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1970 JIMPAWIRRIE SEISMIC SURVEY (Report 1)

1970 PATCHAWARRA CENTRAL SEISMIC & GRAVITY SURVEY (Report 2)

FINAL REPORTS

Submitted by

Bridge Oil NL

1970

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JIMPAWIRRIE SEISMIC SURVEY

for

BRIDGE OIL N.L.

by

AUSTRAL UNITED GEOPHYSICAL PTY. LTD.

PARTY 147

SOUTH AUSTRALIA

1970



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ABSTRACT

A seismic survey was conducted between November 30th and December 11th, 1970 in the Tirrawarra area of the Patchawarra Central Block for Bridge Oil N.L. and Partners. The seismic contractor was Austral United Geophysical Pty. Ltd.

During the survey, 104 profiles were shot along 52 miles of line. Terrain conditions consisted of flat clay pan overlain by sand ridges in the West and East and "crab hole" country around the centre of the area of operations.

The work was of a detailed nature to evaluate structure indicated by earlier work.

No new structures were outlined but confirmation of previously known structure was achieved.

INTRODUCTION

The seismic survey was conducted in the South Eastern part of the Patchawarra Central Area of Petroleum Licences 5 and 6 in South Australia. (See Location Map, Plate 1). The partners in the operation were Bridge Oil N.L., Delhi International Oil Corporation, Santos Limited, Basin Oil N.L., Reef Oil N.L. and Vamgas N.L. Bridge Oil N.L. of Sydney N.S.W. was the operator for this survey.

The contractor was Austral United Geophysical Pty. Ltd., of Brisbane, Queensland. The survey was conducted by Field Party 147 with its office in Adelaide, South Australia. Details of personnel and equipment of Party 147 are presented in Appendices I and II.

The survey was supervised by J.E. and C.J. Milner, Consultant Geophysicists of Brisbane, Queensland, on behalf of Bridge Oil N.L.

The topography consists of flat, dry claypans overlain by a series of high sand ridges trending North-north West. In more or less the centre of the Jimpawirrie area, the sand dunes are absent and the clay flats, which here are subject to inundation from Coopers Creek, are pitted with "crab holes". This type terrain makes for difficult and slow travelling unless driving on bulldozed tracks.

Camp was established about three miles north of the site of Tirrawarra No. 1. Access to this area by road is from Moomba, through Gidgealpa and Merrimelia to Tirrawarra. From camp, use was made of old tracks and seismic lines as well as newly bulldozed tracks for access to the work areas. The airstrip at Tirrawarra was used by light aircraft for movement of personnel and supplies.

The weather proved somewhat of a problem during the survey. Most days were hot to very hot, several bad sandstorms struck during the period and some rain was recorded on the 4th of December.

Statistics for the survey are presented in Appendix III.

PURPOSE OF THE SURVEY

The general aim of this short survey was to provide additional structural information in the north western part of the Coopers Basin and in particular to investigate indications of structures suitable for the accumulation of hydrocarbons that had been suggested by earlier work.

Since the previous seismic work, the potential of the area had been upgraded by the discovery of oil and gas at the Bridge Oil Tirrawarra No. 1 well. It was hoped to outline structures similar to that at Tirrawarra with this current survey.

REGIONAL GEOLOGY

The survey was conducted in the North Eastern part of the Coopers Creek Basin in South Australia.

The Coopers Creek Basin was probably formed subsequent to the Siluro-Ordovician Bowring Orogeny. Sedimentation within this Basin may have started in the Devonian. However, so far only Permian and younger sediments have been encountered and identified in the numerous wells drilled up to date. The greatest volume and areal extent of sedimentation was during the Jurassic and Cretaceous.

Folding in the Coopers Creek Basin was gentle and in general took place along lines of weakness in the underlying Lower Palaeozoic rocks. Most of this folding started during the deposition of the Permian as can be demonstrated at such structures as the Gidgealpa-Merrimelia Anticline.

Underlying the Permian and younger rocks, Middle and Lower Palaeozoic rocks occur. They are usually much more disturbed and often constitute economic basement.

The Jurassic and Cretaceous sequences contain thick beds of shales and sandstones which could be source and reservoir beds for hydrocarbon generation and entrapment given the proper hydrodynamic and structural conditions.

Especially the Triassic sediments are expected to be prospective in this area because of possible depositional pinch outs towards the western edge of the Coopers Creek Basin and the possible occurrence of Upper Triassic sediments as encountered in the Pandieburra - Putamurdi area.

Permian sediments throughout the Coopers Creek Basin are prospective as evidenced by the Gidgealpa, Moomba, Daralingie, Toolachee and Tirrawarra discoveries, as well as the newly discovered Moorari field.

Carboniferous and Devonian sediments have not been proven to occur within the Coopers Creek Basin. It is possible that a petroliferous sequence such as exists at Gilmore could be present within the Patchawarra low, the central part of which occurs in the farmout area.

Ordovician sediments encountered in the vicinity of the area proved to be steeply dipping and tight and so far do not form attractive targets for oil or gas exploration.

In summary, the hydrocarbon potential of the Patchawarra low of the Coopers Creek Basin is great, with multiple objectives in much of the area, both structural and stratigraphic.

EXISTING GEOPHYSICS

Magnetic basement depth estimates by C.G.G. range from 13,200 to 8,600 feet within the survey area. It should be noted however that these are only estimates and considerable differences may be expected. In general past drilling in the Coopers Creek Basin proved the estimates to be too shallow.

Gravity data in the survey area indicate the presence of intra basement (or at least pre-Permian) contrasts which will be investigated by this survey.

Seismic reflection profiling has indicated a number of anticlinal structures as well as a significant thickness of Permian rocks.

FIELD PROCEDURE1. General.

Most base camp requirements were supplied from Adelaide. The airstrip adjacent to the Tirrawarra wellsite was approximately three miles south of camp and light aircraft conveyed supplies and mail to this site on a more or less regular basis. Fuel for the operation was supplied by road transport from Lyndhurst.

Radio communication between the field crew and the Adelaide office was maintained by a private Single Side Band Network. All requests, progress reports etc. were passed on through this network.

Travelling conditions varied within the area. Most vehicles had difficulty negotiating the higher sand dunes and winching was often necessary. The "crab hole" country made for slow if not difficult travelling.

2. Bulldozing.

A D7E bulldozer was adequate for the initial line cutting but could not cope with the additional clearing work made necessary by the sandstorms "blowing in" the previously cut track. It was found necessary to use a second machine, a D6, for this rework. Both machines were contracted from J.A. Graham and Company of Brisbane, Queensland.

3. Surveying.

Plate 5 gives the location and elevation of all current survey shot points. Appendix IV lists all permanent markers together with elevations, and latitudes and longitudes.

Elevations for the survey are related to Mean Sea Level at Port Adelaide, South Australia by indirect ties to the South Australian Department of Lands Bench Marks system along the Strzelecki Track.

Horizontal control is related indirectly to astrofixes and tellurometer stations set by Delhi International Oil Corporation, the South Australian Department of Lands and the Department of National Mapping.

All shot point locations were established by chained distances which were checked by stadia readings using a Topcon Theodolite.

Plate 1A shows the layout of the lines shot in the area. From this it can be seen that no complete loops were made and closures were not computed. Ties to old work were generally good for both vertical and horizontal control.

4. Drilling.

Shot holes were drilled by 3 Mayhew 1000 air-water combination drilling rigs. All holes were preloaded by the drillers.

Drilling conditions varied, formations encountered were sand, clay and gravel and combinations of these. All holes were drilled with water or mud. Adequate water supply for the drills was often difficult to maintain as it was often necessary to haul water long distances over rough tracks and steep sand dunes.

Hole depths varied but generally good records were obtained with the depth of hole at 90 feet on the claypans. Where the shotpoint location fell on a sand dune, the drillers increased the shot depth so that charges remained at more or less the same elevation.

5. Recording.

Split spreads with distances of 2640 feet between shotpoints were employed to obtain continuous subsurface coverage on all lines in the survey. See Plate 2 for the Cable Layout Diagram. Geophone group interval was 220 feet and within each group, the geophones were laid in an in-line pattern with an interval of 10 feet. Twenty four HS-J geophones connected in a series - parallel arrangement made up each geophone group.

Recordings were made through a set of PT-100 instruments which incorporate TGA-1 amplifiers and were recorded on tape with a P.M.R.-20 magnetic recording system. Paper monitors and field playbacks were made through a V.R.O.-6D Camera. Monitor records and tapes were recorded with out-out

filtering. Field playbacks which were used to check the information on tape and for preliminary interpretation were made using a 1/20 - 2/60 filter setting. This setting has a band pass of 16 to 60 cycles per second measured 6db down from peak response.

COMPUTATION AND INTERPRETATION

Reflection times were corrected to sea level datum by the simple uphole method (see Plate 3). A sub weathering velocity of 6,500 feet per second was used for all lines shot. This figure is the same as has been used for all previous work in the area.

Hand plotted time sections were made in the field from the filtered playbacks and a preliminary interpretation was based on these sections. The final interpretation was based on the corrected playback sections.

All reflection times were converted to depth in feet below sea level before mapping was carried out. The "C" Horizon times were converted to depth by the Cooper Basin Time Depth Curve (Plate 14). This depth was adjusted by means of the "C" Adjustment Map (Plate 12) to meet regional velocity gradients. The "C"- "P" interval time was converted to thickness with the "C"- "P" Time Thickness Curve and then this too was adjusted to meet the regional velocity gradients (see the "C"- "P" Adjustment Map Plate 13). The corrected "C" depth was added to the corrected "C" to "P" interval to give the depth to the "P" Horizon. A constant velocity of 13,000 feet per second was used to convert the "P" - "Redbeds" interval time to thickness. This then was added to the "P" depth to obtain the depth of the "Redbeds" Horizon.

PROCESSING

All playback processing of magnetic tapes was handled by Ray Geophysics (Aust.) Pty. Ltd., Perth, Western Australia.

Tapes, records, all static and dynamic corrections were sent to Perth from the crew. Static corrections were based on computed values at the shotpoints and interpolated values between shotpoints. The interpolated values were adjusted by means of a template to correct for trace to trace differences in elevation and/or depth of weathering. This method gives good results if the variations on individual traces are "averaged" over several different reflections. However, the method must be somewhat suspect where the record shows only poor quality reflections.

The dynamic corrections applied were the same as for the last survey in the area. For this survey, a basic function computed from the Velocity Survey at Tinga Tingana No. 1 was adjusted to fit the data in this area. The adjustments are presented in Appendix V.

The parameters used by the playback centre are listed on the sections (Plates 4a to 4h). Presentation is in the form of a Variable Area/Wiggle Trace combination on film.

Elevations, shothole depth and logs, and surface to datum times are presented on the sections.

QUALITY OF RESULTS

The quality of the data was generally fair to good especially on the shallower horizons. The "C" Horizon is always of good quality and character and is continuous over the whole area. The "P" Horizon displays its normal diversity of character but in general remains of good quality. The "Top of Redbeds" Horizon is based on a reflector of fair to poor character and quality and in places is carried only by doubtful correlation. However, it is felt that the structural picture presented is legitimate even though it may actually be something other than the Redbeds.

Included in this report as Appendix VI is a discussion of the "Lower Gidgealpa (Tirrawarra) Sand" by J. E. Milner. The quality of the event upon which this horizon is based as well as the structural aspects of the map (Plate 9) are presented in this appendix.

DISCUSSION OF RESULTS

Three structural control maps and two isopach maps are presented with this report. The structural maps are titled 1. "C" HORIZON (APPROXIMATE TOP OF CRETACEOUS TRANSITION BEDS) (Plate 6), 2. "P" HORIZON (BASE OF MESOZOIC) (Plate 8) and 3. TOP OF REDBEDS (Plate 11). The isopachs are titled "C-P" ISOPACH (Plate 7) and "P - REDBEDS" ISOPACH (Plate 10).

1. THE "C" HORIZON is based on a reflected event which maintained fair to good character and continuity. This Horizon was tied to previous work and represents the Top of the Transition Beds of Lower Cretaceous Age.

Regional strike is North East - South West parallel to the Gidgealpa - Merrimelia Anticline. Paralleling this major feature are a series of gentle folds with the axis of the first Anticline striking North East through Tirrawarra. This is separated from the next ridge by a trough running from LT 50 to LU96. The next Anticline runs along Line BCC and has closure at the intersection of Lines BDB and BDC and also at the site of Moorari No. 1.

2. The "P" HORIZON is based on a reflected event which maintained fair to good character and continuity. Control was carried from previous work and from the Tirrawarra well. The north-western flank of the Gidgealpa - Merrimelia Anticline is faulted at this level and doubtful

correlations have been made to the Merrimelia Wells which are on the up side of the fault.

This Horizon represents the unconformity surface between the Mesozoic and older rocks. In the area mapped, the older rocks are Permian sediments and so although the map is titled Base of Mesozoic, it can be taken as a map of the top of the Permian.

Basically the same features are present on this Horizon as on the shallower event but relief is greater. As mentioned previously, the northern flank of the Gidgealpa - Merrimelia Anticline is faulted to some extent. The related folding seems more complex than on the "C". The first anticline seems "broken up" with separate closures at B 74, BCD 53 and at Tirrawarra. The anticline along Line BCC has closure at BDB 57, BCC 75 and at Moorari.

3. The "TOP OF REDBEDS" HORIZON is based on an event of fair to poor character and continuity. The Horizon should represent the top of the Redbeds as found in Innamincka No. 1. The age of these beds is in doubt but seems likely to be Lower Paleozoic and possibly Cambrian.

Even though the exact nature of the mapped reflector is in doubt, the structural presentation seems to be a valid picture of the old sedimentary basin and shows the general pattern of all the Pre-Permian Sediments.

Here again, there is a similarity in structure between this map and the shallower ones. North from the fault along the flank of the Gidgealpa - Merrimelia Anticline, the first smaller anticline is again "broken up". The Tirrawarra structure is the apex of this fold and closure of around 600 feet is indicated. The trough to the North of this is relatively deeper than before and around Shot-point BCQ 56, it swings due South from the normal North East - South West strike. The anticline along Line BCC shows closure at the intersection of BCC and FT then strikes North East to culminate in the Moorari structure.

North West from the trough associated with this structure, data becomes poorer and the Horizon has not been carried any further in this direction.

4. The "C" - "P" ISOPACH shows that these two Horizons have only a slight unconformity between them. Generally, the "C" Horizon shows less relief than the "P" and so there is some thinning of the interval on the structural highs and some thickening in the lows. Except for minor local changes, variation in thickness is limited and the variation that is present depends almost completely on the overall structure.

5. The "P" - REDBEDS ISOPACH again follows the picture presented in other maps. This map gives an indication of the thickness of the sedimentary section from the Cambrian (?) to the Permian. Thickness varies from approximately 2300 feet to 3400 feet. The thinnest areas occur on the structural highs and the thickest in the areas of deep sedimentation.

CONCLUSIONS

This survey did not disclose any new structures in the area. The overall shape of the Tirrawarra structure was better defined as was the Moorari structure. This information is valuable in the planning of development wells as well as in the estimation of reserves.

The discovery at Tirrawarra aroused new interest in this area and the recent discovery at Moorari justified this interest. A notable point regarding both fields is their relatively small size. This seems to indicate that seismic work on a fairly tight grid must be obtained before the rest of the area can be disregarded.

Lines BDB and BDC confirmed the small high that had been mapped near the intersection of BCC and FT. This structure has around 200 feet of relief on the Redbeds Horizon but less than half on this on the "P". This makes it considerably smaller than either Tirrawarra or Moorari. However it is possible that it could form a hydrocarbon reservoir and the proximity to these other producers could make a small field economical.

The differences between the calculated depths for the "C" and "P" Horizons at Tirrawarra and at Moorari and the actual depths recorded through drilling, indicate that some changes in the Adjustment Maps are necessary. The average velocity to the "C" Horizon after the adjustments have been taken into

account is approximately 200 feet per second faster than the velocity obtained from the reflection time and the drilled depth at both of these wells. The adjusted average "C" - "P" interval velocity at the wells is somewhat less than the figure obtained by using the thickness measured by drilling and the "C" - "P" interval time.

At Tirrawarra, the calculated "C" depth is greater than the actual depth and the "C" - "P" interval is less than the actual. These two errors cancel out and the result is that the calculated "P" depth is the same as the drilled depth. The deeper events are more or less correct since these are based on the "P" depth.

At Moorari, the calculated "C" depth is greater than the drilled depth and again the calculated "C" - "P" interval is thinner than the actual. However, here the net result of these two errors is that the calculated "P" depth is approximately 100 feet too deep. This has introduced a similar error in the deeper events.

In conclusion, the area as proved by Tirrawarra and Moorari is highly prospective and all small structures need to be investigated. Drilling on at least one small high should prove whether they can be commercial and if so more seismic work will need to be carried out to be sure that none of these structures has been overlooked.

REFERENCES

Details of geology and geophysics pertinent to this area are included in the following reports on geophysical operations carried out by Delhi International Oil Corporation and Santos Limited as well as previous work by Bridge Oil N.L. in the Coopers Creek Basin.

1. Geophysics

Delhi-Santos Innamincka-Betoota Aeromagnetic Survey, 1961, by Aero Service Corporation. Reinterpreted by C.G.G., 1963.

Delhi-Santos Diamantina River-McGregor Range Seismic Survey, 1963, by United Geophysical Corporation.

Delhi-Santos Birdsville-Lake Frome Gravity Survey, 1964, by Geophysical Service International.

Delhi-Santos Coopers Creek Seismic and Gravity Survey, 1964, by United Geophysical Corporation.

Delhi-Santos Lake Gregory Helicopter Gravity Survey, 1965, by Wongela Geophysical.

Delhi-Santos Strzelecki-Cooper Seismic and Gravity Survey, 1965, by United Geophysical Corporation.

Delhi-Santos Eromanga-Frome Seismic and Gravity Survey, 1966, by United Geophysical Corporation.

Delhi-Santos Coopers Basin Seismic and Gravity Survey, 1967, by United Geophysical Corporation.

Delhi-Santos South West Coopers Basin Gravity Survey, 1968, by United Geophysical Corporation.

Bridge Oil N.L. Tirrawarra Seismic Survey, 1970, by United Geophysical Corporation.

Bridge Oil N.L. Patchawarra Central Seismic and Gravity Survey, 1970, by United Geophysical Corporation.

2. Geology

Gidgealpa No. 1 - 7 Well Completion Reports by Delhi International Oil Corporation.

Merrimelia No. 1 - 4 Well Completion Reports by Delhi International Oil Corporation.

Kalladeina No. 1 Well Completion Report by Delhi International Oil Corporation.

Pandieburra No. 1 Well Completion Report by Delhi International Oil Corporation.

Putamurdie No. 1 Well Completion Report by Delhi International Oil Corporation.

Tirrawarra No. 1 Well Completion Report by Bridge Oil N.L.

APPENDIX I - EQUIPMENTRECORDING

- 1 Toyota Land Cruiser four wheel drive recording truck, with recording cab.
- 1 24 channel set of SIE TGA-1 amplifiers with PMR 20 Magnetic Tape system with VRO - 6D Recording Oscilloscope.
- 600 HS - J 14 cycle per second geophones in strings of 12.
- 156 HS 1 refraction geophones (4.5 cycles).
- 4 $\frac{1}{2}$ mile cables with takeout interval 220 ft. and communication cables and CDP switching circuitry.
- 3 Transceivers for Radio Shooting.
- 1 Toyota Land Cruiser, four wheel drive cable truck.
- 1 Toyota Land Cruiser, four wheel drive personnel carrier.

SHOOTING

- 1 International AB 160 four wheel drive shooting truck complete with flat bed water tank and explosives magazines.

SURVEYING

- 1 Topcon Theodolite and complete set of ancillary surveying equipment.
- 1 Toyota Land Cruiser, four wheel drive.

DRILLING

- 3 Drills, Mayhew 1000 with mud pump and Gardner Denver air compressor for air - water drilling mounted on Ford F800 four wheel drive trucks.

- 3 Water Trucks, 2 Ford F800 and 1 International AB 180, all four wheel drive with flat 1000 gallon water tank.
- 1 Toyota Land Cruiser four wheel drive personnel carrier.

SUPPLY

- 1 International AB 160 four wheel drive truck with 1000 gallon flat water tank.

WORKSHOP

- 1 Shop Caravan, equipped with air compressor, power drills, hand tools and other equipment for repair and maintenance of equipment.
- 1 Welder outfit, complete with electric and acetylene welding equipment and supplies.

CAMP

- 1 Kitchen Caravan, air conditioned, complete with utensils, equipment and supplies.
- 1 Dining Caravan, air conditioned, complete with fixtures and tableware.
- 1 Shower Caravan, complete with pressure water system and water heater.
- 1 Trailer mounted Lister 45 KVA Power Plant with fixtures.
- 4 Air conditioned Sleeper Caravans.
- 1 Line Camp Kitchen Caravan.
- 1 Complete set of linen, beds etc. for accommodation of personnel.

OFFICE

- 1 Air conditioned Office Caravan, complete with printer, calculator, drafting equipment and 2 radio transmitters for communication.
- 1 Toyota Land Cruiser, four wheel drive.

BULLDOZING

- 1 Catapillar D7E Tractor (contracted from J.A. Graham and Co.).
- 1 Catapillar D6 Tractor (contracted from J.A. Graham and Co.). (used as standby to D7E).

APPENDIX II - PERSONNEL

Party Chief	P. Drew
Seismologist	A. Geddes (Field) (W. Thirlwell) (Interpretation)
Party Manager	L. Barkett
Observer	D. Nash
Surveyor	B. Matthes
Drillers	D. Frampton W. Johnson M. Stinson

An additional 22 helpers completed
the crew of 30 men.

Supervision by H.D. Gray.

