velocities and dynamic properties were measured on about 90 drill hole cores from the Cotter "E" dam site A.C.T. (Geological Branch); Broome Jetty site, W.A. (W.A. Department of Works); and the

ROCK TESTING (cont'd)

Risdon Brook dam site, Tasmania (Tasmanian Mines Department).

Ten samples of concrete from the airfield at Darwin were tested for the Department of Works.

REGIONAL SURVEYS

1. REGIONAL GRAVITY SURVEYS

Pendulum Measurements

The doubly read Melbourne-Tokyo tie was completed. However there is a difference of about $2\frac{1}{2}$ mgal between this set of readings and that obtained using a similar set of equipment in 1959. The reason for this is not clear but from further work which has been carried out in Australia it appears that part of the trouble may be instrumental although the sets of readings at Melbourne and Tokyo are consistent within themselves. Correspondence is continuing on this point.

Stations at Sydney, Brisbane, Mackay, Townsville and Cairns (forming part of the East Coast Chain) have been doubly occupied. Only a preliminary analysis of the results has been made to date but it appears that there are some significant differences between values for some of the stations and values obtained by the Cambridge pendulums and since adjusted by gravity meter connections. It is planned to carry out laboratory tests on the equipment during the summer. Modifications to some of the units has already commenced.

Isogal Regional Gravity Survey

The purpose of this survey is to strengthen the Australian National Gravity Network by making gravity meter ties between existing pendulum stations and establishing additional primary and secondary base stations at intervals of approximately 100 miles along east-west traverses crossing Australia. The values of gravity along the east coast of Australia are reasonably well known and this survey will carry these values across Australia. The results of these traverses will later be combined with those of north-south traverses to form a unified network.

A minimum of three gravity meters are carried backwards and forwards between successive stations by a fast light aircraft to obtain good drift control and minimize meter errors. Gravity meters used on this survey are La Coste G20, Master Worden 548, World Wide 35 and/or Sharpe Canadian 145. The base stations at airstrips along the east-west traverses are selected to have minimum gravity differences to minimize calibration factor problems.

The full programme for 1964 is shown on map G65-93-2 (Plate 28) and should be completed by January 1965. The number of base stations is 183 and a total of over 400 stations (Including bases, excentres and ties to existing surveys) will be established or re-occupied.

Final analysis of the results will take some time, but preliminary investigations indicate a standard deviation of about 0.1 mgal referred to the datum for each east-west traverse. The survey will considerably strengthen the Australian network.

Regional N.S.W. & Q'land.

This survey was not carried out because of higher priority commitments elsewhere following staff resignations.

Regional Gravity Victoria

74 new gravity stations were read and several existing stations were reoccupied to tidy up some deficiencies in the gravity net in Eastern Victoria. The results of this work will be incorporated in the Bulletin covering the regional gravity of Victoria.

Earth-tide recording

Recordings at the Old Melbourne Observatory were obtained during the early part of the year, but this work had to be discontinued because of the shortage of staff.

Gravity map of Australia

Some data were prepared for addition to the 1 degree square files but this activity was curtailed because of the shortage of staff and because in the long run it will be easier to retrieve this information from the data tapes. However it is unlikely that automatic computing programmes will be available for this process for some time. As an interim measure the 1" = 40 miles Bouguer anomaly contour maps (incorporating regional and sedimentary densities) have been pieced together to give a fair overall coverage of Australia.

Gravity meter tests

Calibrations as required.

Automatic Computing Procedures

The programme for reduction of raw data to observed gravity stage was developed but to date has not tested satisfactorily. Using hand computed observed gravity values, programmes have been developed and tested to carry the reduction through to final Free-air and Bouguer anomaly values. Programmes have been made available to Wongela Geophysical for use in reducing their data obtained under contract to the Bureau.

Reorganization of the filing system has continued. The renumbering of all survey data is well advanced.

PLATE 28

AUSTRALIA

SCALE
100 0 100 200 300 400 MILES

ISOGAL REGIONAL GRAVITY SURVEY
1964

LEGEND

Perth ▲ Existing Pendulum Station
Weipa △ Proposed Primary Station
o Proposed Secondary Station
Sydney (CR) Calibration Range
——— Traverse (Multiple Tie)
- - - - Transit (Single Tie)

(BASED ON G20-31)

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS
TO ACCOMPANY RECORD NO. G65-93-2

2. REGIONAL MAGNETIC SURVEYS

Isogonic Map:

The isogonic map of Australia for the epoch 1965.0 was completed. Although this was based on a much more complete network of stations than previous maps, most of the changes were those predicted by secular variation. The principal change was a decrease in the rate of increase of declination in the south-east of Australia.