APPENDIX III - STATISTICS

Starting Date First Shot	30th November, 1970
Completion Date Last Shot	11th December, 1970
Total Profiles Shot	104
Total Number of Shots	104
Conventional Miles Subsurface Coverage	52
Contract Recording Field Time	151.25
Non Contract Recording Drive Time	15.00
Total Hours Recording Time	166.25
Total Nitramon Used (lbs)	1982
Normal Charge Size (lbs)	20
Total Primers Used	124
Total Detonators Used	106
Total Number of Holes Drilled	105
Total Number of Feet Drilled	9530
Contract Drilling Field Time	305.50
Non Contract Drill Driving Time	41.50
Total Hours Drilling Time	347.00
Total Number of Blade Bits Used	6
Total Number of Rock Bits Used	-
Line Numbers	BDA thru BDH

APPENDIX IV
PERMANENT MARKERS

<u>Line</u>	<u>S.P.</u>	<u>Elev.</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Intersection</u>
BDA	51	96.4	27°45'09"	139°56'42"	
BDA	74	110.1	27°41'29"	140°07'05"	J-96
BDB	50	88.4	27°41'01"	139°53'02"	
BDB	60	98.6	27°38'56"	139°57'21"	
BDC	50	99.8	27°40'24"	139°57'03"	
BDC	58	97.2	27°37'35"	139°54'43"	
BDD	57	123.2	27°41'21"	140°01'52"	
BDD	69	98.6	27°37'03"	139°58'30"	BCC-80
BDD	74	101.8	27°35'14"	139°57'07"	
BDE	50	120.4	27°45'32"	140°06'33"	
BDE	59	195.5	27°41'35"	140°06'38"	(BDE/BDA)
BDF	50	108.9	27°37'45"	140°07'37"	BCF-59
BDF	57	148.7	27°34'41"	140°07'54"	
BDG	50	111.8	27°38'19"	140°08'56"	BCF-62
BDG	65	138.2	27°33'59"	140°14'26"	
BDH	50	127.6	27°34'45"	140°06'02"	
BDH	57	84.0	27°31'54"	140°04'48"	

APPENDIX V.VELOCITY FUNCTION ADJUSTMENTS

<u>Two Way Time</u>	<u>ΔT Jimpawarrie</u>	<u>ΔT Tinga Tingana</u>	<u>Adjustment</u>
sec.	sec.	sec.	sec.
0	.370		
.1	.320	.355	+.035
.2	.270	.275	+.005
.3	.220	.220	.000
.4	.182	.182	.000
.5	.150	.145	-.005
.6	.127	.125	-.002
.7	.110	.108	-.002
.8	.096	.096	.000
.9	.084	.085	+.001
1.0	.074	.074	.000
1.2	.054	.054	.000
1.4	.042	.042	.000
1.6	.033	.033	.000
1.8	.025	.025	.000
2.0	.018	.022	+.004

The moveout curves are based on an initial velocity of 6,500 feet per second with a maximum distance of 2,640 feet.

APPENDIX VILOWER GIDGEALPA (TIRRAWARRA) SAND

By J. E. Milner

The map of the Lower Gidgealpa (Tirrawarra) Sand is presented in this report as Plate 9.

The horizon is of fair quality and is characterised by a strong peak at or near the top of the Lower Gidgealpa producing sand occurring in the Tirrawarra No. 1 well. The time isopach between this peak and the "P" Horizon was converted to thickness using an interval velocity of 12,500 feet per second and due to a lack of knowledge of lateral changes in this velocity, this thickness has not been subjected to adjustment. Depths were obtained by adding this thickness to the "P" Horizon depths. The calculated thicknesses at Tirrawarra and Moorari are approximately those observed in these wells and it is therefore felt that the event is typical of the structure on the Tirrawarra sand.

Basically the structure is that observed on the "P" Horizon with increased relief. The Tirrawarra structure shows a much larger area of closure, while the Moorari feature shows increased vertical closure. Four other closures are indicated i.e. at the junction of Lines FT and BCC, around BDH 52, B 75 and AAC 5. The first three are of small critical closure and changes in the "P" Horizon depths could destroy them. The probability of an accumulation at AAC 5 depends upon the fault providing a migration barrier.

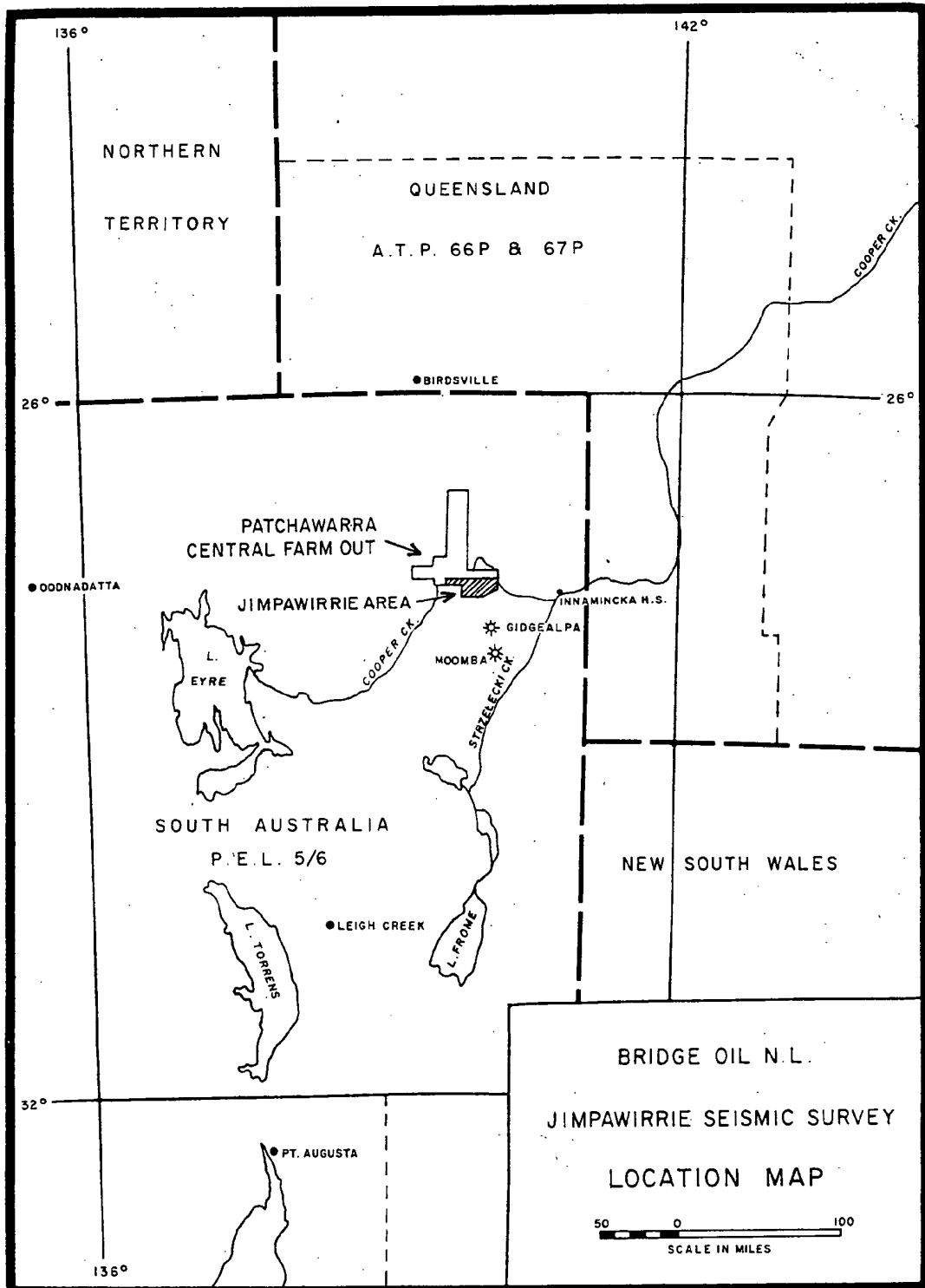
Respectfully Submitted

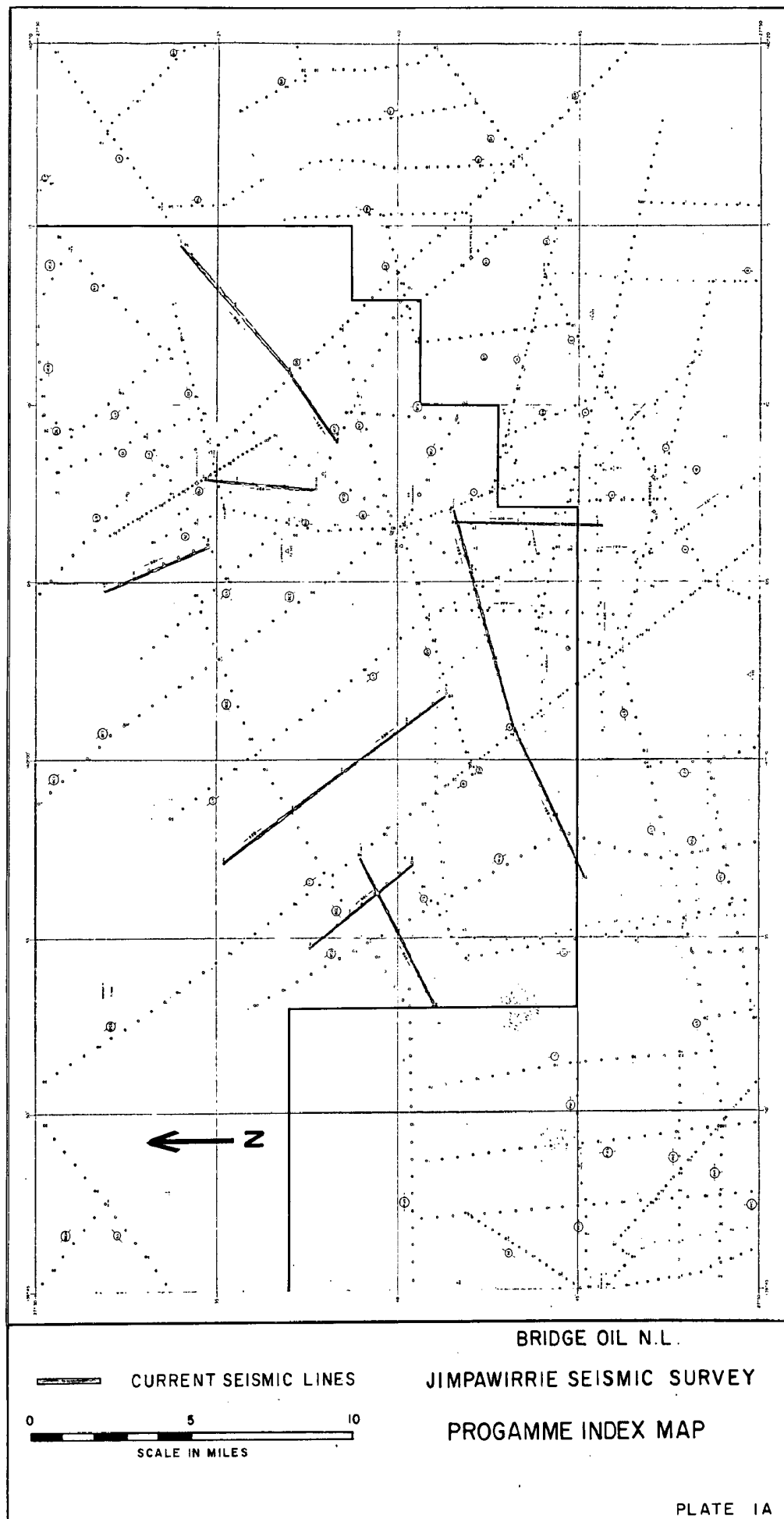
by

Austral United Geophysical Pty. Ltd.

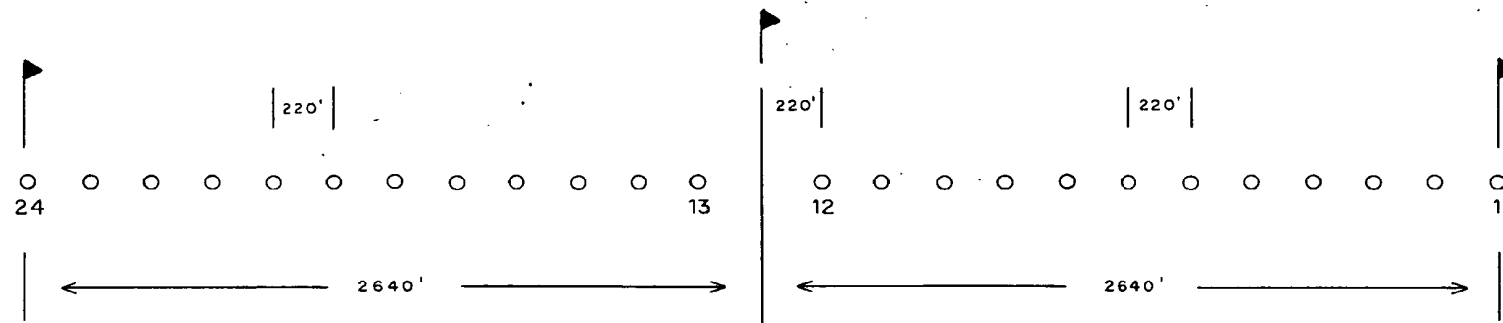
Party 147

..... *P. J. Drew*
P. J. Drew.
PARTY CHIEF.





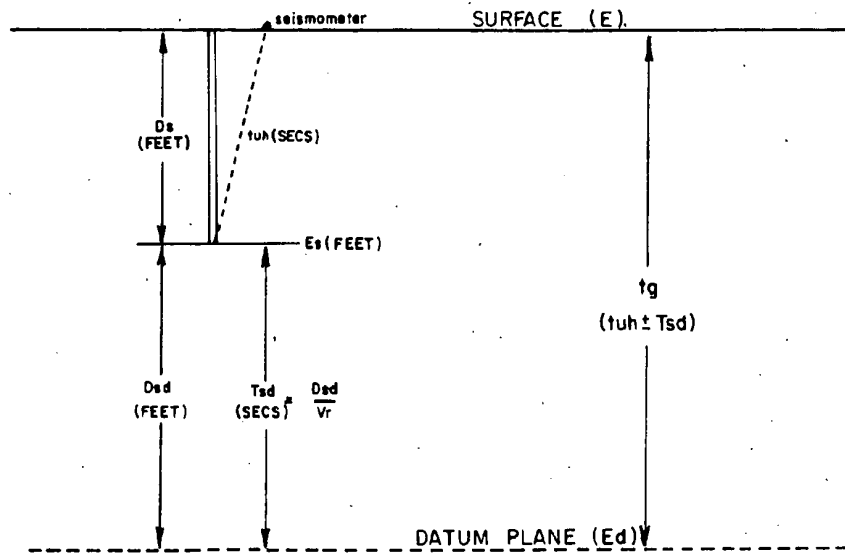
NORMAL CABLE LAYOUT



O GEOPHONE POSITIONS

SHOT POINTS

DATUM CORRECTION METHOD



E = elevation at shot point

Ds = depth of charge

Es = elevation of charge = $E - D_s$

Dsd = distance from charge to datum plane

Ed = elevation of datum plane

tuh = observed up-hole time recorded by shot point seismometer

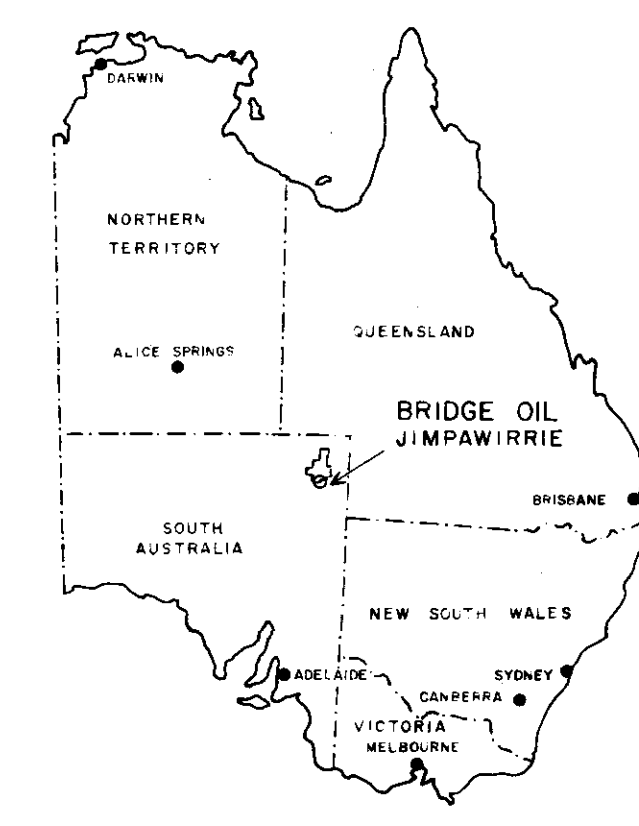
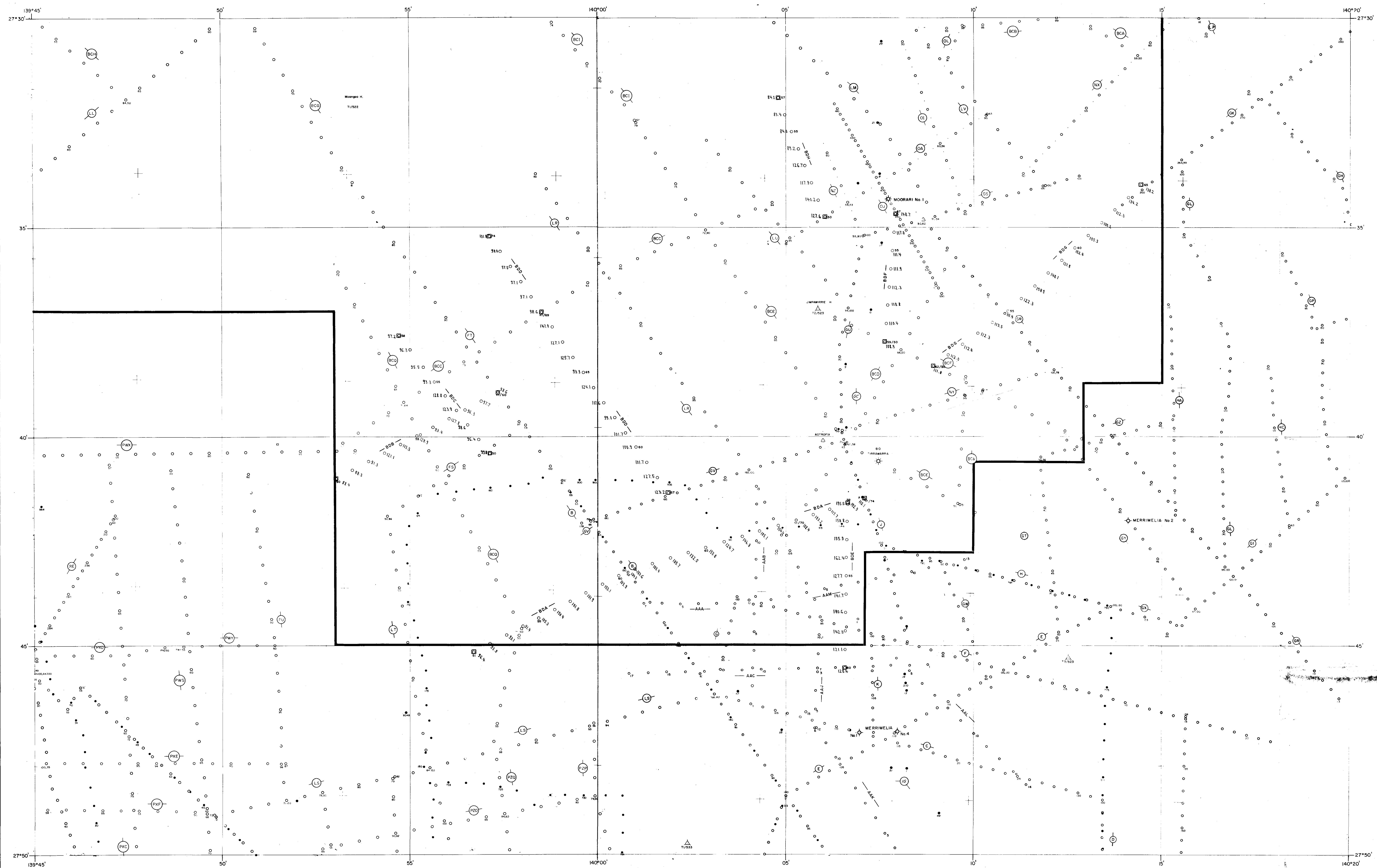
Tsd = time from charge to datum = $\frac{Dsd}{V_r}$

Vr = velocity in sub-weathering zone

tg = time correction from surface to datum

= algebraic sum of tuh & Tsd

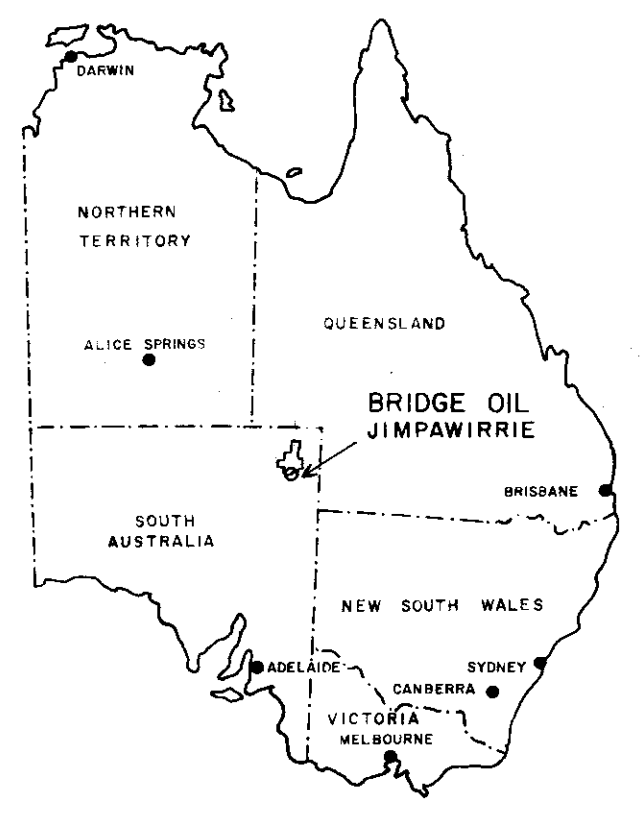
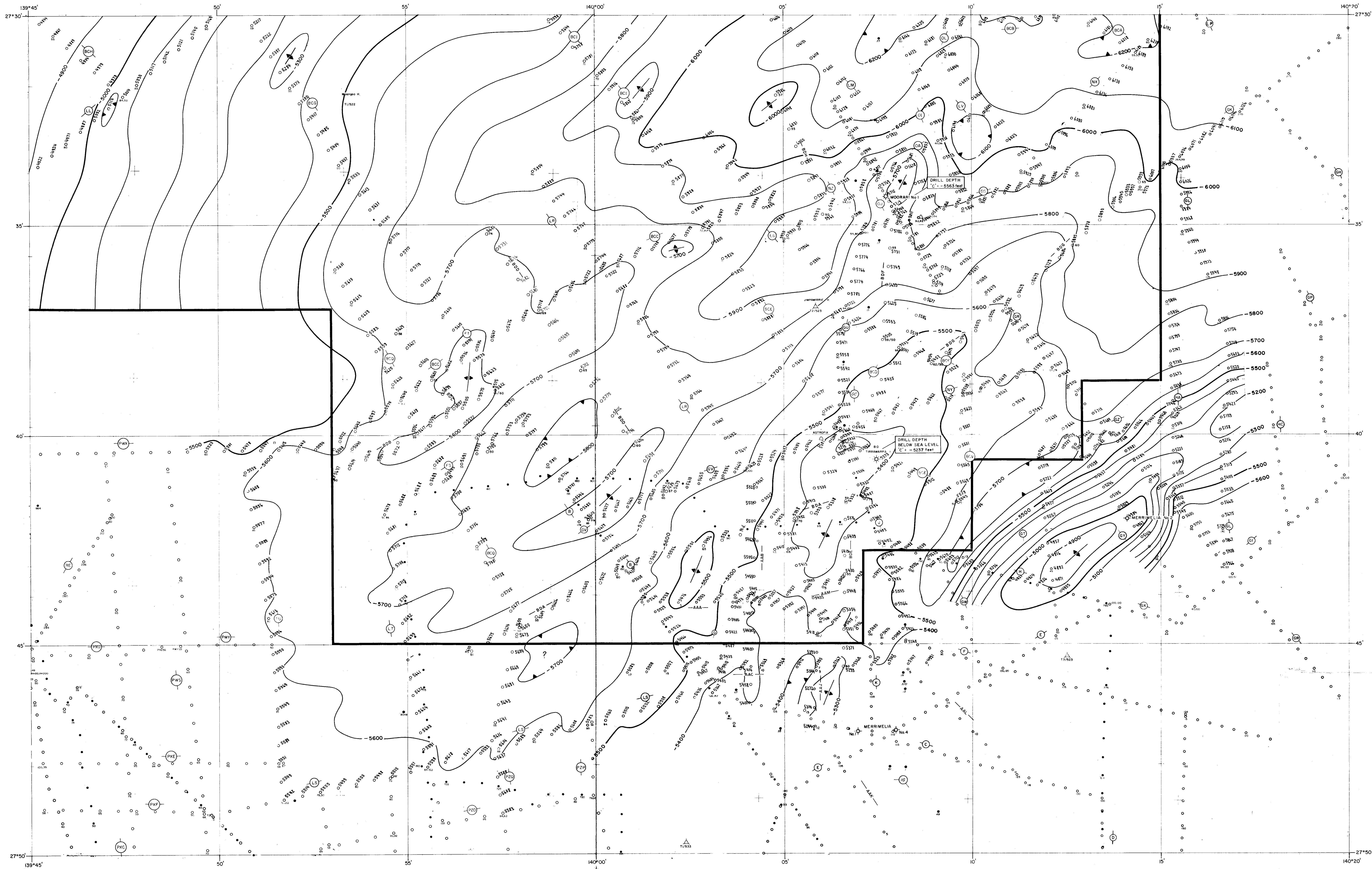
TOTAL CORRECTION = $Tsd \pm tg$



LEGEND
● SHOT POINT
△ TELLUROMETER STATION
□ PERMANENT MARKER

SURVEY
FOR
BRIDGE OIL N.L.
BY
AUSTRAL UNITED GEOPHYSICAL PTY. LTD.
JIMPAWIRRIE SEISMIC SURVEY
SOUTH AUSTRALIA
**SHOT POINT LOCATION
AND ELEVATION MAP**

DATUM: SEA LEVEL
DATE: JANUARY 1971
PARTY 147
SCALE 1:60,000
RECEIVED
DEPT. OF MINES
SECURITY
1212
1971



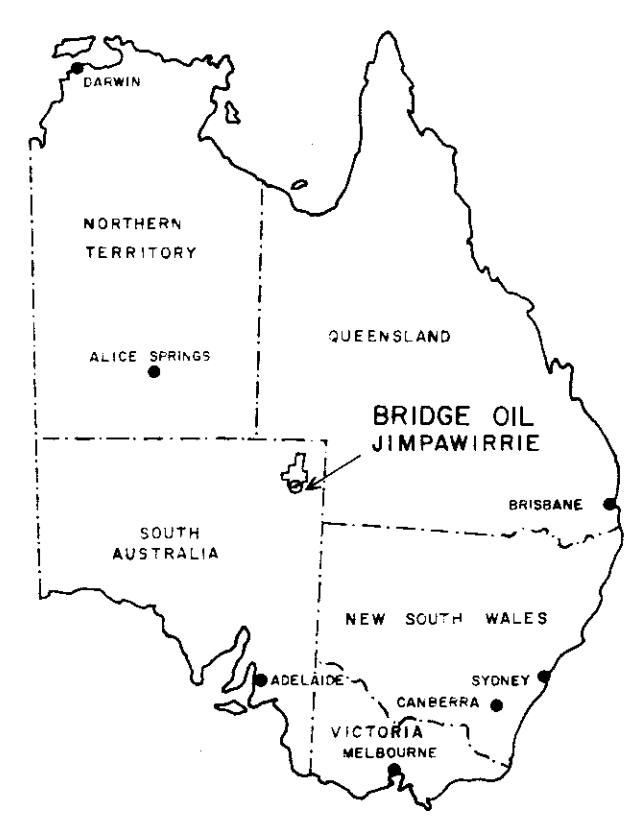
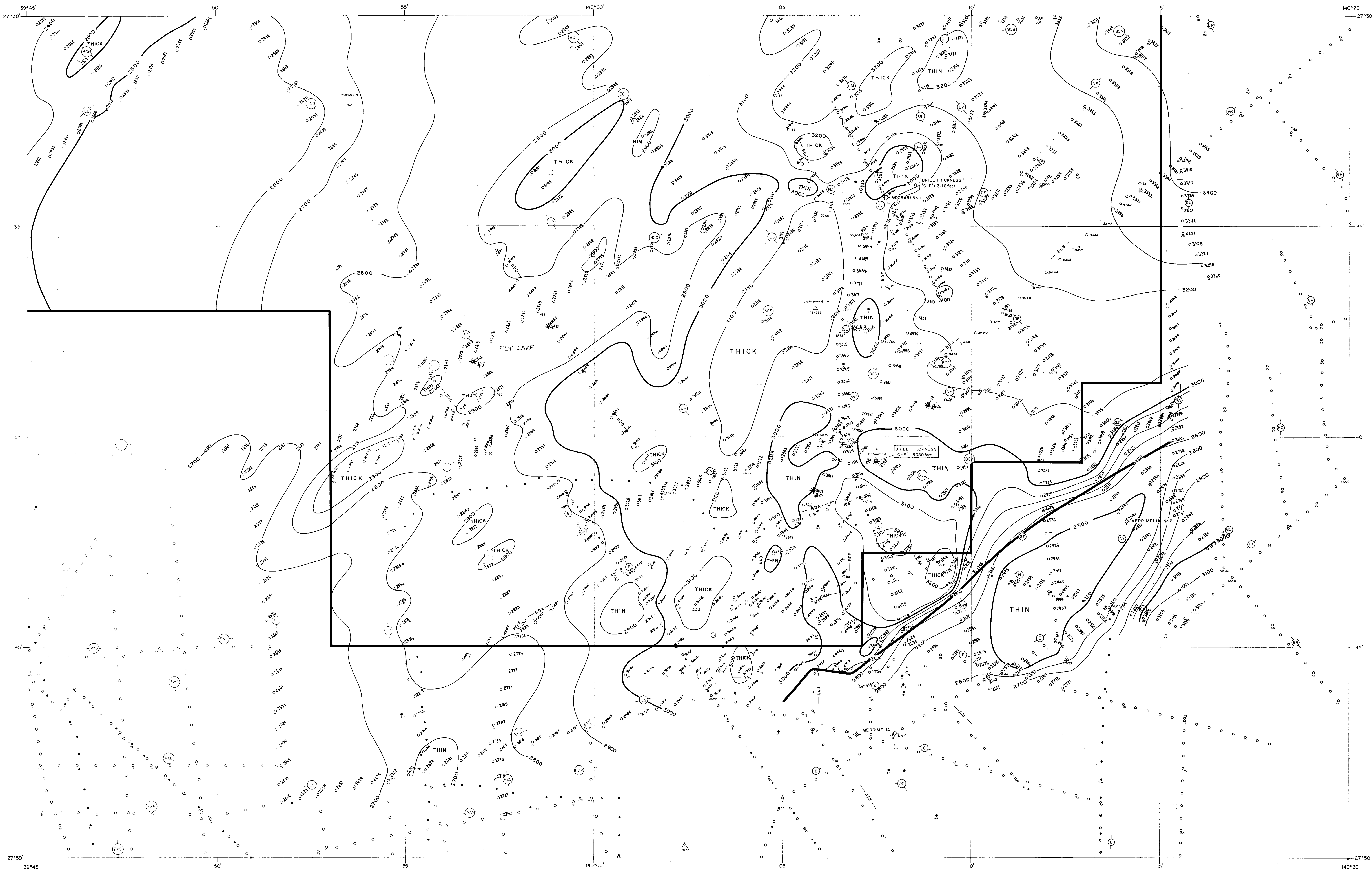
SURVEY
FOR
BRIDGE OIL N.L.
BY
AUSTRAL UNITED GEOPHYSICAL PTY. LTD.
JIMPAWIRRIE SEISMIC SURVEY
"C" HORIZON
(APPROXIMATE TOP OF
CRETACEOUS TRANSITION BEDS)

CONTOUR INTERVAL: 100 feet
DATUM: SEA LEVEL
INTERPRETATION BY: J.E. MILNER
P.J. DREW / W.J.S. THIRLWELL

VELOCITY ADJUSTED
DATE: JANUARY 1971
PARTY 147

SCALE 1:60,000
1000 5000 10,000 15,000
FEET

RECEIVED
12 APR 1971
DEPT. OF MINES
SECURITY
1212-20
PAGE 6

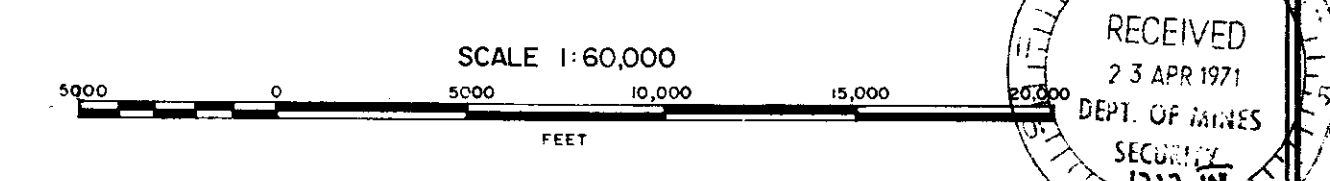


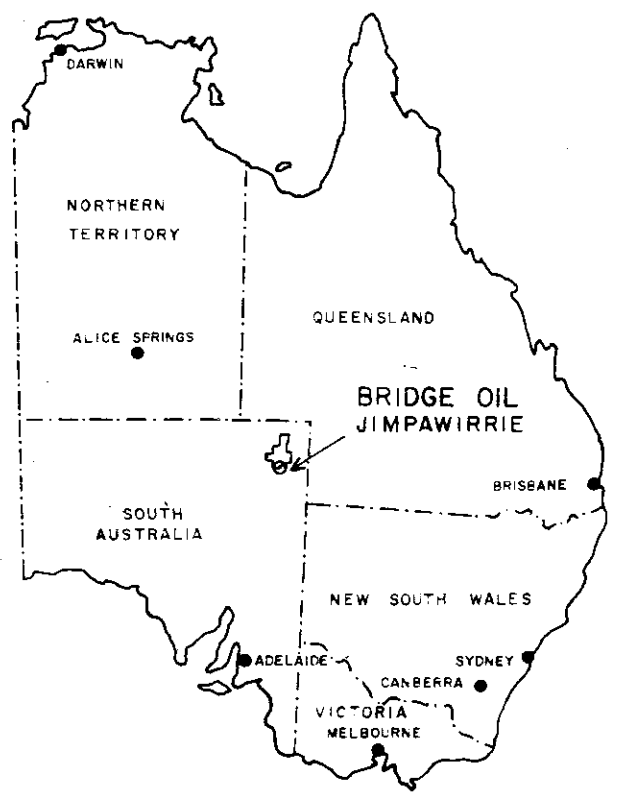
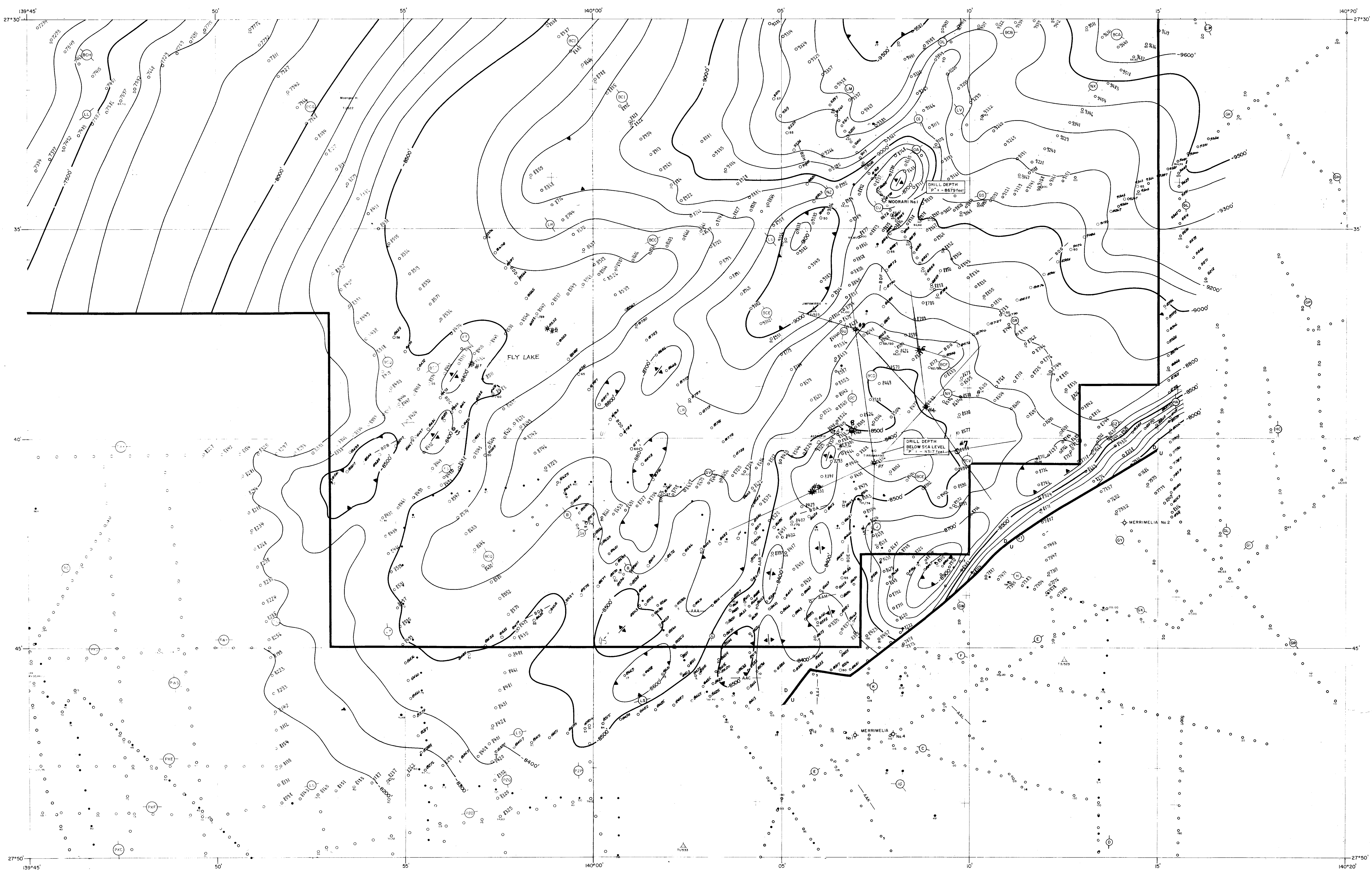
SURVEY
FOR
BRIDGE OIL N.L.
BY
AUSTRAL UNITED GEOPHYSICAL PTY. LTD.
JIMPAWIRRIE SEISMIC SURVEY

"C - P" ISOPACH

CONTOUR INTERVAL: 100 feet
DATUM: SEA LEVEL
INTERPRETATION BY: J.E. MILNER
P.J. DREW / W.J.S. THIRLWELL

VELOCITY ADJUSTED
DATE: JANUARY 1971
PARTY 147



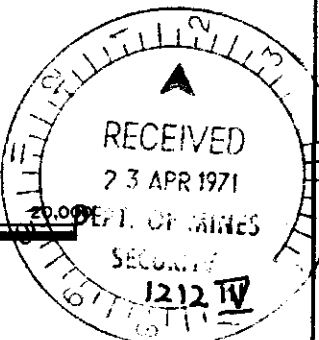
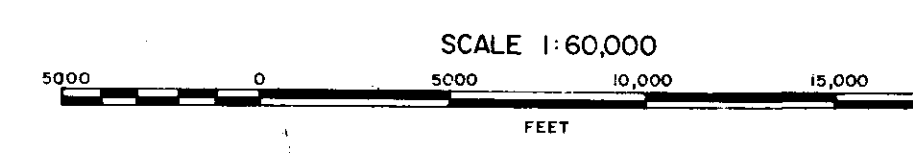


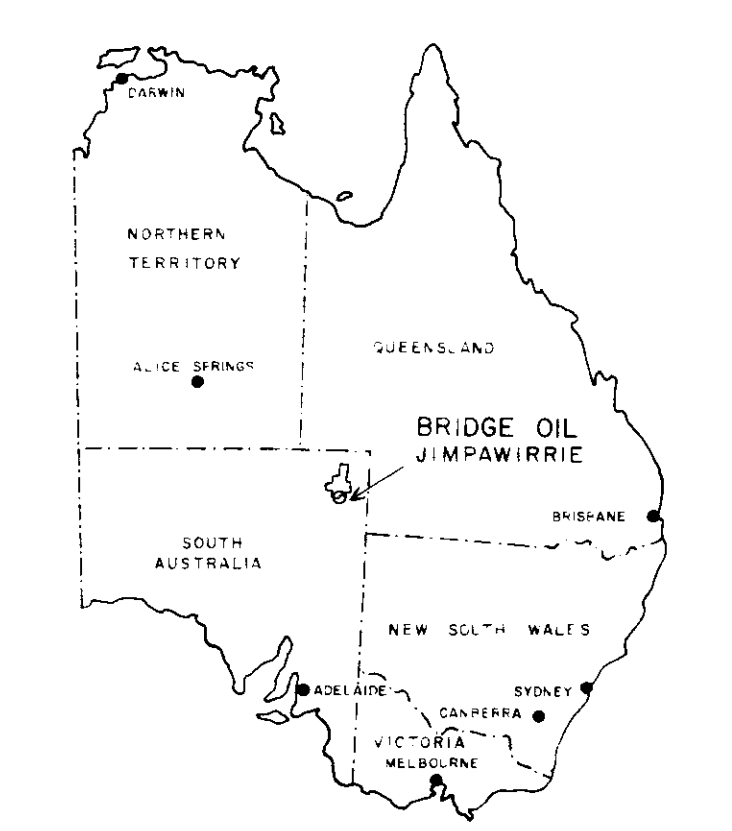
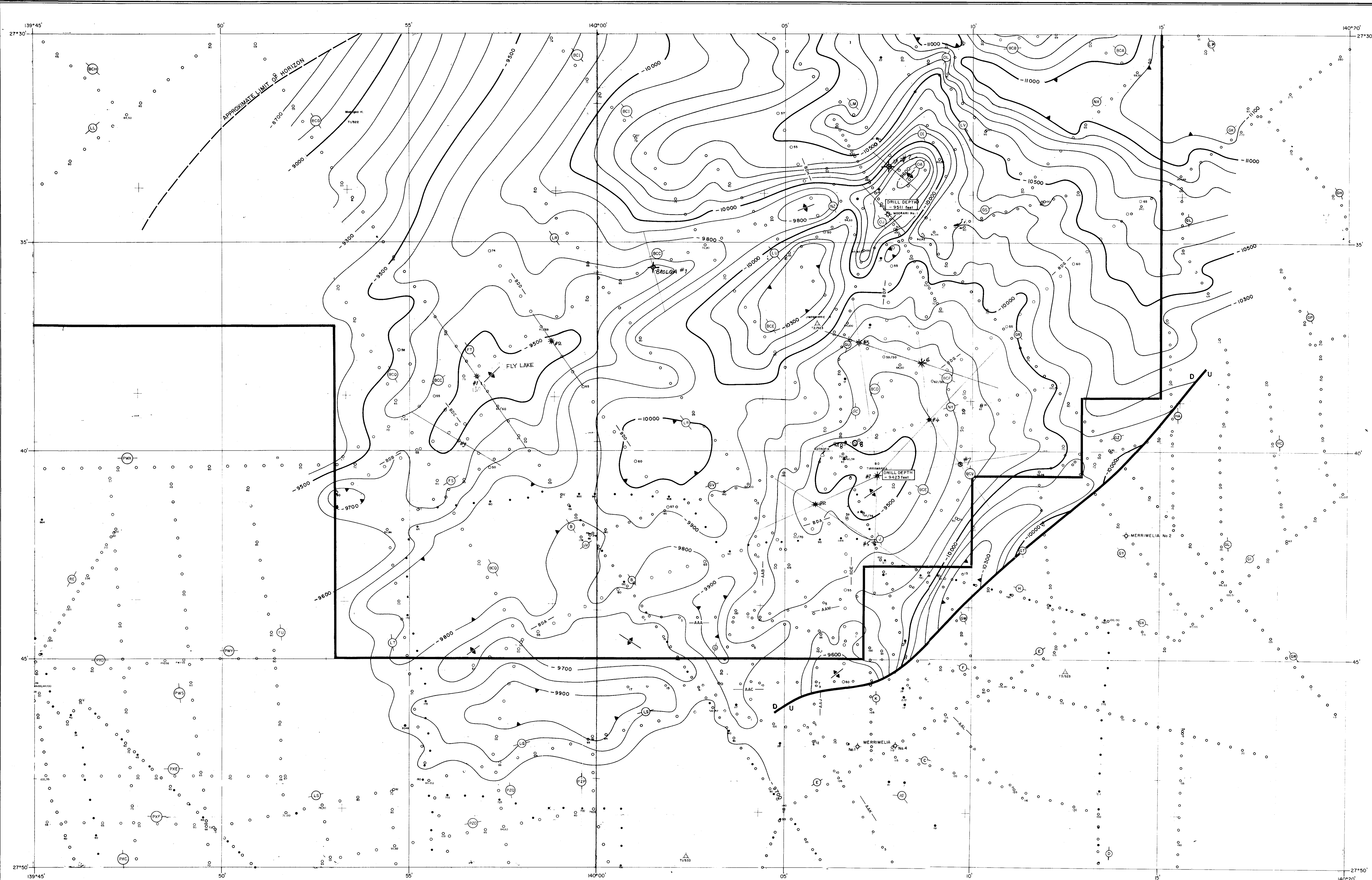
SURVEY
FOR
BRIDGE OIL N.L.
BY
AUSTRAL UNITED GEOPHYSICAL PTY. LTD.
JIMPAWIRRIE SEISMIC SURVEY