Detailed declination surveys:

Detailed declination surveys, involving a reading every five miles of traverse, were completed over 750 miles in Tasmania, 1500 miles in north-west Queensland and 1200 miles along the coast of N.S.W. A traverse with a station every 25 miles was made from Cloncurry to Toowoomba. Results are not yet available. See accompanying map for details. (Plate 29).

Reoccupation of Islands:

Magnetic stations on Willis Island, Ocean Island, Nauru, Christmas Island, and Cocos Island, were reoccupied. The reading at Cocos Island removes a discrepancy in secular variation apparent from the 1947 and 1960 measurements. (Plate 30).

Terrella Model Experiments:

Work on the Terrella model continued throughout the year. A more realistic pattern of field directions was obtained after the installation of a low conductivity mesh to simulate the shallow water north of Australia. This, however, introduced elliptical polarisation which is not apparent in magnetograms. A search for elliptical polarisation in magnetograms, using digital computation, has been started.

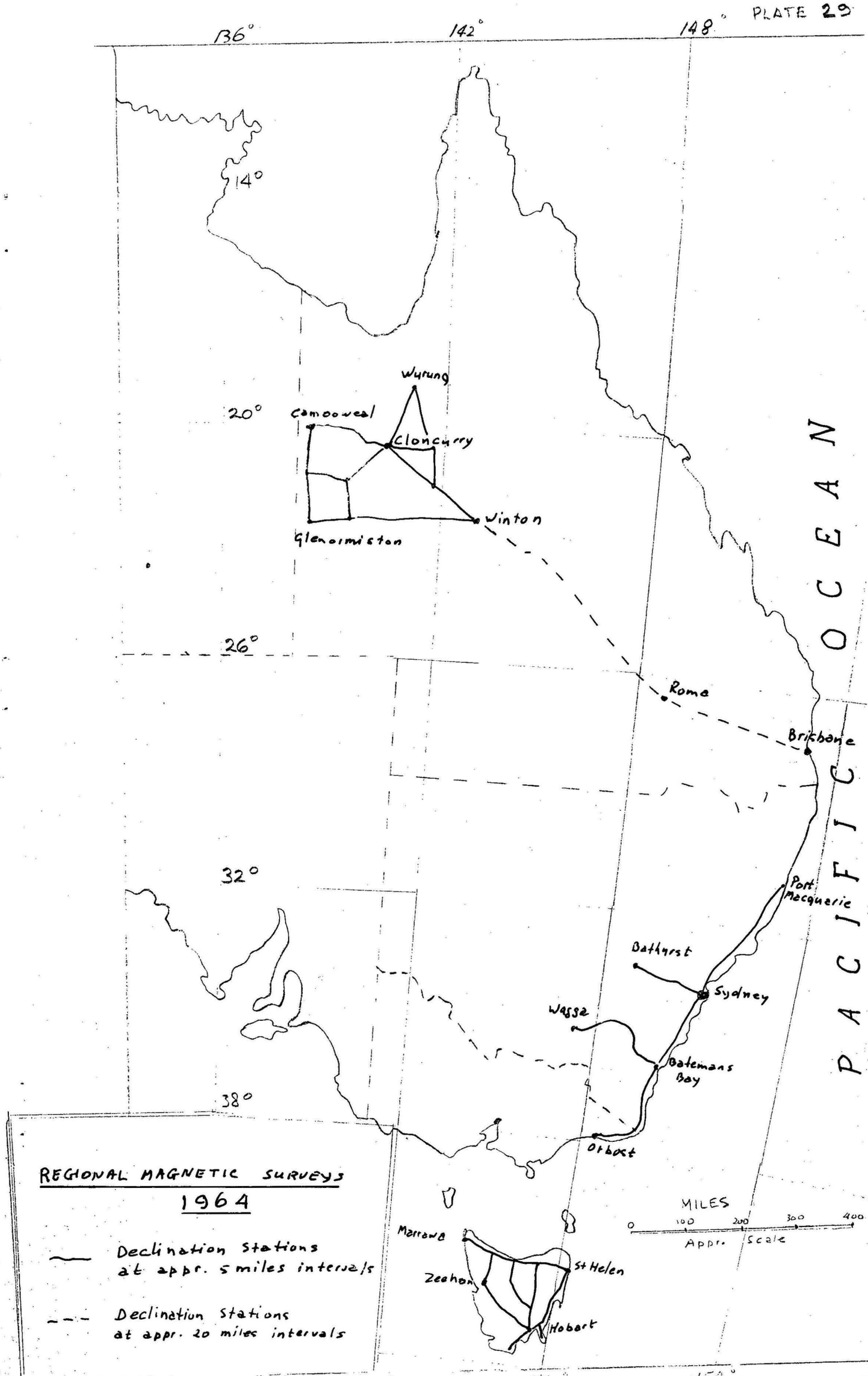
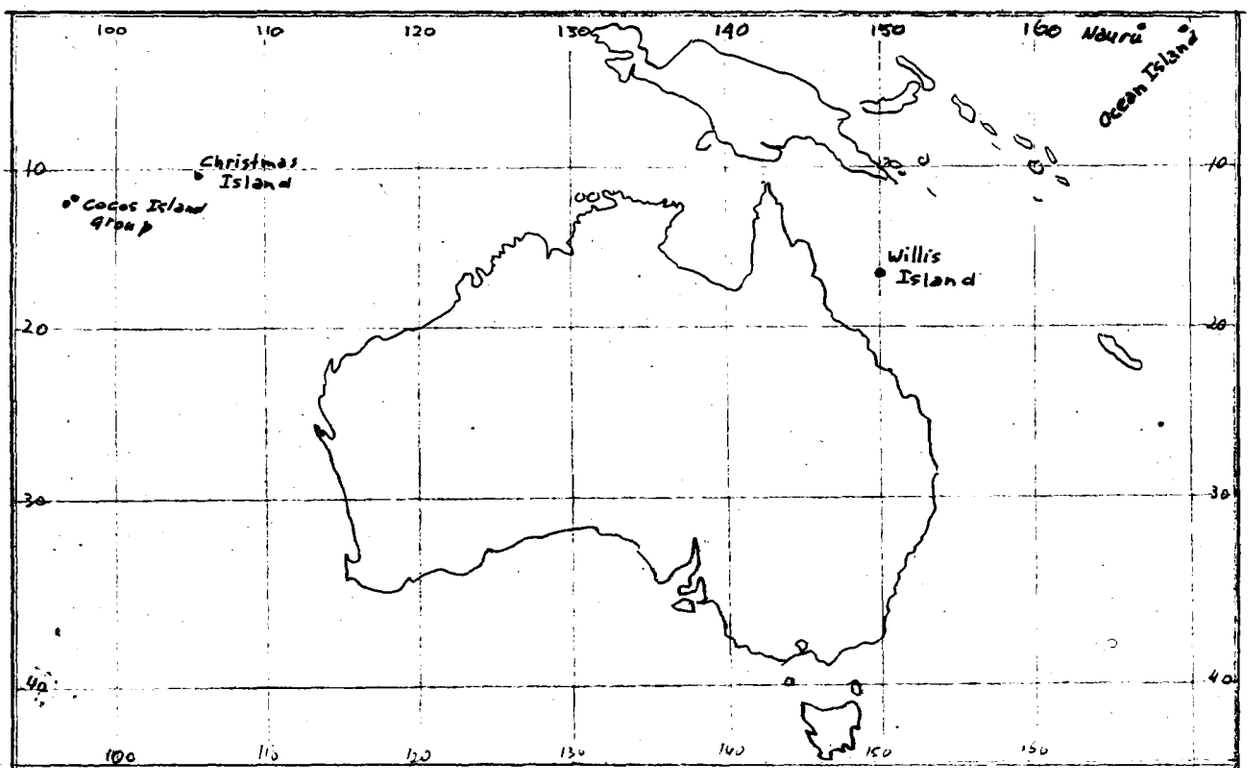

136°
142°
148°
14°
20°
26°
32°
38°
Wyrung
Camooweal
Cloncurry
Winton
Glenormiston
Roma
Brisbane
Port Macquarie
Bathurst
Sydney
Wagga
Batemans Bay
Otbost
Marrawa
St Helen
Zeehan
Hobart
PACIFIC OCEAN
MILES
0 100 200 300 400
Appr. Scale
REGIONAL MAGNETIC SURVEYS
1964
Declination Stations at appr. 5 miles intervals
Declination Stations at appr. 20 miles intervals
142°
145°
154°

PLATE 30



REGIONAL MAGNETIC STATIONS
1964

On Islands in the Pacific and Indian Oceans

OBSERVATORIES

Remote Seismic Recording:

The seismometer and recorder are in operation. The telemetering equipment has been built and is awaiting P.M.G. approval before being installed.