"P" HORIZON
(BASE OF MESOZOIC)

CONTOUR INTERVAL: 100 feet
DATUM: SEA LEVEL
INTERPRETATION BY J.E. MILNER
P.J. DREW / W.J.S. THIRLWELL

VELOCITY ADJUSTED
DATE: JANUARY 1971
PARTY 147

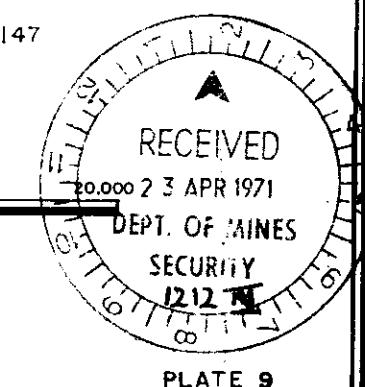


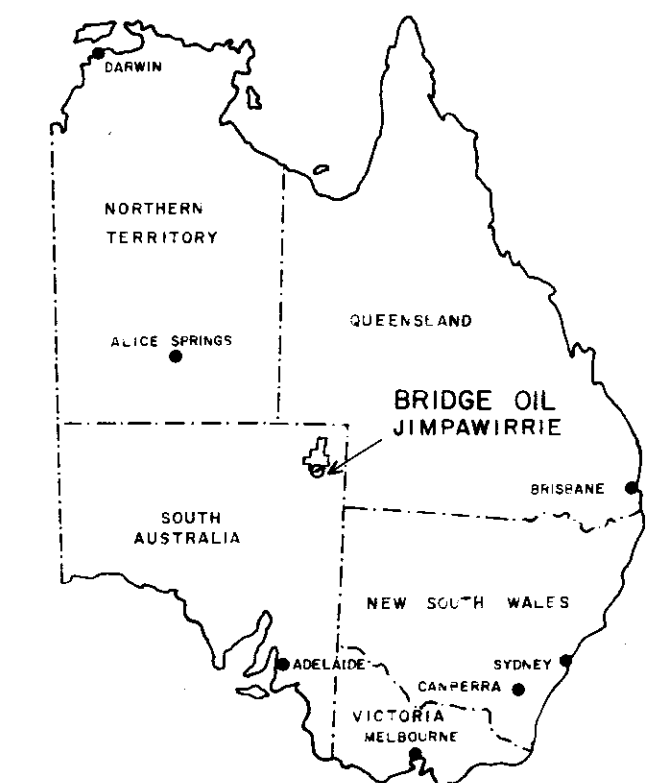
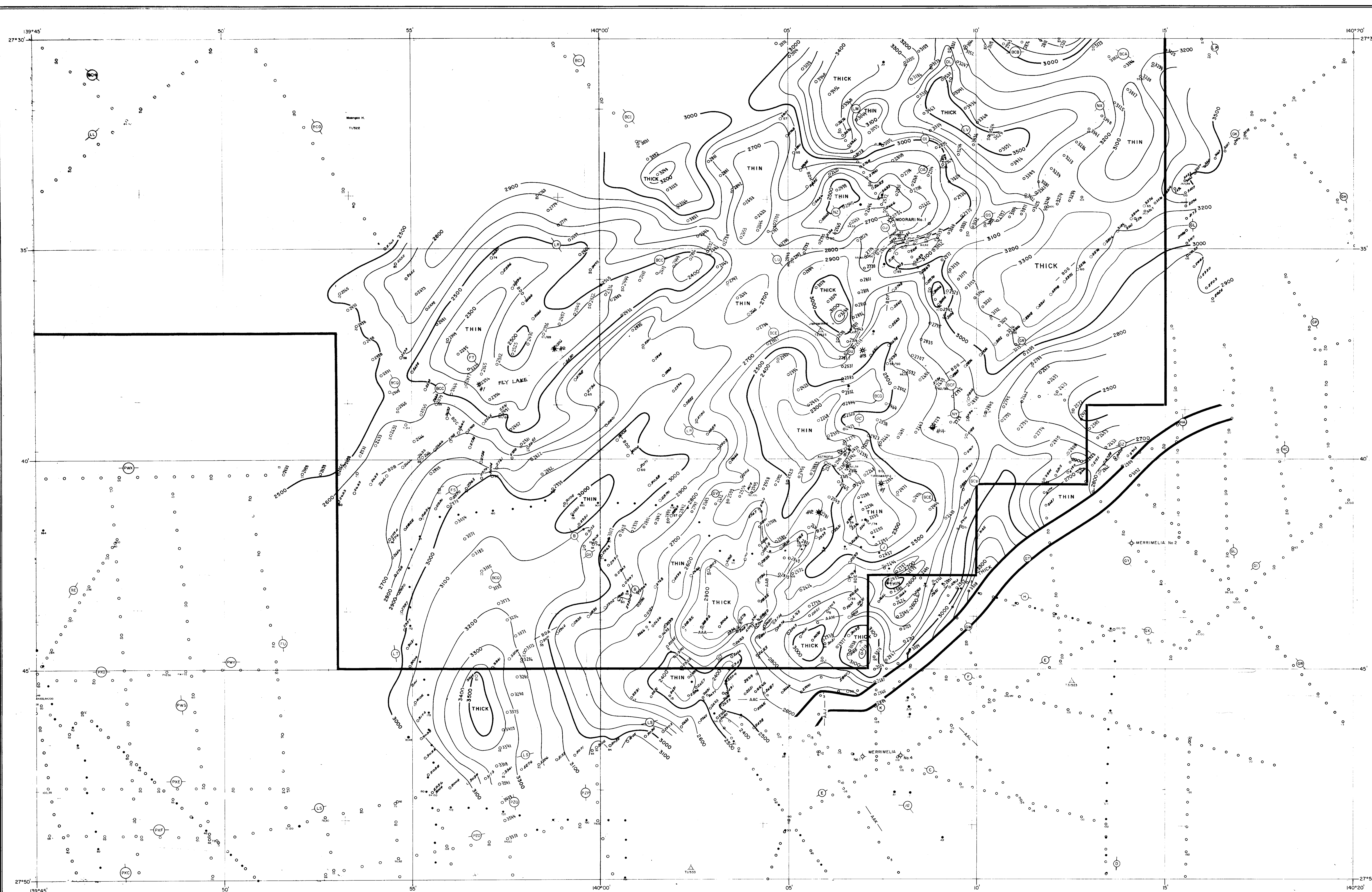


SURVEY
FOR
BRIDGE OIL N.L.
BY
AUSTRAL UNITED GEOPHYSICAL PTY. LTD.
JIMPAWIRRIE SEISMIC SURVEY
TOP LOWER GIDGEALPA
(TIRRAWARRA) SAND

CONTOUR INTERVAL: 100 feet
DATUM: SEA LEVEL
INTERPRETATION BY: J.E. MILNER
VELOCITY ADJUSTED
DATE: JANUARY 1971
PARTY 147

SCALE 1:60,000
1000 5000 10,000 15,000
FEET



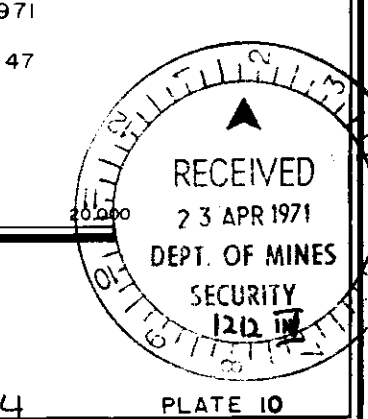


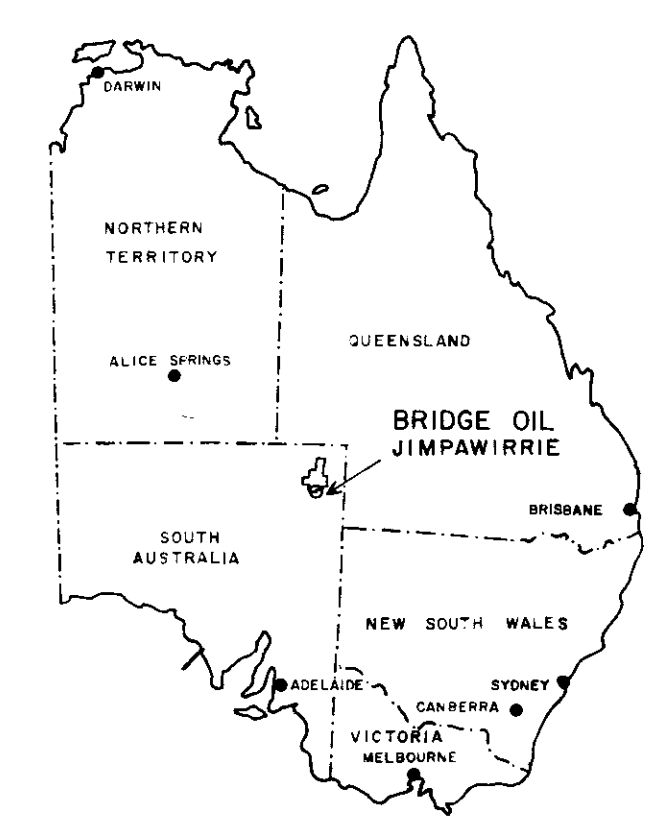
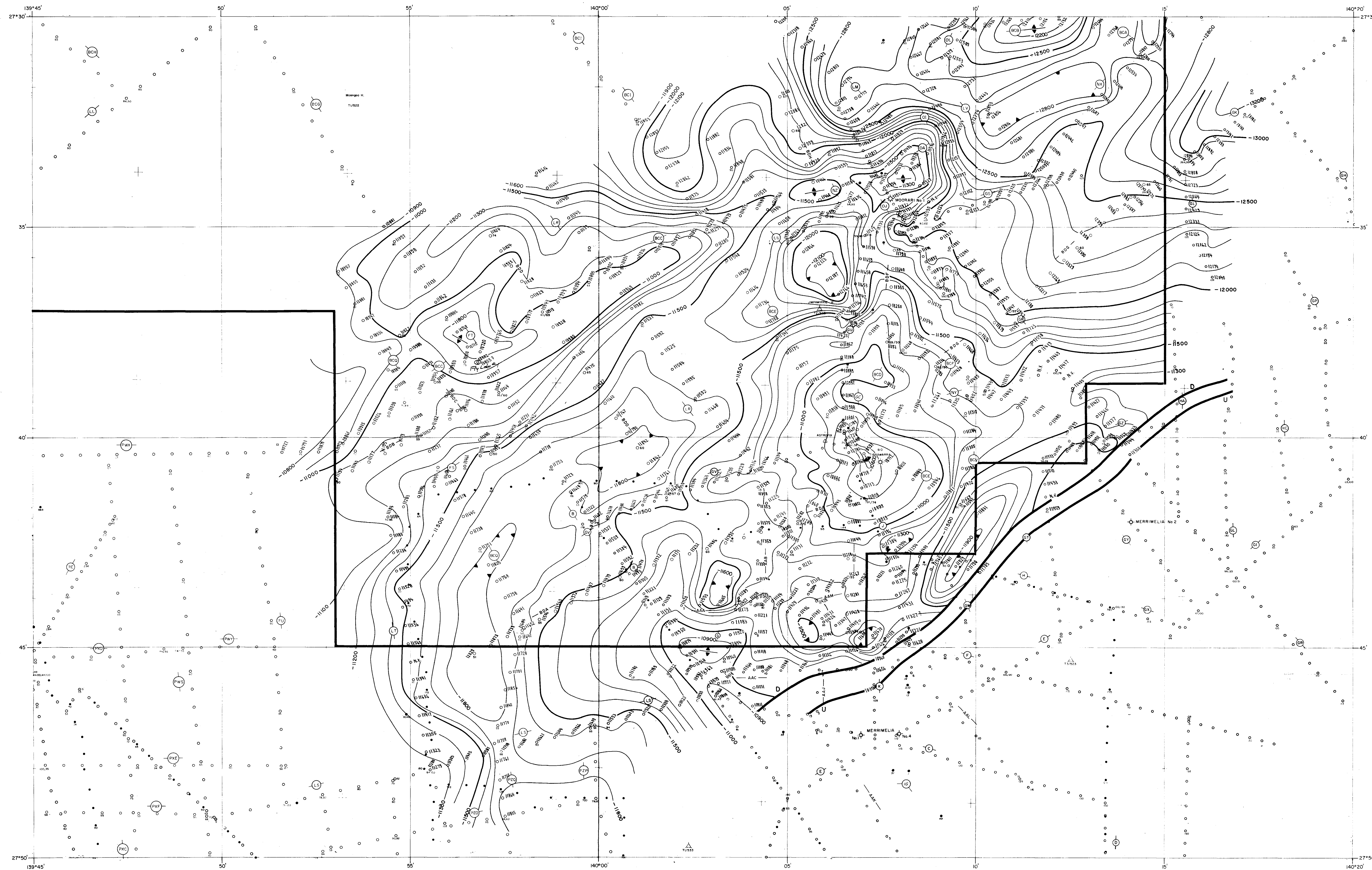
SURVEY
FOR
BRIDGE OIL N.L.
BY
AUSTRAL UNITED GEOPHYSICAL PTY. LTD.
JIMPAWIRRIE SEISMIC SURVEY
"P-REDBEDS" ISOPACH

CONTOUR INTERVAL: 100 feet
DATUM: SEA LEVEL
INTERPRETATION BY P.J. DREW
W.J.S. THIRLWELL

VELOCITY ADJUSTED
DATE: JANUARY 1971
PARTY 147

SCALE 1:60,000
5000 10000 15000
FEET

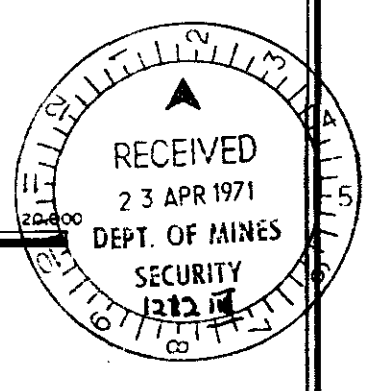


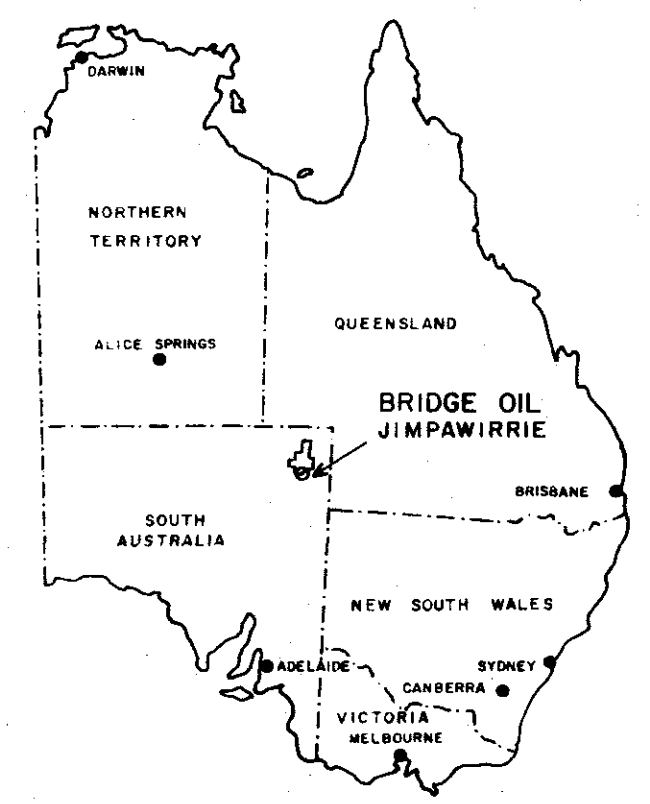
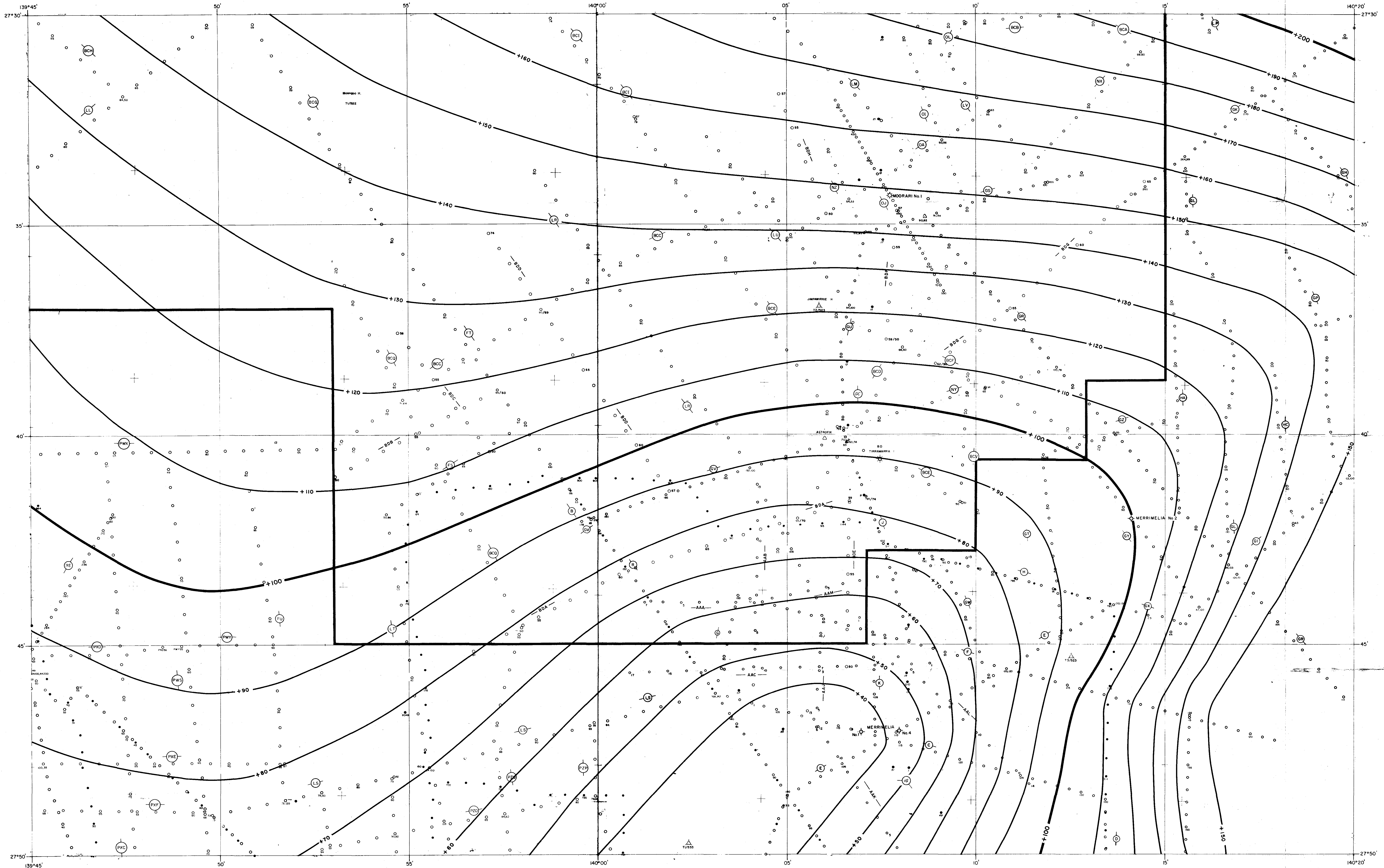


SURVEY
FOR
BRIDGE OIL N.L.
BY
AUSTRAL UNITED GEOPHYSICAL PTY. LTD.
JIMPAWIRRIE SEISMIC SURVEY

TOP OF REDBEDS

CONTOUR INTERVAL: 100 feet
DATUM: SEA LEVEL
INTERPRETATION BY: P.J. DREW
W.J.S. THIRLWELL
VELOCITY ADJUSTED
DATE: JANUARY 1971
PARTY 147
SCALE 1:60,000
1000 5000 10000 15000
FEET



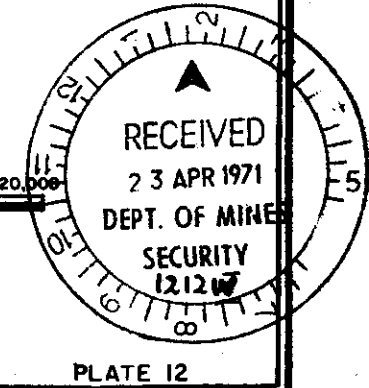


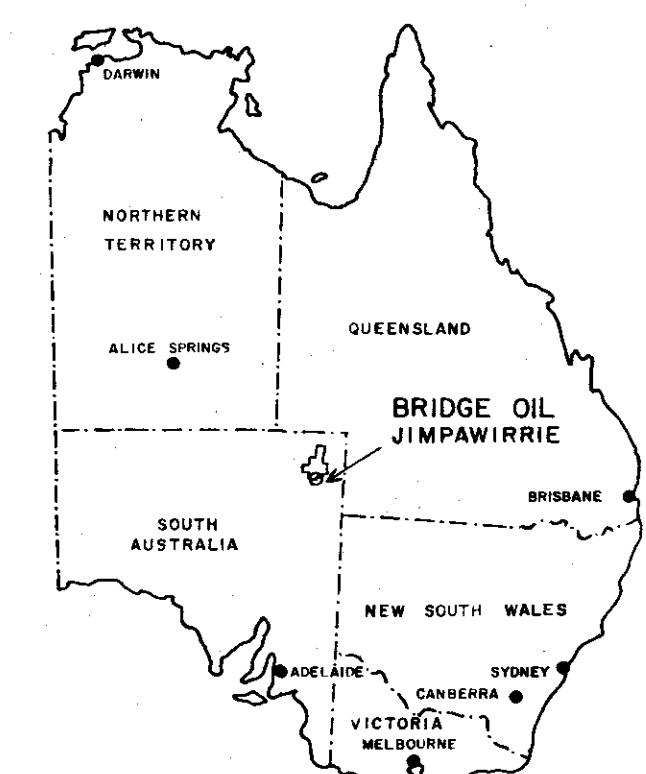
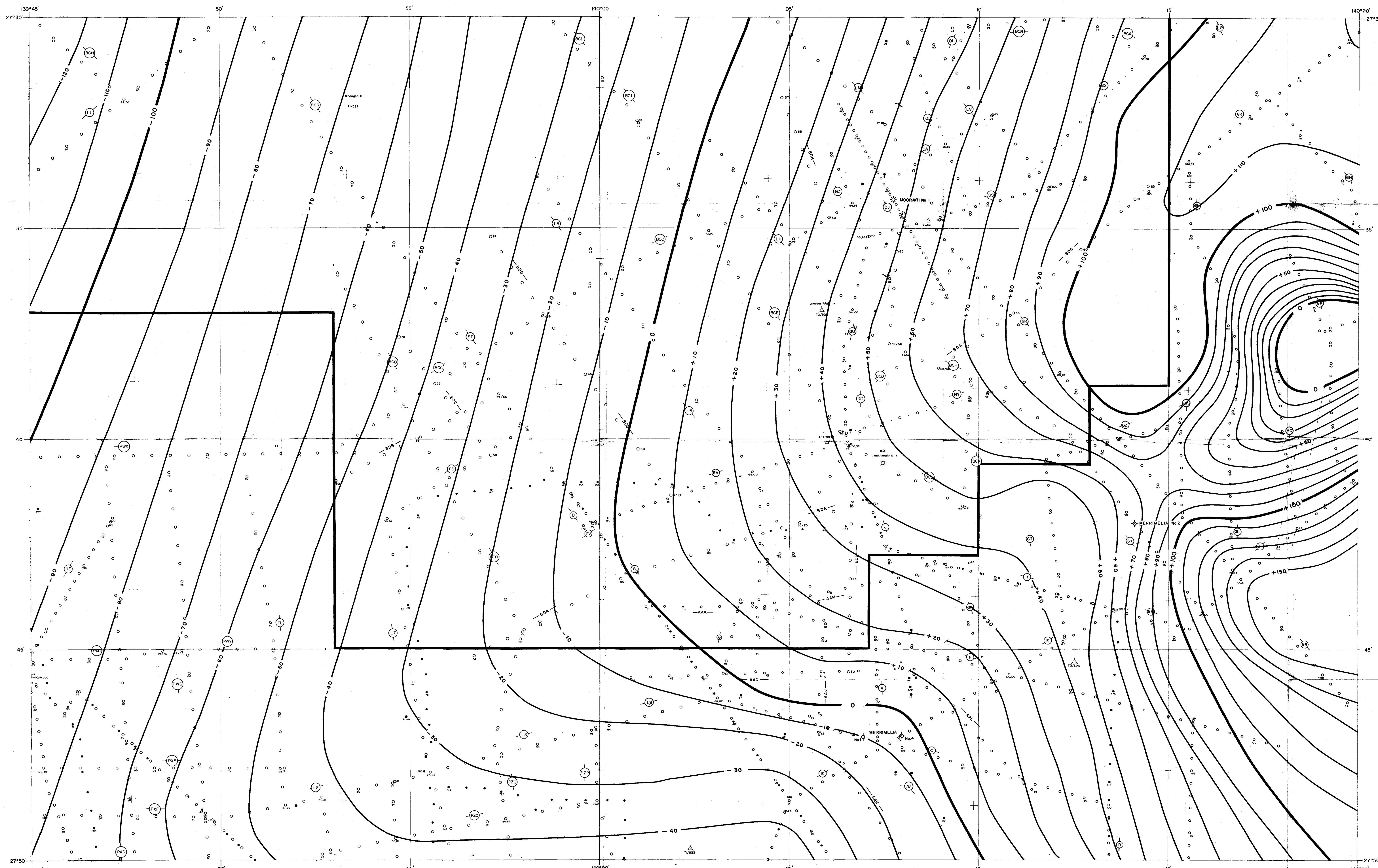
SURVEY
FOR
BRIDGE OIL N.L.
BY
AUSTRAL UNITED GEOPHYSICAL PTY. LTD.
JIMPAWIRRIE SEISMIC SURVEY

"C" ADJUSTMENT MAP

CONTOUR INTERVAL: 10 feet
INTERPRETATION BY DELHI INT. OIL CORP.
PARTY 147
JULY 1969

SCALE 1:60,000
1000 0 10000 20000 30000 40000 50000 60000 70000 80000 90000 100000
FEET

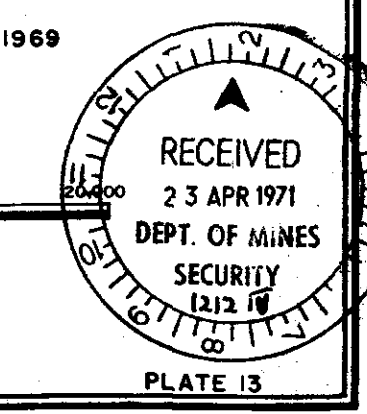


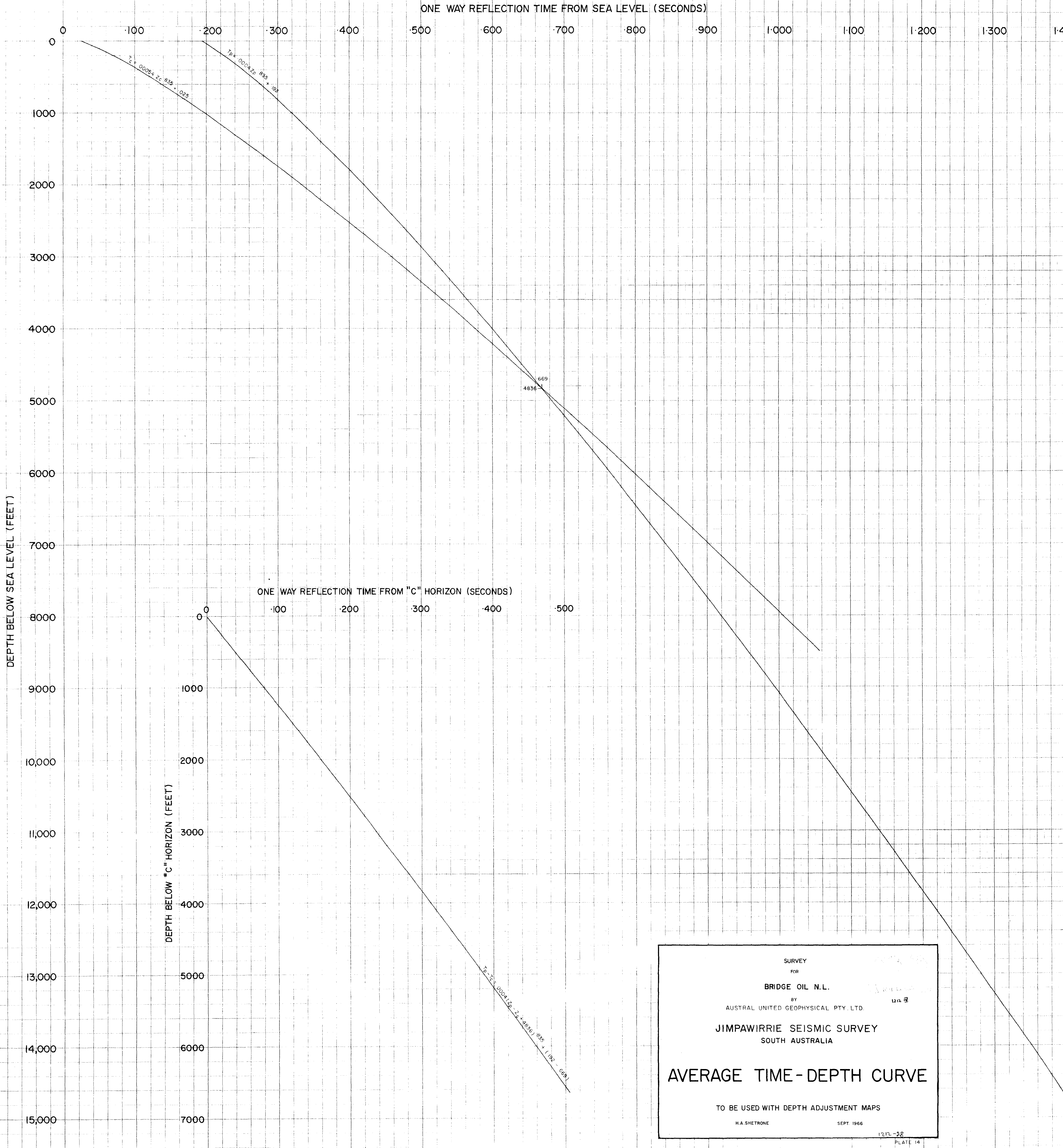


SURVEY
FOR
BRIDGE OIL N.L.
BY
AUSTRAL UNITED GEOPHYSICAL PTY. LTD.
JIMPAWIRRIE SEISMIC SURVEY
"C" - "P"
ADJUSTMENT MAP

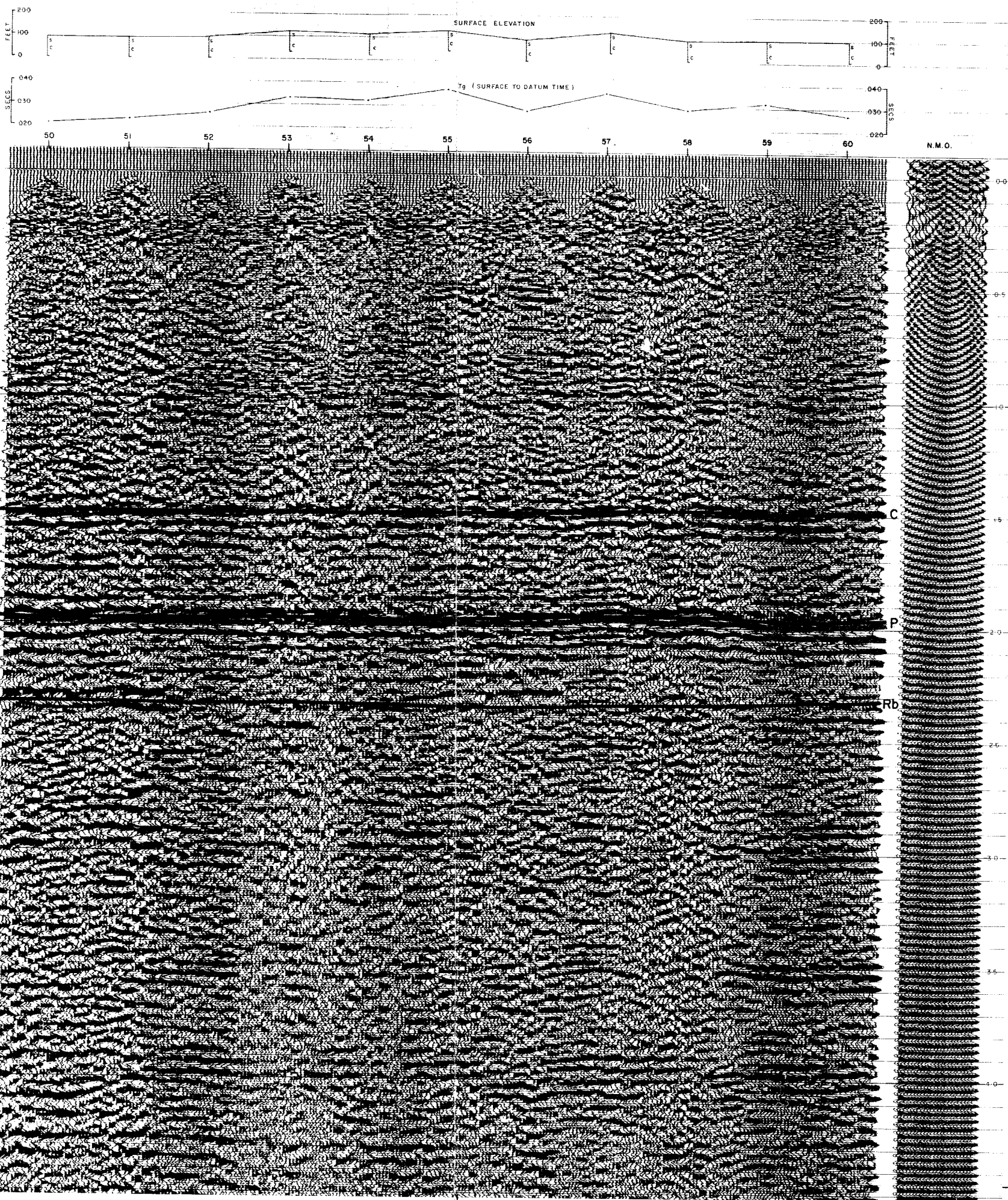
CONTOUR INTERVAL: 10 feet
PARTY 147
INTERPRETATION BY DELHI INT. OIL CORP.
JULY 1969

SCALE 1:60,000
0 5000 10000 15000
FEET





SURVEY
FOR
BRIDGE OIL N.L.
BY
AUSTRAL UNITED GEOPHYSICAL PTY. LTD.
JIMPAWIRRIE SEISMIC SURVEY
SOUTH AUSTRALIA
AVERAGE TIME - DEPTH CURVE
TO BE USED WITH DEPTH ADJUSTMENT MAPS
H.A. SHETRONE
SEPT. 1966
1212-28
PLATE 14



LINE BDB

SHOT HOLE LEGEND

C = Clay
 G = Gravel
 S = Sand
 SC = Sandy Clay
 SS = Sand Stone
 SH = Shale
 LS = Lime Stone
 RK = Rock

SCANNED

Records shot by

AUSTAL UNITED GEOPHYSICAL CORP

Party 147

Section by

RAY GEOPHYSICS (AUST) PTY LTD

Date JAN 1971

DETECTORS/GROUP 24 GROUP INTERVAL 220'

SP INTERVAL 2640 DATUM Sea Level

FILTER W RECORDING NONE PLAYBACK

AVC MED RECORDING MED PLAYBACK

CORRECTION VELOCITY 6500/sec MIX NONE

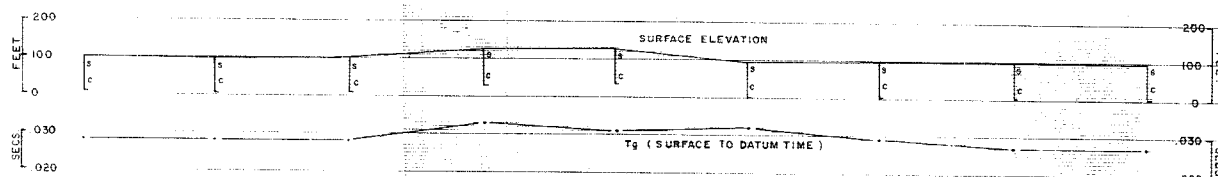
SCALE 1" = 1760' HORIZONTAL 1" = 4" VERTICAL

BRIDGE OIL N.L.

JIMPAWIRRIE SEISMIC SURVEY AREA

LINE BDB S.P's 50-60

(212-11)



LINE BDC

SHOT HOLE LEGEND

C - Clay
 G - Gravel
 S - Sand
 SC - Sandy Clay
 SS - Sand Stone
 SH - Shale
 LS - Lime Stone
 RK - Rock

SCANNED

Records shot by

AUSTRAL UNITED GEOPHYSICAL CORP.

Party 147

Section by

RAY GEOPHYSICS (AUST.) PTY. LTD

Date JAN 19 1971

DETECTORS/GROUP 24 GROUP INTERVAL 220'

SP INTERVAL 2640 DATUM Sea Level

FILTER A RECORDING NONE PLAYBACK

AVC MED RECORDING MED PLAYBACK

CORRECTION VELOCITY 6500/sec MIX NONE

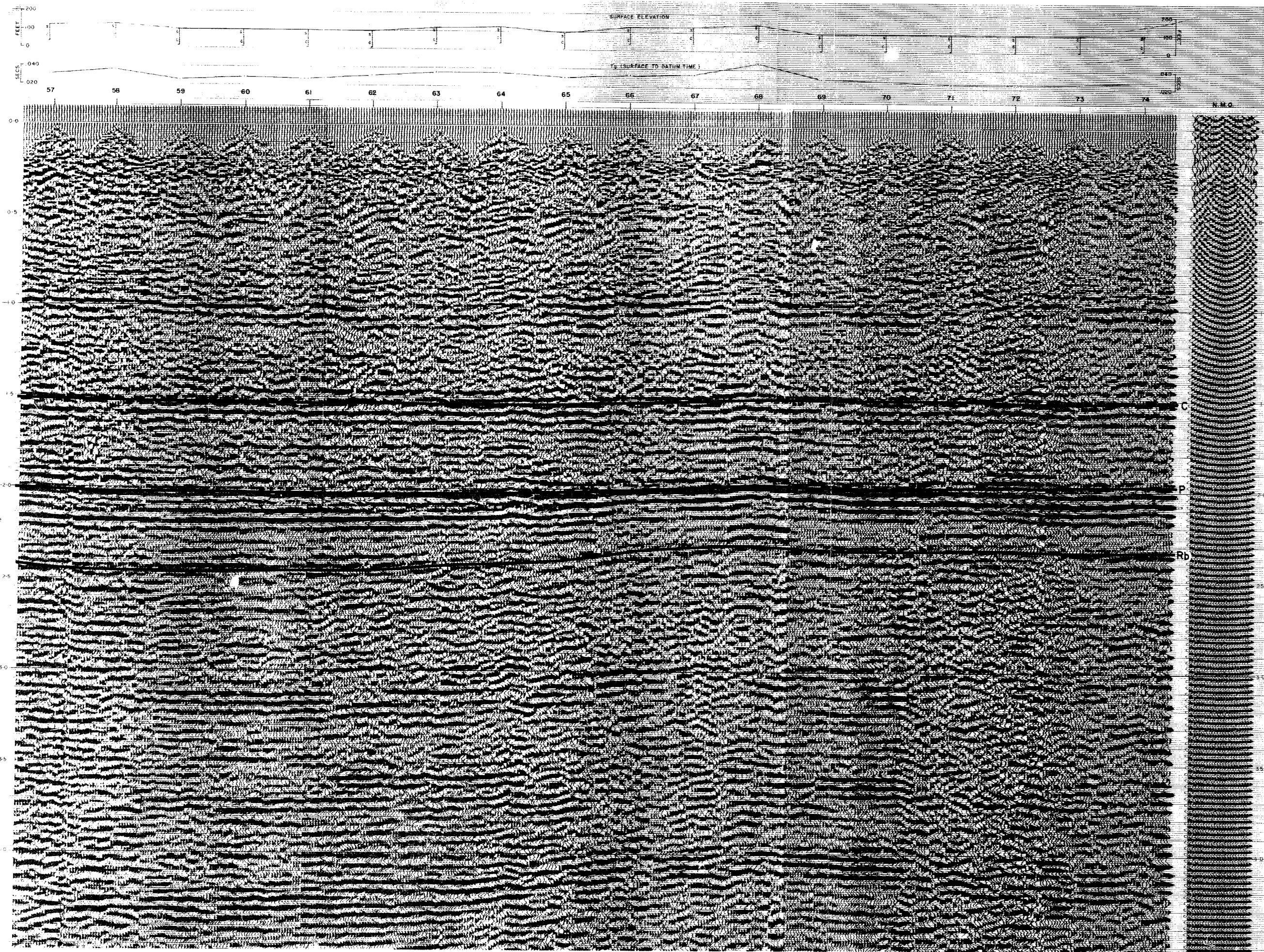
SCALE 1" = 1760' HORIZONTAL 1sec = 4" VERTICAL

BRIDGE OIL N.L.

JIMPAWIRRIE SEISMIC SURVEY AREA

LINE BDC S.P's 50-58

1212-12

LINE BDD

SHOT HOLE LEGEND

C = Clay
 G = Gravel
 S = Sand
 SC = Sandy Clay
 SG = Sand Stone
 SH = Shale
 LS = Lime Stone
 RK = Rock

SCANNED

Records shot by
 AUSTRAL UNITED GEOPHYSICAL CORP

Party 147

Section by
 RAY GEOPHYSICS (AUST.) PTY LTD.

Date: JAN , 1971

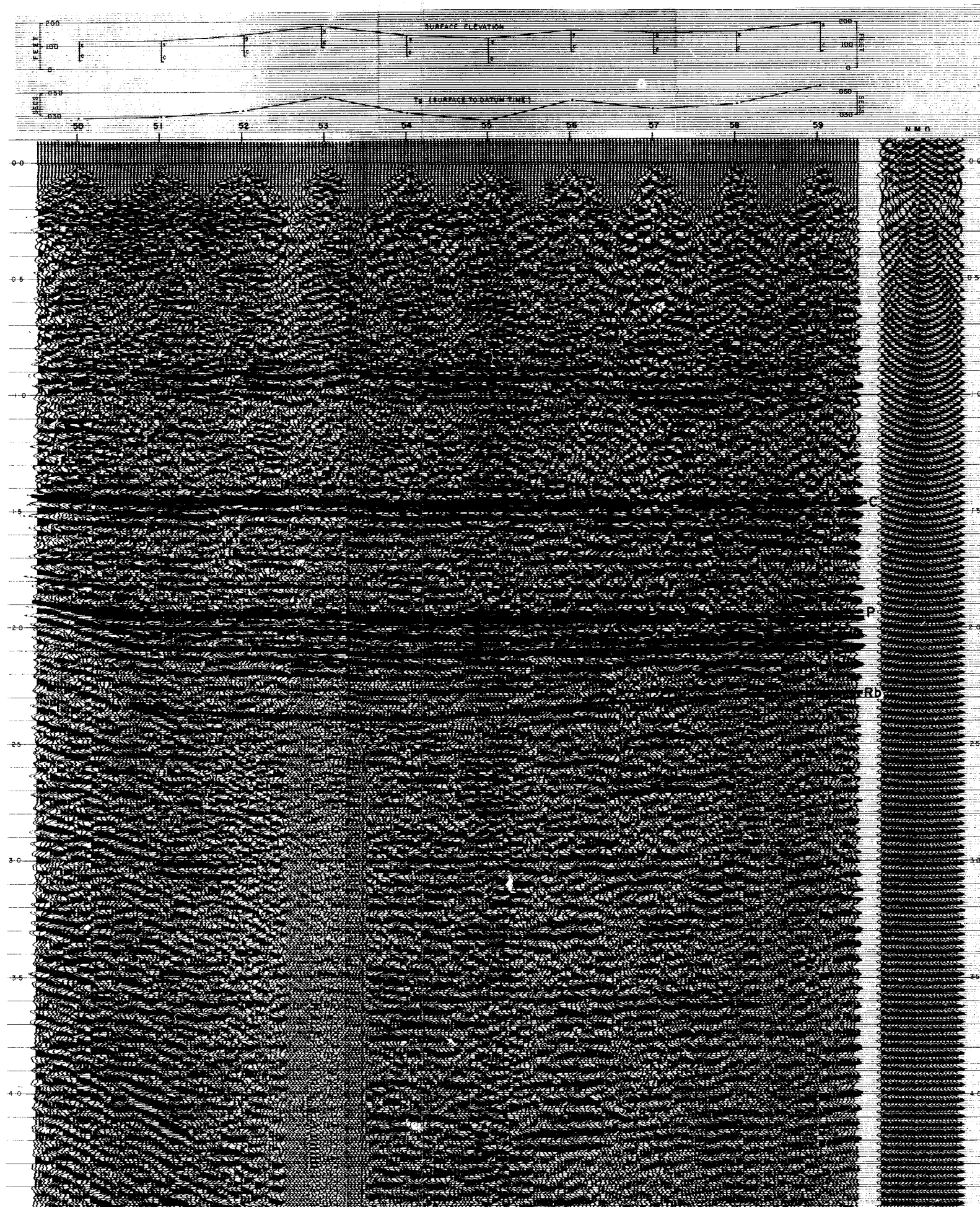
DETECTORS/GROUP 24 GROUP INTERVAL 220'
 SP INTERVAL 2640 DATUM Sea Level
 FILTER W RECORDING NONE PLAYBACK
 AVC MED RECORDING MED PLAYBACK
 CORRECTION VELOCITY 6500/sec MIX NONE
 SCALE 1" = 1760' HORIZONTAL 1sec = 4.2' VERTICAL

BRIDGE OIL N.L.