Geomagnetic Data Processing:

About one third of the backlog (to 1960) of magnetogram scaling has been cleared. Practically all computing to be done on Silliac has been completed. The project is being reprogrammed for the CDC computer.

Toolangi Observatory:

The normal programme of geomagnetic recording continued. An inductometer, using magnetic tape recording, was operated for the University of Queensland. Standardisations using proton precession magnetometers were carried out. The normal programme of seismic recording was continued.

Mundaring Observatory:

The normal programme of geomagnetic, seismic and ionospheric recording was carried out. The first phase of the field seismology programme was finished. Information from this, combined with that derived from exploration seismic methods, has given a picture of the crustal structure of southern Western Australia more complete than was previously known. This indicates that the Darling Fault may have a throw of 60,000 to 70,000 feet; the lower 30,000 to 40,000 feet of sediments in the Perth Basin are very dense. The upper mantle has an unusually high velocity of 8.48 km/sec in this area. There is an intermediate layer with velocity 7.24 km/sec at a depth of about 15 km beneath the shield; and about 20 km deep west of the Darling Fault.

A study of the seismicity of Western Australia revealed an important tectonic feature now known as the "Cape Riche - Yandanooka lineament". This separates two natural regions - the Salt Lake Division and the South-West division of Jutson. Minor earthquakes are frequent along the lineament, which is also a boundary of the area where charnockitic rocks occur. Bouguer anomalies are 0 to +20 mgal to the west, and -40 to -60 mgal to the east of the lineament.

Port Moresby:

The normal programme of geomagnetic, seismic and ionospheric recording continued. Equipment for field seismology studies was received and tested. Recording of radio scintillations was carried out for R.R.B.

Antarctic Observatories:

The normal programme of geomagnetic and seismic recording was continued at Macquarie Island, Mawson and Wilkes. The rapid run magnetograms from Macquarie Island were used extensively by the Geophysical Institute of Alaska in their conjugate point study.

Darwin:

Seismic recording with a three component Willmore continues. Exploratory drilling in search of a suitable site for a future standard seismic observatory was carried out at intervals throughout the year.

I.S.R.C. Programme:

A pilot programme of reporting seismic events with data cards has been in operation for the last two years. Toolangi, Mundaring and

I.S.R.C. Programme (cont'd)

Mawson have participated. The pilot programme is now finished and the full programme has come into operation. All B.M.R. geophysical observatories will participate. Already several hundred completed cards have been sent from Melbourne, reporting arrivals at Toolangi and Mawson.

LABORATORIES

1. DESIGN & DEVELOPMENT

Serious shortage of professional staff and the amount of work involved in producing three crystal clocks for the Port Moresby Observatory, placed the emphasis of the group's work during 1964 on equipment design and production rather than on developmental work. Thus it has not been possible to fulfil all five functions of the group as outlined in the 1962 summary.

Timemark Programming Unit

This instrument was designed to provide coded time marks for observatory records at Wilkes. As far as is known, its operation has been satisfactory.

Airborne Proton Magnetometer

Prototype development reached the stage when the instrument could be used for survey purposes. A standard deviation of three gammas is obtainable with readings twice per second. Further development should reduce the standard deviation to about one gamma. The instrument has operated in VH-GEO throughout the current field season. The results of the Tennant Creek survey were particularly encouraging, as contouring at five gamma intervals was possible.

Some ancillary equipment in VH-GEO was modified for compatibility with this magnetometer.

Observatory Proton Magnetometers

The two proton magnetometers, built for observatory standardisations, were overhauled and modified for greater reliability at temperatures down to - 10°C.

A prototype power supply, for operating these instruments from the ac mains, was designed. Compatibility tests have still to be carried out.

Fluxgate Magnetometers

Some time was spent investigating temperature effects in B.M.R. designed fluxgates. Temperature stability of backing-off current supplies was only found possible over a small temperature range. Further work is in progress, both on this problem and also on temperature stability of the fluxgate detector.