JIMPAWIRRIE SEISMIC SURVEY AREA

LINE BDD S.P's 57-74

1212-13



SHOT HOLE LEGEND

C = Clay
G = Gravel
S = Sand
SC = Sandy Clay
SS = Sand Stone
SH = Shale
LS = Lime Stone
RK = Rock

SCANNED

Records shot by

AUSTAL UNITED GEOPHYSICAL CORP

Party 147

Section by

RAY GEOPHYSICS (AUST) PTY LTD

Date JAN , 19 71

DETECTORS/GROUP 24 GROUP INTERVAL 220'

SP INTERVAL 2640 DATUM Sea Level

FILTER $\frac{1}{s}$ RECORDING NONE PLAYBACK

AVC MED RECORDING MED PLAYBACK

CORRECTION VELOCITY 6500/sec MIX NONE

SCALE 1" = 1760' HORIZONTAL 1 sec = 4' VERTICAL

BRIDGE OIL N.L.

JIMPAWIRRIE SEISMIC SURVEY AREA

LINE BDE S.P.'s 50 — 59

1212-14

061

LINE BDF

SHOT HOLE LEGEND

C = Clay
 G = Gravel
 S = Sand
 SC = Sandy Clay
 SS = Sand Stone
 SH = Shale
 LS = Lime Stone
 RK = Rock

SCANNED

Records shot by

AUSTAL UNITED GEOPHYSICAL CORP.

Party 147

Section by

RAY GEOPHYSICS (AUST) PTY LTD

Date: JAN , 1971

DETECTORS/GROUP 24 GROUP INTERVAL 220'

SP INTERVAL 2640 DATUM Sea Level

FILTER W RECORDING NONE PLAYBACK

AVC MED RECORDING MED PLAYBACK

CORRECTION VELOCITY 6500/sec MIX NONE

SCALE 1" = 1760' HORIZONTAL 1sec = 4' VERTICAL

BRIDGE OIL N.L.

JIMPAWIRRIE SEISMIC SURVEY AREA

LINE BDF S.P.'s 50-57

1212-15

062

LINE BDG

SHOT HOLE LEGEND

- C = Clay
- G = Gravel
- S = Sand
- SC = Sandy Clay
- SS = Sand Stone
- SH = Shale
- LS = Lime Stone
- RK = Rock

SCANNED

Records shot by
AUSTRAL UNITED GEOPHYSICAL CORP
Party 147

Section by
RAY GEOPHYSICS (AUST) PTY LTD
Date JAN 1971

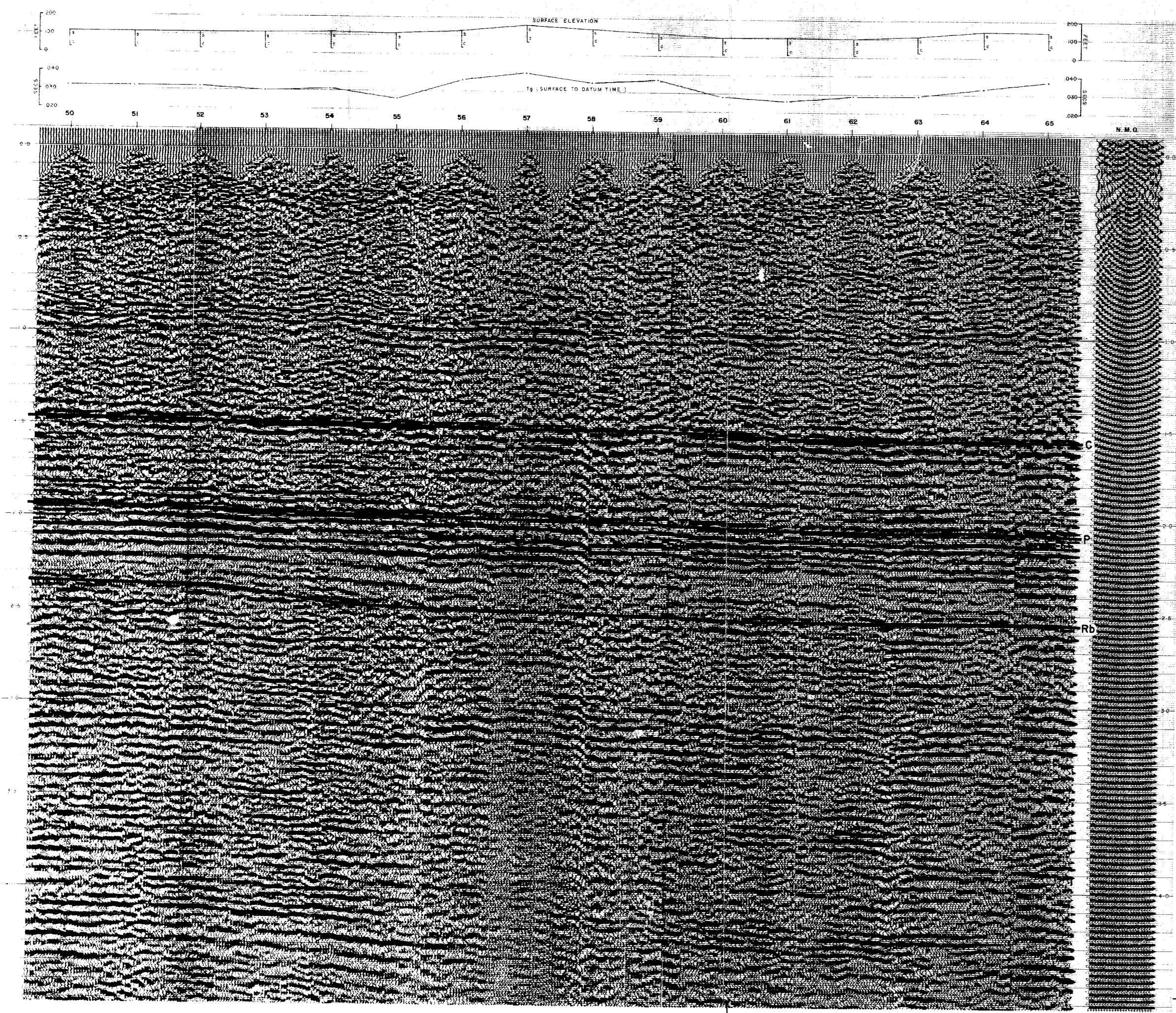
DETECTORS/GROUP 24 GROUP INTERVAL 220'
SP INTERVAL 2640 DATUM Sea Level
FILTER W RECORDING NONE PLAYBACK
AVC MED RECORDING MED PLAYBACK
CORRECTION VELOCITY 6500/sec MIX NONE
SCALE 1" = 1760' HORIZONTAL 1sec = 4.2' VERTICAL

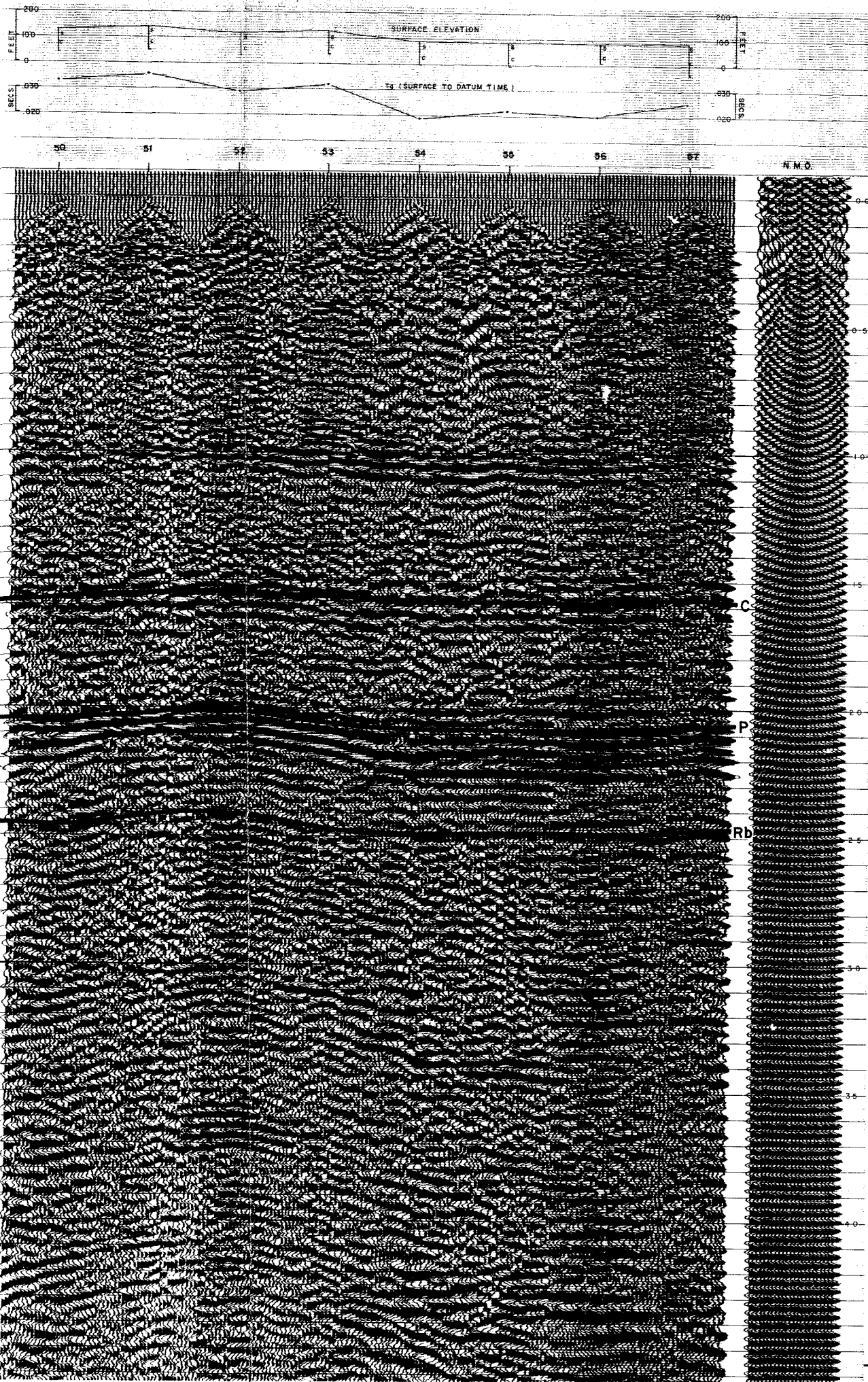
BRIDGE OIL N.L.

JIMPAWIRRIE SEISMIC SURVEY AREA

LINE BDG S.P.s 50-65

1212-16





063

LINE BDH

SHOT HOLE LEGEND

C = Clay
G = Gravel
S = Sand
SC = Sandy Clay
SG = Sand Stone
SH = Shale
LS = Lime Stone
RK = Rock

SCANNED

Records shot by

AUSTRAL UNITED GEOPHYSICAL CORP.

Party 147

Section by

RAY GEOPHYSICS (AUST) PTY. LTD

Date: JAN , 1971 .

DETECTORS/ GROUP 24 GROUP INTERVAL 220'

S.P. INTERVAL 2640 DATUM Sea Level

FILTER 1W RECORDING NONE PLAYBACK

AVC MED RECORDING MED PLAYBACK

CORRECTION VELOCITY 6500/sec MIX NONE

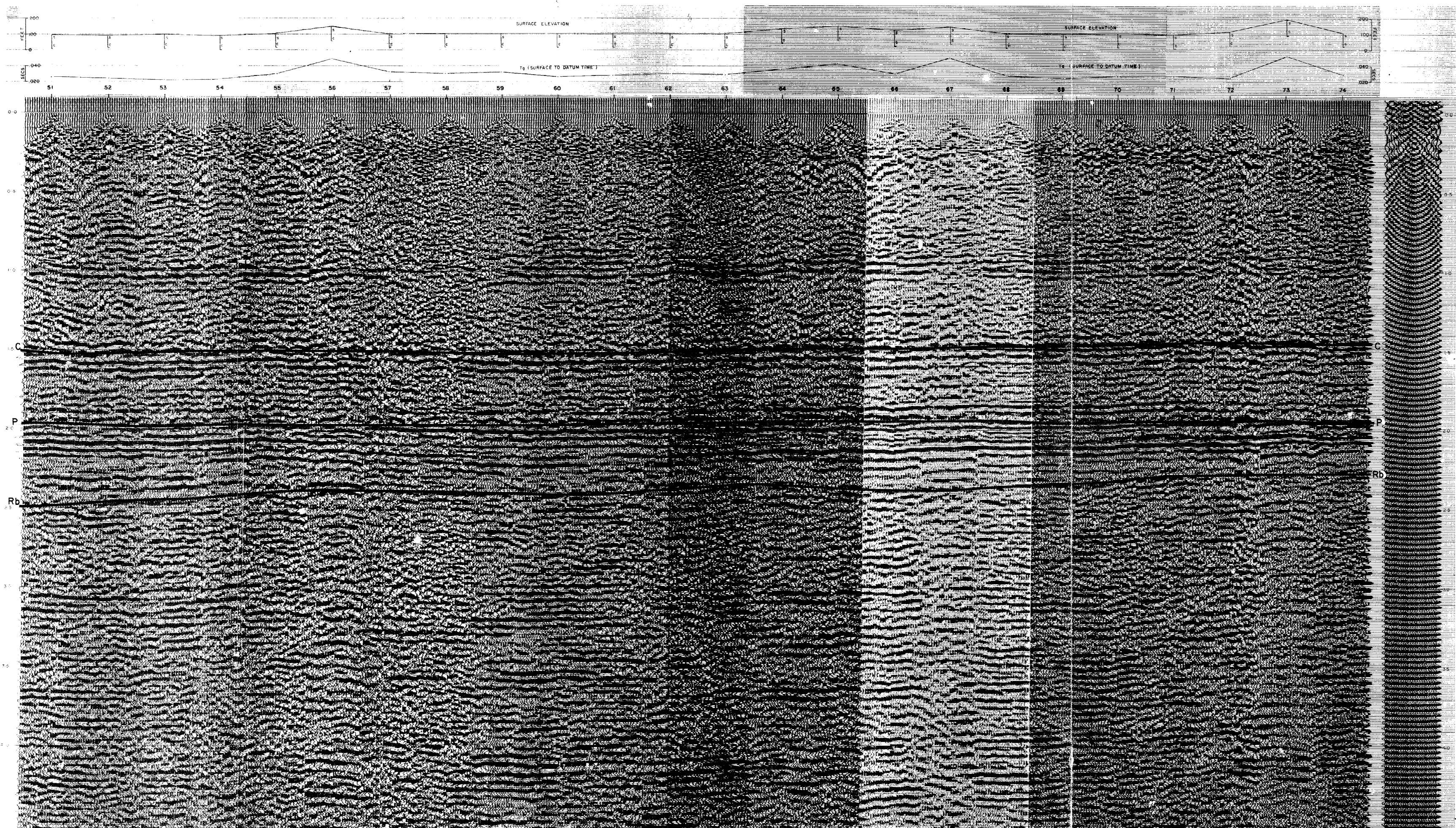
SCALE 1" = 1760' HORIZONTAL 1sec = 4 2" VERTICAL

BRIDGE OIL N.L.

1212-17

JIMPAWIRRIE SEISMIC SURVEY AREA

LINE BDH S.P.'s 50-57



064

4TH FLOOR Strongroom

~~REMOVED~~

PATCHAWARRA CENTRAL

SEISMIC AND GRAVITY SURVEY

FINAL REPORT

FOR

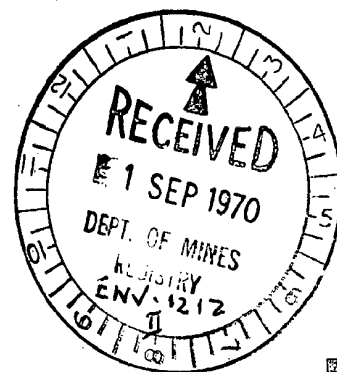
BRIDGE OIL N.L.

BY

UNITED GEOPHYSICAL CORPORATION

PARTY 131

SOUTH AUSTRALIA



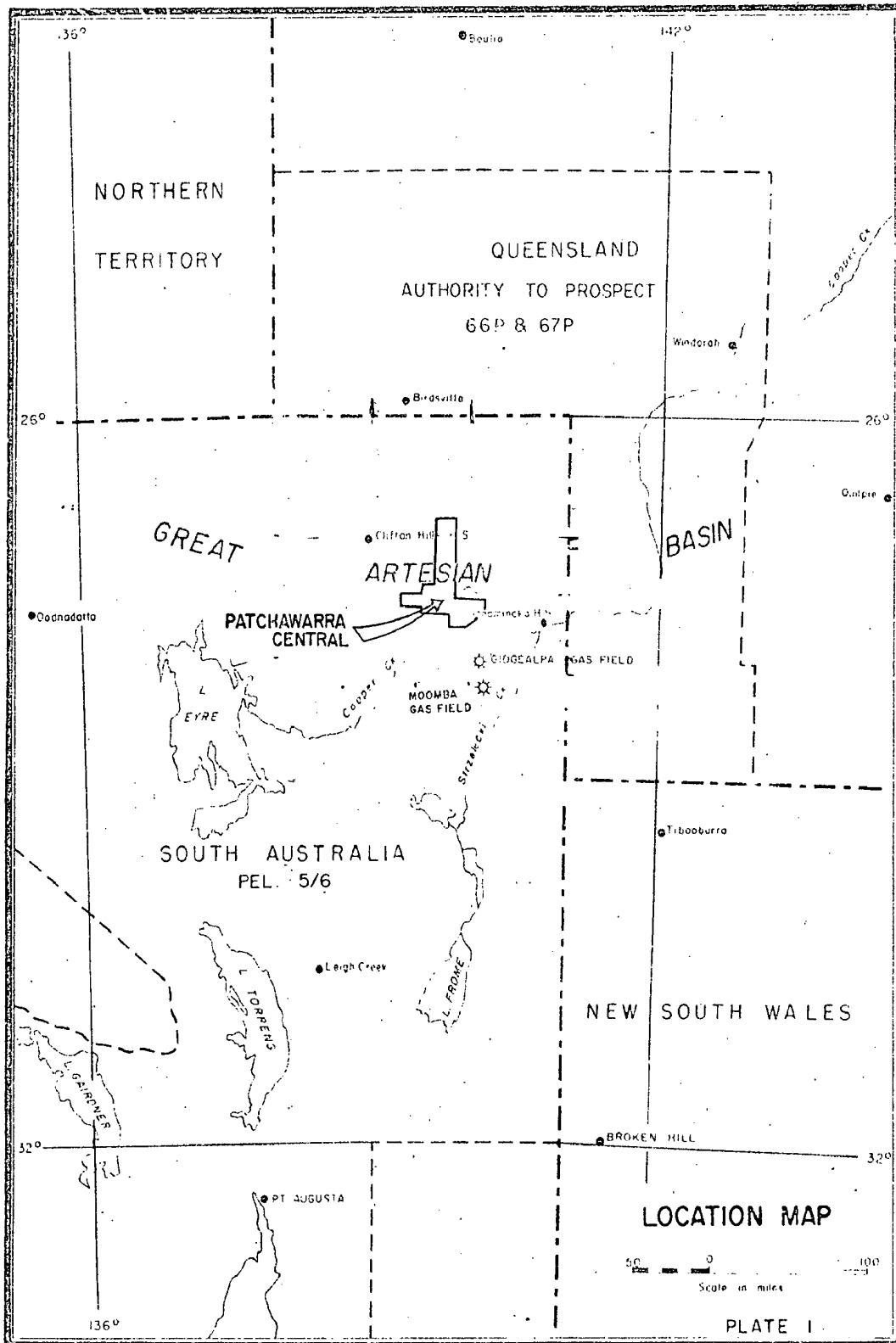
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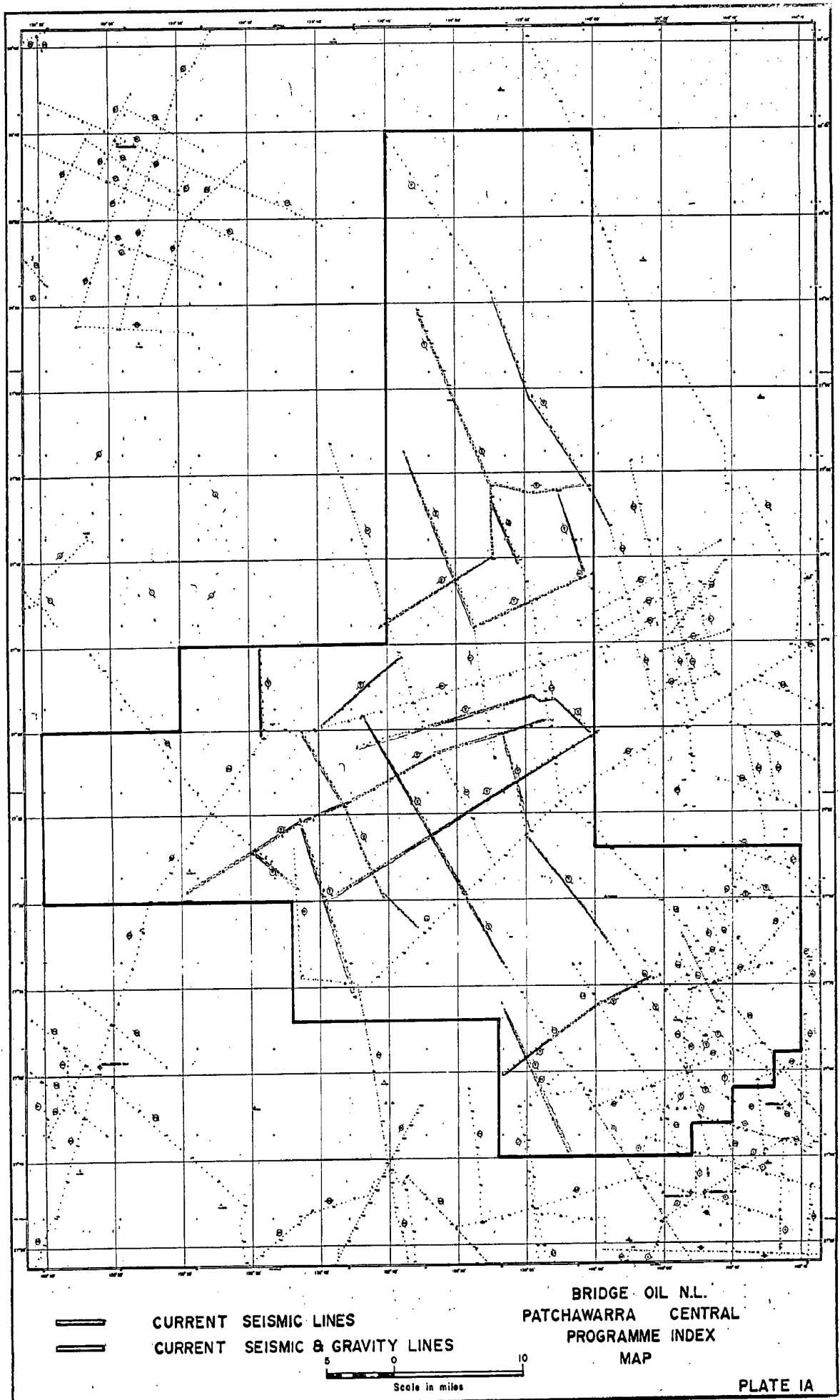
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*Supplied by Bridge Oil N.L.