Design was commenced of a three-component fluxgate variograph for use by the Observatory Section in first order regional surveys.

A ground station magnetometer was constructed for use, as a magnetic storm warning device, by the VH-GEO party.

Crystal Clocks

Production of three crystal controlled clocks, for the crustal thickness programme in New Guinea, was completed during the year. These clocks provide the following facilities:-

1. Mechanical time display.
2. Comparison with and adjustment to radio time signals, with an accuracy of ± 10 milliseconds.
3. Various contact closures for time marks on the seismometer records.
4. Accurate 50 cps power output to drive the recorders.

Although a prototype had been built, more design effort was required for reliable operation of the mechanical and power output sections.

Crystal Clocks (cont'd)

Each station includes a battery charger and time-signal receiver. The commercial units obtained had to be modified for reliability and full compatibility.

Handbooks for the clocks are in the course of preparation.

Drafting

The electronic drafting section completed 234 new drawings. This includes drawings for the Maintenance and Testing Group.

Coil Winding

A total of 115 inductors, transformers, etc., were wound.

Miscellaneous

Preliminary design of a magnetically shielded room, for the Canberra laboratories, was carried out.

Assistance was given to the Gravity Section in modifying and adjusting the G.S.I. pendulum apparatus.

Various electronic components were investigated for reliability and applicability to B.M.R. equipment.

2. MAINTENANCE AND TESTING

Throughout the year, the maintenance group carried out a continuous programme of maintenance, overhaul, and installation of geophysical equipment. Work included major overhauls of seismic equipment from both sedimentary basin seismic parties and of airborne geophysical equipment from both the DC3 and Cessna survey aircraft. Work of this nature is generally confined to the interfield season and the above tasks were completed by March. In addition, both aircraft returned to Melbourne for a short period about mid-year and the opportunity was taken to do further overhaul work at this time.

The group was responsible for installing and initiating operating procedures on the recently purchased seismic playback equipment. This machine is essentially an analogue computer which corrects and enhances seismic field data recorded on magnetic tape. Results are presented in the form of a subsurface cross-section. The equipment was installed in March and was operating within a few weeks. Some time was lost due to difficulty in obtaining accurate adjustment of the optical system and due to certain critical spare parts not being delivered until some weeks after installation. After these initial troubles were overcome the machine has operated reliably.

Several design and construction projects were completed (or nearly completed) during the year. These are listed below.

1. Temperature Logger for use by the Geological Branch.

2. Dual 5 ampere variable DC power supply for use with resistivity measuring equipment in difficult areas.

3. Coded Timing Unit to enable shot instant and uphole-geophone time to be transmitted by F.M. radio from the shot point to the recording cab.

4. Geophone Patch Panel for use with multiple coverage seismic shooting techniques.

5. A frequency modulated telemetry system to allow remote recording of a seismometer installed at the Melbourne Observatory, by means of P.M.G. telephone lines.

This group is also responsible for measurement of physical properties of rock and core samples and a large number of samples was handled during the year. Magnetic susceptibility is measured on a susceptibility meter which was designed and built in the laboratory. Elastic properties of rock samples are determined from measurements of the velocity of elastic waves through the specimen and from measurements of natural resonant frequencies. The equipment has recently been modified to plot amplitude against frequency of the excited sample automatically.

Drafting officers attached to the group have assembled master copies of handbooks for most of the Branch's geophysical equipment. Master and field copies of books for several items of equipment have been amended and expanded.

WORKSHOPS

Most of the workshop capacity was required for routine maintenance and testing of geophysical equipment, and modifications to existing equipment. The majority of the jobs were small, but two of the bigger jobs were re-installation of the Birdwell 10,000 ft. winch and Shell CVL logger in a 4 x 4 vehicle, and the overhaul and re-installation of the elevation-meter in a vehicle.

The mechanical components for 3 crystal clock timing units, were designed and built in the workshops. These units form part of 3 sets of special seismic equipment required for a crustal thickness project in New Guinea.

The design of a special set of Helmholtz coils for use at Port Moresby observatory was completed, and design work commenced on the mechanical parts for a 3 component fluxgate magnetometer for the observatory group.

Two new instruments were constructed for the Geological Branch - a parallel guidance mechanism for use with a Wild stereoscope and a thermistor probe and winch for engineering investigations.

The workshop generally was better staffed than last year and all sections were fully employed. A considerable amount of time was spent on different aspects of training, particularly of apprentices.