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ABSTRACT

A seismic and gravity survey was conducted for Bridge Oil N.L. by United Geophysical Corporation during January-February and May-June 1970. The area surveyed was within the Patchawarra Central Area of P.E.L.'s 5 and 6, South Australia.

Results showed a Palaeozoic erosional surface dipping generally from north-west to south-east overlain by Mesozoic and younger rocks roughly conformable to it.

Within the Palaeozoic section several events were mappable and were tentatively correlated as follows.

In the south-east the structure on the erosional surface is typical of that occurring in the Permian of that area. Progressing north-west the Permian pinches out against south-east dipping Cambrian(?) rocks and the erosional surface becomes typical of the structure of the Cambrian(?) subcrop. Further to the north-west the Cambrian(?) subcrop gives way to the subcrop of the Volcanic(?) section which lies beneath it.

There is some suggestion that the sequence reverses further to the north-west, however seismic results are inconclusive. Gravity results on the other



hand strongly suggest that a basin exists to the north-west.

There are no significant structural closures and any accumulation of hydrocarbons would be stratigraphically controlled.

INTRODUCTION

The seismic survey was conducted for Bridge Oil N.L. of Sydney, N.S.W. in the Patchawarra Central Area, a farm-out from Delhi-Santos of part of P.E.L.'s 5 and 6, South Australia (See Location Map Plate 1.). That part of the area to the east of 140°E longitude is known as the Tirrawarra area.

The first part of the survey was conducted between the 22nd to 28th January and 31st January to 19th February 1970, and the second work period was 21st May to 11th June 1970.

The geophysical contractor was United Geophysical Corporation with main offices in Pasadena, California, U.S.A., and Australia area office in Brisbane, Queensland. The survey was conducted by Seismic Party 131 with offices in Adelaide, South Australia. Details of equipment and personnel are presented in Appendices I and II.

The survey was supervised on behalf of Bridge Oil N.L., by J.E. and C.J. Milner, Consultant Geophysicists of Brisbane, Queensland.



The topography of the area consists of arid claypan flats and high sand-dunes. To the far north "gibber" plains of the duracrust type cover large areas. The area is drained by tributaries of the Cooper's Creek network and vegetation is restricted to the banks of these few generally dry creek beds and associated flats and water holes.

During the first work period base camp was set up between the Line BCJ and Boggy Lake whilst the inter-section of Lines BCI and LL was considered more convenient during the second. Fly camps were used in the remote northern area.

Access within the surveyed areas was provided by bulldozed lines, access tracks and old seismic lines.

During the first work period the climate consisted of mostly very hot days and warm nights with periods of strong gusty winds and sand storms. Dangerous static charge conditions created by a severe sandstorm caused an early shut-down of the first work period. Heavy rain slowed operations in February for several days. However, seasonal changes brought very cold nights and warm days during the second work period.

The Gravity Survey was conducted during and for some time after the first work period. Points were metered



at quarter mile intervals coincident with shot-points and mid-points along the seismic lines.

Statistics for the area are presented in Appendix III.



PURPOSE OF THE SURVEY

(Supplied by Bridge Oil N.L.)

The general objective of the survey programme was to provide structural and stratigraphic control in the north western part of the Coopers Creek Basin.

The area is to the north of the Gidgealpa - Merrimelia structural trend. The Gidgealpa structure is a well known gas condensate field, while encouraging oil and gas shows were encountered in wells on the Merrimelia structure.

Further details of the objectives of the survey were:-

1. To define petroleum prospects thought to be favourable for structural and/or stratigraphic drilling.
2. To define the edge of the Permian basin which may provide clues to the location of stratigraphic traps.
3. To determine the relation of Upper Triassic sediments as encountered in Pandieburra and the Lower Triassic sediments known from the Gidgealpa - Merrimelia area.



4. To investigate the Pre-Permian sequence which at Gidgealpa contained highly prospective dolomites with gas shows.
5. To reveal structural leads which may be further investigated if results of drilling (as in (1) above) indicate this is desirable.
6. To provide data which will contribute to a better understanding of basin architecture.
7. To utilize the technique of Offset Profiles as an aid in stratigraphic definition, particularly in respect to Lower Permian and Middle and Lower Palaeozoic sediments.
8. To provide gravity data along all new seismic traverses as an aid to interpretation of seismic data.



REGIONAL GEOLOGY

(Supplied by Bridge Oil N.L.)

The survey was conducted in the North Eastern part of the Coopers Creek Basin in South Australia.

The Coopers Creek Basin was probably formed subsequent to the Siluro-Ordovician Bowring Orogeny. Sedimentation within this Basin may have started in the Devonian. However, so far only Permian and younger sediments have been encountered and identified in the numerous wells drilled up to date. The greatest volume and areal extent of sedimentation was during the Jurassic and Cretaceous.

Folding in the Coopers Creek Basin was gentle and in general took place along lines of weakness in the underlying Lower Palaeozoic rocks. Most of this folding started during the deposition of the Permian as can be demonstrated at such structures as the Gidgealpa-Merrimelia Anticline.

Underlying the Permian and younger rocks, Middle and Lower Palaeozoic rocks occur. They are usually much more disturbed and often constitute economic basement.



The Jurassic and Cretaceous sequences contain thick beds of shales and sandstones which could be source and reservoir beds for hydrocarbon generation and entrapment given the proper hydrodynamic and structural conditions.

Especially the Triassic sediments are expected to be prospective in this area because of possible depositional pinch/outs towards the western edge of the Coopers Creek Basin and the possible occurrence of Upper Triassic sediments as encountered in the Pandieburra - Putamurdi area.

Permian sediments throughout the Coopers Creek Basin are prospective as evidenced by the Gidgealpa, Moomba, Daralingie and Toolachie discoveries. The Permian sediments produce in the newly discovered Tirrawarra oil field.

Carboniferous and Devonian sediments have not been proven to occur within the Coopers Creek Basin. It is possible that a petroliferous sequence such as exists at Gilmore could be present within the Patchawarra low, the central part of which occurs in the farmout area.

Ordovician sediments encountered in the vicinity of the area proved to be steeply dipping and tight and so far do not form attractive targets for oil or gas exploration.



In summary, the hydrocarbon potential of the Patchawarra low of the Coopers Creek Basin is great, with multiple objectives in much of the area, both structural and stratigraphic.

EXISTING GEOPHYSICS

(Supplied by Bridge Oil N.L.)

Magnetic basement depth estimates by C.G.G. range from 13,200 to 8,600 feet within the survey area. It should be noted however that these are only estimates and considerable differences may be expected. In general past drilling in the Coopers Creek Basin proved the estimates to be too shallow.

Gravity data in the survey area indicate the presence of intra basement (or at least pre-Permian) contrasts which will be investigated by this survey.

Seismic reflection profiling has indicated a number of anticlinal structures as well as a significant thickness of Permian rocks.



FIELD PROCEDURE1. General

Most base camp requirements were supplied from Adelaide. Suitable airstrips were constructed in close proximity to both base camps and chartered aircraft conveyed supplies and mail to the crew on-site approximately once a week. Fuel for the operation was supplied by road transport from a depot at Lyndhurst whilst explosives were trucked from Brisbane.

Radio contact between base camp and personnel in the field was maintained via the recording crew. Contact with the town office was provided through the Royal Flying Doctor Radio Network and by this means telegrammed requests, progress reports etc. could be passed on.

Travelling conditions varied within the area.

Lower powered vehicles had difficulty negotiating the higher sand dunes and winching operations were occasionally necessary. Following the rain in February vehicle boggings were common. However it was generally found that under normal conditions travelling within the area was not excessively difficult.



2. Bulldozing

A D7-E bulldozer was found adequate to cut seismic lines and access roads. This unit was supplied on contract by Buchanan & Fogarty of Mount Gravatt, Brisbane, Queensland.

3. Surveying

Plate 7 gives the location and elevation of all current survey shot points. A total of 65 new Permanent Survey markers were established for the survey.

Elevations for the survey are related to mean sea level, Port Adelaide, by indirect ties to the South Australian Department of Lands Bench Mark system along the Strzelecki track.

All shot point locations and gravity stations were established by chained distances which were checked by stadia readings using a K & E transit.

Horizontal and vertical control for both the seismic and gravity surveys were established by ties to previous control, astrofixes, bench marks and tellurometer stations set by Delhi International Oil Corporation, the South Australian Department of Lands and the Department of National Mapping.



Since the area was originally surveyed by Delhi-Santos and their contractors, and a considerable network of seismic and gravity lines were mapped, the new lines, part of this survey were simply tied into much of the previous work. Under these circumstances, complete survey loops are difficult to make and closure loops difficult to show. Delhi personnel have been integrating the new seismic lines into their main network.

In addition to the surveying of seismic lines cross-country ties were made from the ends of untied lines to enable gravity loop closures to be made.

For further data on the surveying and gravity aspects of the survey see Appendix IV.

4. Drilling

Shot holes were drilled by 3 Mayhew 1000 air-water combination drilling rigs and all charges were pre-loaded by the drillers.

Drilling conditions varied, formations encountered were sand, clay and gravel and combinations of these. Except in the far north where air drilling was occasionally possible, all holes were drilled with



water. Adequate water supply for the drills was often difficult to maintain as it was often necessary to haul water long distances. Several water wells drilled in the Xmas Creek area were unsuccessful.

Hole depths varied but generally optimum records could be obtained at 75 to 90 feet on the claypans. On the sandhills the shot depths were increased to maintain an approximate common elevation for all charges. In the far north a hard calc-silicate rock formation known locally as "dura crust" encountered near the surface made drilling difficult.

5. Seismic Recording

Split spreads with distances of 2640' between shot points were employed to provide continuous subsurface coverage over most of the survey. The Common Depth Point technique with station intervals of 220 feet and shot point intervals of 880 feet, providing 300% subsurface coverage was used on line BC0 to supplement the above procedure. (See plate 2).

It was found that provided the charge was placed directly on top of the impenetrable duracrust where that layer was shallower than the normal drilling depth but deeper than 50 feet a reasonable record could be obtained. However quality deteriorated



at shallower depths and multiple coverage was used to improve the quality of the sections where "dura-crust" was encountered at less than 50 feet and could not be economically penetrated.

Recordings were made through United 1-38B amplifiers and were recorded on tape with an A.M. Techno 451 Tape System. Monitor records and tapes were recorded without filtering (1-W) and medium A.V.C. field playbacks were made without mix using a 5-7 filter setting with a frequency band pass of 20 to 60 Hz. measured 6db down from peak frequency.

Twenty-four H.S.J-14 cycle geophones per trace inline were used with intervals between geophones varying from ten to fifteen feet.

6. Gravity Recording

The gravity meter used for the survey was Worden Gravity Meter No. 518. A sensitivity determination for this instrument was run over the Adelaide Gravity Range ASC-1 to ASC-2 before and during the survey.

The following results were obtained by using the established difference of 62.60 milligals.

No. 518	November 6th, 1969	-	0.10347 Mg/DD.
	February 23rd, 1970	-	0.10348 Mg/DD.



All gravity bases were set at five mile intervals along the seismic lines. These were marked by steel pickets with attached metal tags. These tags displayed the relevant line and shot-point numbers. Gravity stations were marked by wooden stakes with similar metal tags attached.

The gravity base network is shown on the gravity loop closure map (Plate 8). Previously established gravity bases were utilized and a total of 30 new bases were established during the current survey. See Appendix 4(a). All bases are tied through a system of loops to the Innamincka isogal station.

Gravity meter drift control for stations were obtained by readings of gravity bases within a two hour drift period. Linear drift was assumed and drift corrections applied to stations on a time/total drift basis.

COMPUTATION1. Seismic

Reflection times were corrected to sea level datum by a simple uphole method. The method involves utilizing the sum of the uphole time and an appropriate correction to allow for the elevation of the shot above datum. For a more rigorous description of the method refer to Plate 3. A subweathering velocity of 6'500'/s was used for all static correction computations throughout the survey. This velocity is consistent with that used earlier in Patchawarra Central and adjacent areas.

2. Gravity

The elevation correction used was a combination of the free air and the Bouguer correction. A correction factor of 0.06892 Mg/ft. of elevation change was continued during the survey to agree with previous work. This correction factor corresponds to a near surface density of 1.9 gm/cc. (See Appendix IV(c)).

Final Bouguer gravity values were computed by subtracting the observed gravity and the elevation correction from the theoretical gravity. Latitude corrections were determined by scaling from the pre-plotted 1:100,000 survey base map of the area and by reference to the "Table of Theoretical Gravity and International Ellipsoid".

The mean mistie for the survey was calculated as .05 milligals and an estimated standard error may be calculated as follows:

	<u>Accuracy of field data</u>	<u>Milligal Equivalent</u>
Gravity Control $\Delta g =$	$\begin{matrix} + \\ - \end{matrix} 0.05 \text{ mgal.}$	$\begin{matrix} + \\ - \end{matrix} .05 \text{ mgal.}$
Elevation Control $\Delta e =$	$\begin{matrix} + \\ - \end{matrix} 1.4 \text{ ft.}$	$\begin{matrix} + \\ - \end{matrix} 0.10 \text{ mgal.}$
Horizontal Control $\Delta h =$	$\begin{matrix} + \\ - \end{matrix} 300 \text{ ft. N-S}$	$\begin{matrix} + \\ - \end{matrix} 0.06 \text{ mgal.}$
Estimated standard error =	$\begin{aligned} & \begin{matrix} + \\ - \end{matrix} \sqrt{\frac{(\Delta g)^2 + (\Delta e)^2 + (\Delta h)^2}{3}} \\ & = \begin{matrix} + \\ - \end{matrix} \sqrt{\frac{(0.05)^2 + (0.10)^2 + (0.06)^2}{3}} \\ & = \begin{matrix} + \\ - \end{matrix} .073 \text{ mgal.} \end{aligned}$	

These values are strictly estimates of the magnitude of possible errors.



PROCESSING

All playback processing of magnetic tapes was handled by Ray Geophysics (Aus.) Pty. Ltd., Perth, Western Australia and all pertinent data both static and dynamic was supplied by United.

United supplied the Playback Centre with details of the Tinga Tingana No. 1 well velocity survey. Minor adjustments to the derived function from this well were made to suit the velocity gradient in Patchawarra Central and it was found that the same moveout curve was applicable to the entire program.

The $T\Delta T$ plot of the Tinga Tingana velocity function is shown as plate 3a whilst a summary of adjustments to this curve is presented as Appendix V.

The end results of processing were presented in the form of wiggle trace-variable area film sections. No filtering was used in the processing and only a medium A.V.C. was applied. A 2/1 Mix was employed on some of the early lines, but this was dispensed with for the latter part of the programme.



INTERPRETATION AND RESULTS

For a general appreciation of data quality and structural relationships of the horizons mapped refer to Plates No. 4, 5 and 6.

The quality of the data ranged from good over most of the area (particularly in the shallow levels) to poor in the far north duracrust country. The variation in quality may be no better illustrated than by reference to plate 5. The data quality is fair at the "C" horizon and "P" horizon levels but rather poor at deeper levels.

It was found that data recorded during the second work period was of a somewhat better quality than that recorded in nearby areas during the first work period. Better "coupling" or energy transmission characteristics of the surface sand material, following heavy rain between the two work periods, is believed responsible.

Generally, however, poor data are attributed to such near surface effects as sand dunes and weathering variation. Subsurface faulting and lithology changes are also contributing factors.



Except in the deeper subsurface levels to the far south of the area, the quality of data made it possible to map four horizons with a reasonable degree of confidence. Due to the lack of velocity control in the area, it was decided to present the final data in two-way time. Accordingly the various horizon times were picked from the playback sections and no adjustments of a regional nature were applied. Standard local adjustments were made to provide the most satisfactory ties to the very early work in the area. These adjustments conform to those previously used in the area.

The four structural control maps and one isopach map presented with this report are entitled "C" HORIZON (Approximate Top of the Lower Cretaceous Transition Beds); "P" HORIZON (Base of Mesozoic): "TOP OF CAMBRIAN(?); "TOP OF VOLCANICS/TOP OF REDBEDS" and "C-P" ISOPACH.

1. The "C" HORIZON is based on a reflected event which maintained fair to good character and continuity. This horizon has been tied into previous work and should represent the Approximate Top of the Lower Cretaceous Transition Beds. Regional strike direction is approximately northeast/southwest although this regional trend appears to be more northerly in the far north. In the south-east,



dip becomes steeper towards the Tirrawarra area. Due to its general conformity with the underlying "P" horizon, structural features at the "C" level are a duplication of what appears at the "P" level although relief of such structures are more pronounced on the latter. That is, where folding occurs on the "P" horizon the "C" horizon is generally more likely to exhibit gentle undulations.

2. The "P" HORIZON is based on a reflected event which maintained fair to good character and continuity. Control from this horizon was carried from the Tirrawarra area which was in turn tied somewhat questionably to the Merrimelia Wells. Indirect ties to the Kalladeina No. 1 Well appear quite satisfactory.

This horizon should represent the unconformity between Mesozoic and Palaeozoic sedimentation. In the south-east the structure on this erosional surface is typical of that occurring within the Permian of that area. Progressing north-west the Permian pinches out against south-east dipping Cambrian rocks and this is the flank of the Permian basin in this area.

Within the basin itself there does not appear to be any significant local variation in thickness of



the Permian unit, except for the regional thinning on the basin flanks. In the south, a low amplitude anticlinal trend bounded on its north flank by the line BCC plunges to the east. To the west this feature broadens and closure is probably minimal at this point. This feature is bounded structurally on the north and south by two broad synclinal structures. These two features appear to deepen towards the east and may eventually converge in this direction.

Elsewhere in the Permian such structures as are present appear minor, are of limited extent and are obscured by basement faulting to which they are most probably related.

Outside the basin to the northwest, the structures on the "P" horizon are of Cambrian(?) age. Further to the north-west the Cambrian(?) strata pass into what has been mapped as the top of a volcanic(?) sequence. This is of uncertain age. However "P" horizon structures in this area are typical of that occurring on the eroded Volcanic(?) subcrop.

To the far north it is impossible to confirm or deny the presence of any Palaeozoic sediments. On line BCN (Plate 6) there appears some suggestion of section thickening to the north. However no such thickening is evident on lines BCO and BCP. Gravity



data would indicate deeper basement towards the north end of line BC0. Seismic data is inconclusive on this point, the "P" horizon appearing to be gently undulating throughout the area. The general quality of data is so poor in the north that any assertion on the presence of any Palaeozoic section here must remain hypothetical at this stage.

3. The "TOP OF THE CAMBRIAN(?)" was mapped on the basis of a reflected event of from fair to poor quality. Structural character may be described as fair but the horizon lacks continuity. The exact nature of its relationship with the Tirrawarra "Redbeds" is difficult to show and any postulated relationship emphasizing anything other than its stratigraphic position beneath the "Redbeds" would be difficult to substantiate due to the poor quality of the down dip information. Control was maintained through older work tied to Kalladeina No. 1 but again poor data and lack of a velocity survey in the Kalladeina Well make reliance on these ties questionable. It shows a typical basin "floor and flank" configuration although Lower Palaeozoic sediments may lie immediately above it. Structures within the Permian section proper are probably controlled from the Cambrian(?) Horizon and horizons beneath the Cambrian(?).



This horizon probably represents economic basement in the area.

4. The "TOP OF THE VOLCANICS" was mapped on the basis of a reflected event of poor quality and poor structural character. The continuity is poor and its relationship to the deep horizons of the Tirrawarra difficult to ascertain. Also due to the poor data quality its own nature is uncertain i.e. whether a single flow sheet or a series of flows.

The "Redbeds" to the south have been carried through ties to the previous work in the Tirrawarra area.

5. The "C-P" ISOPACH shows that the "C" and "P" horizons have a close conformity over the area, although the "C" horizon is generally flatter, sagging only slightly into the more pronounced lows of the "P" horizon, thinning slightly over most of the highs. However except for minor local variations in thickness, thickening down dip into the Tirrawarra area and a slight thickening trend of a regional(?) nature to the north and west, variation in thickening between the two horizons is limited.

The results of the gravity part of the survey are shown on Plate 9, the "BOUGUER GRAVITY" map. A



regional strike direction of north east - south west, veering towards the north in the north of the area supports the seismic interpretation. Deeper basement is indicated in the far north but no anomalies of a local nature are outlined by the gravity.



CONCLUSIONS

The above results may be regarded as the consequence of erosion of an old structural high to the north and west with consequent deposition of sediment to the south and east during late Palaeozoic time. The gravity data would indicate deeper basement to the immediate north west of the Prospect and the relic high may be present as the strongly developed median structure seen on the "P" horizon.

This belt trends in an east-west direction and bisects that part of line BCH lying between lines BCJ and SG. It appears then to veer to the south and bisects that part of line SK lying between lines BCJ and SJ. To the east the trend is less discernible. It may swing to the north generally parallel to the edge of the Permian basin. What can be seen of this relic trend appears to indicate preferential erosion of some Pre-Palaeozoic formation.

The erosion of this high has resulted in thick volumes of Permian and perhaps some Pre-Permian sediment being deposited on these lower areas to the south and east. Erosion continues to the end of the Palaeozoic when Mesozoic sediments were deposited on the unconformity.



Conformable deposition continued throughout the Mesozoic and there is little evidence to suggest any significant Post-Palaeozoic diastrophism.

Finally from Mr. A. J. Kapel of Bridge Oil N.L. - "the survey contributed substantially to the regional knowledge of the Coopers Creek Basin.

It confirmed structural and stratigraphic exploration targets within the Basin. A promising north-east/south-west structural trend was mapped in the south eastern part of the surveyed area. This feature shows structural growth during deposition and although limited closure on the Base of Mesozoic "P Horizon" has been mapped, additional closure may be present on the Lower Gidgealpa Formation which produces in the Tirrawarra No. 1 Well.

It more precisely defined the extent of the Permian sediments within the Coopers Creek Basin. Indications are that promising structural traps may be expected and could possibly be mapped in the centre part of the surveyed area near the edge of the Permian sediments.

It was not possible to determine the relationship between Upper and Lower Triassic due to the absence of events from these units.

It gave some information regarding the relation of the Innamincka Redbeds and the Lower Cambrian Volcanic sequence encountered in the Delhi-Santos No. 1 well. The survey indicates that the Redbeds seem to overly the volcanics from Kalladeina which relationship has previously been encountered in the Spencer No. 1 well.

It was decided early in the survey that offset profiles would not materially add to the stratigraphic definition being obtained and this method was therefore not used.

RECOMMENDATIONS

Recommendations for further work may seem inappropriate in view of the control present in the main body of the area. However to the far north, control is sparse in an area where very little is known about the nature of "P" horizon subcrop.

The presence of the "duracrust" layer has prevented reliable deep data from being recorded using conventional single fold coverage. A short profile using 3 fold coverage C.D.P. did not help greatly.

However it is felt that a policy of perseverance with the multiple coverage technique may be worthwhile. A short survey of this nature consisting of perhaps 2 lines may give the indications sought after.

These two lines should tie the existing work and it is suggested that the first line tie to the end of line BCO and run north-east/south-west to attempt to substantiate the gravity low mapped in the south-west whilst giving additional control in the north east corner of the Prospect. The second line should tie the first line again preferably in the north east. Together these two lines should indicate the



presence or absence of prospective sediments and any further work may be planned from this point.



REFERENCES

Details of geology and geophysics pertinent to this area are included in the following reports on geophysical operations carried out by Delhi International Oil Corporation and Santos Limited in the Cooper's Creek Basin.

1. Geophysics

Delhi-Santos Innamincka-Betoota Aeromagnetic Survey, 1961, by Aero Service Corporation.
Reinterpreted by C.G.G., 1963.

Delhi-Santos Diamantina River-McGregor Range Seismic Survey, 1963, by United Geophysical Corporation.

Delhi-Santos Birdsville-Lake Frome Gravity Survey, 1964, by Geophysical Service International.

Delhi-Santos Cooper Creek Seismic and Gravity Survey, 1964, by United Geophysical Corporation.

Delhi-Santos Lake Gregory Helicopter Gravity Survey, 1965, by Wongela Geophysical.



Delhi-Santos Strzelecki-Cooper Seismic and Gravity Survey, 1965, by United Geophysical Corporation.

Delhi-Santos Eromanga-Frome Seismic and Gravity Survey, 1966, by United Geophysical Corporation.

Delhi-Santos Cooper Basin Seismic and Gravity Survey, 1967, by United Geophysical Corporation.

Delhi-Santos South West Cooper Basin Gravity Survey by United Geophysical Corporation.

2. Geology

Gidgealpa No. 1 - 7 Well Completion Reports by Delhi International Oil Corporation Ltd.

Merrimelia No. 1 - 4 Well Completion Reports by Delhi International Oil Corporation.

Kalladeina No. 1 Well Completion Report by Delhi International Oil Corporation.

Pandieburra No. 1 Well Completion Report by Delhi International Oil Corporation.

Putamurdie No. 1 Well Completion Report by Delhi International Oil Corporation.



APPENDIX IEQUIPMENTRecording

- 1 Ford F-600 four wheel drive recording truck complete with cable reels and recording cab.
- 1 United recording system including 24 model 1-38 amplifiers, techno tape system, and 26 trace camera.
- 864 HS-J series Geophones in strings of 12 each in series.
- 1 Ford F-600 four wheel drive reel truck. Cables for 2,640 feet reflection spreads.
- 1 Toyota four wheel drive utility for personnel carrier.
- 2 25 Watt Eilco transceivers with two shooting units and one recorder unit for radio time break and up-hole for offset and C.D.P. shooting.



Shooting

- 1 Ford F-800 four wheel drive water truck complete with powder and detonator magazines. Complete set of shooting equipment.

Surveying

- 1 Toyota four wheel drive vehicle.
- 1 Complete set of surveying equipment.

Drilling

- 3 Heavy duty Mayhew 1000 combination air-water drills mounted on Ford F-850 four wheel drive trucks.
- 3 Ford F-800 four wheel drive water trucks equipped with 1000 gallon tanks.
- 1 Toyota four wheel drive utility for personnel carrier.

Supply

- 1 Ford F-600 four wheel drive truck equipped with 500 gallon flat tanks and stake body.



Dozer

- 1 Contract D7-E dozer used throughout the operation.

Shop

- 1 Shop caravan equipped with air compressor, drill, vices, hand tools, spare parts, and other equipment for repairs to equipment.
- 1 Welder outfit complete with arc and acetylene welding equipment and supplies.
- 1 Spare parts trailer.

Camp

- 1 Kitchen caravan, air conditioned, complete with utensils, equipment and supplies
- 1 Dinner caravan, air conditioned, with fixtures and tableware.
- 1 Shower caravan complete with pressure water system.
- 2 Trailer mounted Sentinel 36 KVA and Lister 36 KVA light plants for power.
- 4 Air conditioned sleeper caravans.



1 Line camp kitchen.

1 Complete complement of linen, beds etc. for personnel accommodation.

Office

1 Air conditioned office caravan equipped with office machines, drafting equipment and three radio receivers.

1 Toyota four wheel drive vehicle.

Gravity

1 Worden Gravity Meter No. 518.

1 Landrover four wheel drive vehicle.



APPENDIX IICREW PERSONNEL

Party Chief	B. Blackie
Party Manager	J. Boring*
	R. Stuart
Seismologists	S. Thirlwell
	R. Angove
Observer	K. Hunt
Surveyor	D. Parker
Gravity Meter Operators	B. Carr
	M. Lohrman
	B. Matthes
Drillers	D. Mathewson*
	G. White*
	E. Quarry
	D. Johnston
	B. Robinson

Approximately twenty-one additional men completed the crew.

Supervision for United by H. D. Gray

Supervision for Bridge Oil N.L. by J. E. Milner

* Denotes those personnel who were not part of the crew during the second work period.



APPENDIX IIISTATISTICSa. Seismic Survey

Starting Date First Shot (initial commitment) 22nd Jan. 1970.
 Completion Date (initial commitment) 19th Feb. 1970*
 Starting Date First Shot (final commitment) 21st May, 1970
 Completion Date (final commitment) 11th June 1970

* January 29th and 30th spent recording in Tirrawarra Area.

	<u>Unsubsidized</u>	<u>Subsidized</u>	<u>Total</u>
Total Profiles Shot	148	425	573
Total Number of Shots	148	441	589
Conventional Miles Subsurface Coverage	74	194	268
3 Fold Miles Subsurface Coverage	-	6.5	6.5
Conventional Recording Field Time	114.75	340.75	455.50
3 Fold Recording Field Time	-	21.0	21.0
Non-Contract Recording Drive Time	11.25	57.75	69.00
Total Hours Recording Time	126.00	419.50	545.50
Total Dynamite Used	2690	10071	12761
Normal Charge Size	18	22	-
Total Primers Used	152	479	631



	<u>Unsubsidized</u>	<u>Subsidized</u>	<u>Total</u>
Total Detonators Used	151	469	620
Total Number Holes Drilled	149	440	589
Total Number Feet Drilled	12495	36008	48503
Contract Drilling Field Time	236.75	676.25	913.00
Non-Contract Drilling Field Time	34.75	135.25	170.00
Total Drilling Time	271.5	811.5	1083.0
Total Finger Bits Used	4	28	32
Total Rock Bits Used	-	8	8
Line Numbers	BCC, BCG BCH, BCI BCQ, BCS and BCX.	BCG thru BCP BCR thru BCU BCW thru BCZ.	

b. Gravity Survey

	<u>Unsubsidized</u>	<u>Subsidized</u>	<u>Total</u>
Number of stations metered	82	433	515
Number of base stations set	5	25	30
Miles of seismic line metered	19.5	104.5	124

The lines metered during the survey included the following in the unsubsidized area:

BCC (in part) BCG (in part) BCH BCI(in part).

In the subsidized area lines metered were:-

BCH BCI (in part) BCJ (in part), BCM BCN
BCO, BCP (in part), BCR and BCW.



APPENDIX IVSURVEY AND GRAVITY DATA

- (a) The following is a list of all permanent markers established for the seismic survey. Where such locations were also used as gravity base stations for the gravity operation, the shot point is marked thus:- 68*

<u>Line</u>	<u>SP</u>	<u>Status</u>	<u>Latitude</u>	<u>Longitude</u>
BCC	67	Unsubsidized		
"	75	"		
"	80*	"		
BCG	61*	"		
"	70	"		
"	80	Subsidized	27° 22' 27" S	139° 45' 27" E
BCH	50*	Unsubsidized		
"	60*	"		
"	71*	Subsidized	27° 24' 30" S	139° 41' 51" E
"	83*	"	27° 20' 01" S	139° 30' 45" E
BCI	80	Unsubsidized		
"	86*	"		
"	100*	Subsidized	27° 20' 15" S	139° 53' 15" E
BCJ	54*	"	27° 29' 22" S	139° 30' 24" E
"	60*	"	27° 28' 07" S	139° 33' 00" E
"	70*	"	27° 26' 07" S	139° 37' 15" E
"	80*	"	27° 24' 30" S	139° 41' 51" E
"	90*	"	27° 22' 31" S	139° 46' 12" E
"	95*	"	27° 21' 33" S	139° 48' 21" E



<u>Line</u>	<u>SP</u>	<u>Status</u>	<u>Latitude</u>	<u>Longitude</u>
BCJ	100*	Subsidized	27° 20' 51" S	139° 51' 42" E
BCK	62	"	27° 15' 09" S	139° 35' 45" E
BCL	50	"	27° 19' 57" S	139° 39' 45" E
"	60	"	27° 16' 21" S	139° 43' 39" E
BCM	58*	"	27° 13' 42" S	139° 44' 51" E
"	70*	"	27° 11' 10" S	139° 50' 00" E
"	76	"	27° 10' 00" S	139° 52' 36" E
BCN	50*	"	27° 13' 33" S	139° 51' 09" E
"	56*	"	27° 11' 10" S	139° 50' 00" E
"	60	"	27° 09' 33" S	139° 49' 15" E
"	70*	"	27° 05' 39" S	139° 47' 15" E
BCO	50	"	27° 09' 59" S	139° 52' 36" E
"	58*	"	27° 06' 30" S	139° 52' 33" E
"	60	"	27° 05' 39" S	139° 52' 30" E
"	70*	"	27° 01' 45" S	139° 50' 27" E
"	80*	"	26° 57' 45" S	139° 48' 24" E
BCP	54*	"	27° 08' 03" S	140° 01' 00" E
"	60*	"	27° 05' 51" S	139° 57' 45" E
"	70*	"	27° 02' 15" S	139° 56' 57" E
"	80*	"	26° 58' 24" S	139° 54' 48" E
"	90	"	26° 54' 21" S	139° 52' 39" E
"	100	"	26° 50' 54" S	139° 49' 42" E
"	110	"	26° 47' 24" S	139° 46' 45" E
"	116	"	26° 45' 18" S	139° 45' 03" E
BCQ	50	Unsubsidized		
"	64	"		
"	72	"		



<u>Line</u>	<u>SP</u>	<u>Status</u>	<u>Latitude</u>	<u>Longitude</u>
BCR	50	Subsidized	27° 05' 39" S	139° 52' 30" E
"	60*	"	27° 06' 01" S	139° 57' 21" E
"	65*	"	27° 05' 45" S	139° 59' 45" E
BCS	60	Unsubsidized		
"	70	Subsidized	27° 27' 33" S	139° 39' 24" E
"	75	"	27° 25' 15" S	139° 38' 33" E
BCT	-			
BCU	57	"	27° 21' 00" S	139° 42' 39" E
"	70	"	27° 19' 30" S	139° 48' 57" E
"	80	"	27° 18' 30" S	139° 53' 39" E
"	90	"	27° 19' 00" S	139° 58' 06" E
BCU	95	"	27° 20' 18" S	140° 00' 03" E
BCW	91*	"	27° 10' 00" S	139° 54' 30" E
BCX	70	Unsubsidized		
"	79	"		
"	90	"		
"	107	Subsidized	27° 20' 18" S	140° 00' 09" E
BCY	60	"	27° 12' 24" S	139° 55' 54" E
"	69	"	27° 11' 03" S	139° 59' 51" E
BCZ	93	"	27° 08' 57" S	139° 58' 27" E

(b) Survey Control

- (i) Vertical control for the survey was established from the Bench Mark system established in the area by the South Australian Department of Lands.

Reference: Innamincka-Clifton Hills 3rd order Bench Mark levels, 1969. South Australian Department of Lands.



- (ii) Horizontal control for the survey was established using the following Tellurometer Stations:-

	<u>Latitude</u>	<u>Longitude</u>
T1/6843	27° 28' 06" S	139° 30' 33" E
T3/6943	27° 29' 54" S	140° 45' 00" E
T2/523	27° 36' 57" S	140° 05' 48" E
T2/522	27° 40' 30" S	139° 44' 33" E

These stations were set by the South Australian Department of Lands during 1st order Geodetic surveys in the years 1965 and 1967

(c) Origin of gravity reduction factor

The data reduction factor of 0.06982 mgals/ft. was arrived at by assuming a surface density of 1.9 gm / cc.

No density profiles were run during the survey and this figure is based on the results of three density profiles run outside the area. One of these was run in the Gidgealpa area to the south and two were run by United crews over the Innamincka outcrops to the west. The data collected in each of these surveys pointed to a surface density of 1.9 gm/cc. Calculation, sample gathering procedure and statistics are set out in the following.



Delhi-Santos Birdsville-Lake Frome, Gravity Survey,
1964, by Geophysical Service International.

Delhi-Santos Strzelecki-Cooper Seismic and Gravity
Survey, 1965, by United Geophysical Corporation.



APPENDIX V.VELOCITY FUNCTION ADJUSTMENTS

<u>Two Way Time</u>	<u>ΔT Patchawarra</u>	<u>ΔT Tinga Tingana</u>	<u>Adjustment</u>
sec.	Central sec	No. 1 sec.	sec.
0	.370		
.1	.320	.355	+.035
.2	.270	.275	+.005
.3	.220	.220	.000
.4	.182	.150	.000
.5	.150	.145	-.005
.6	.127	.125	-.002
.7	.110	.108	-.002
.8	.096	.096	.000
.9	.084	.085	+.001
1.0	.074	.074	.000
1.2	.054	.054	.000
1.4	.042	.042	.000
1.6	.033	.033	.000
1.8	.025	.025	.000
2.0	.018	.022	+.004

The moveout curves are based on an initial velocity of 6,500/s. with a maximum distance of 2640 feet.

Respectfully Submitted

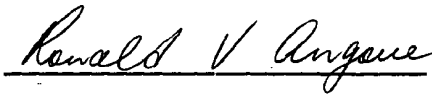
by

United Geophysical Corporation

Party 131



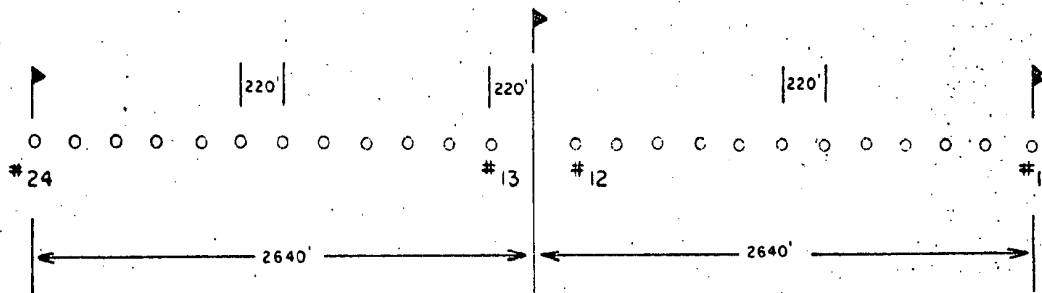
Benson D. Blackie Party Chief.



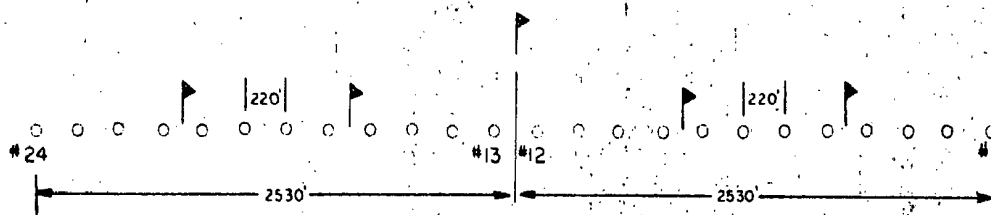
Ronald V. Angove Seismologist.



NORMAL CABLE LAYOUT

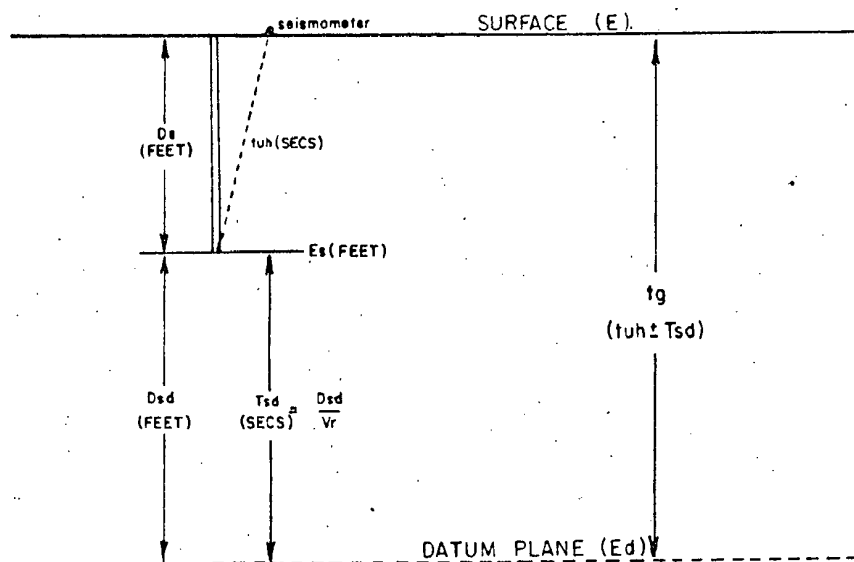


300% C.D.P. CABLE LAYOUT



- ▲ SHOT POINTS
 ○ GEOPHONE POSITIONS

DATUM CORRECTION METHOD



E = elevation at shot point

Ds = depth of charge

Es = elevation of charge = E - Ds

Dsd = distance from charge to datum plane

Ed = elevation of datum plane

tuh = observed up-hole time recorded by shot point seismometer

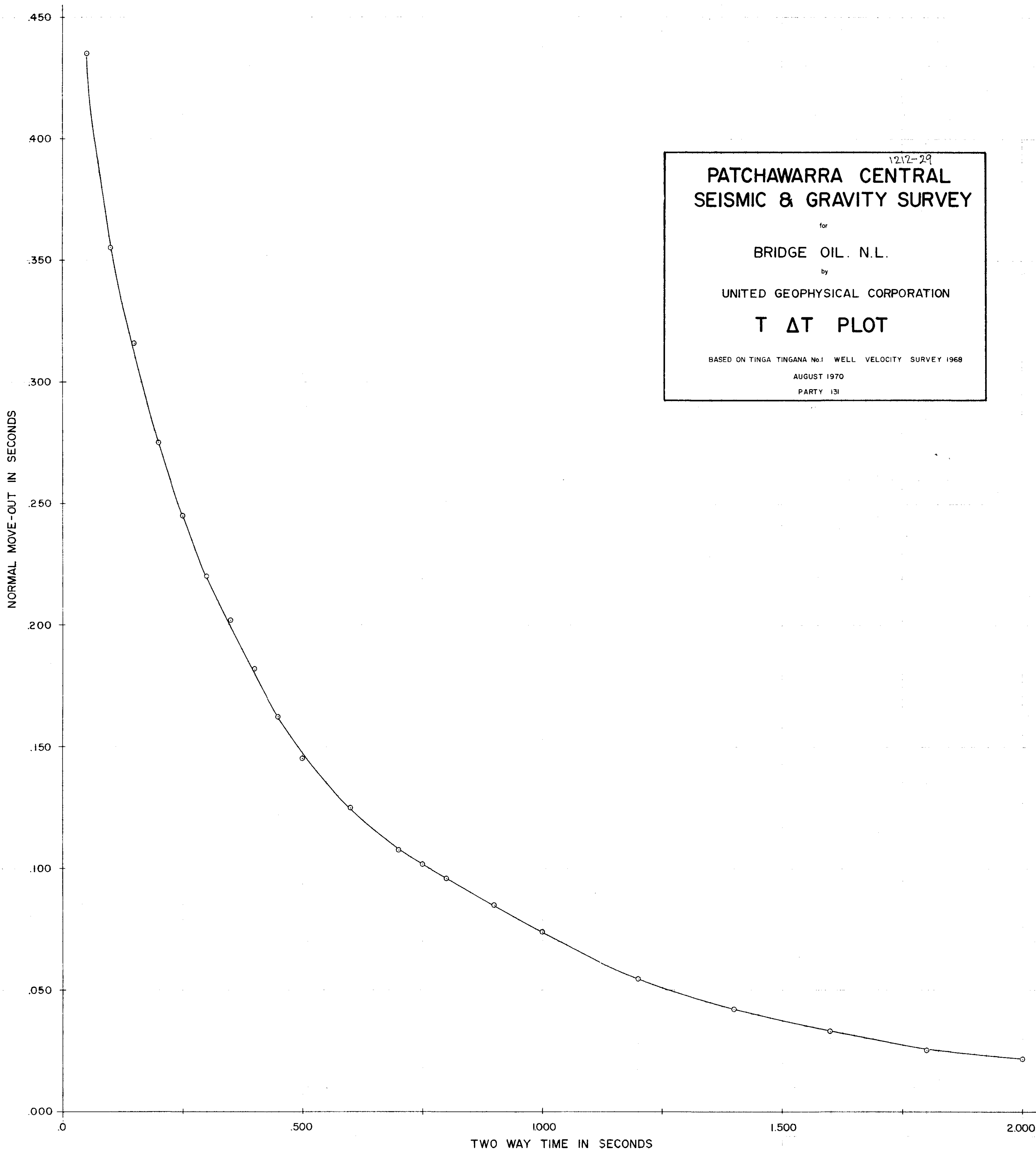
Tsd = time from charge to datum = $\frac{Dsd}{Vr}$

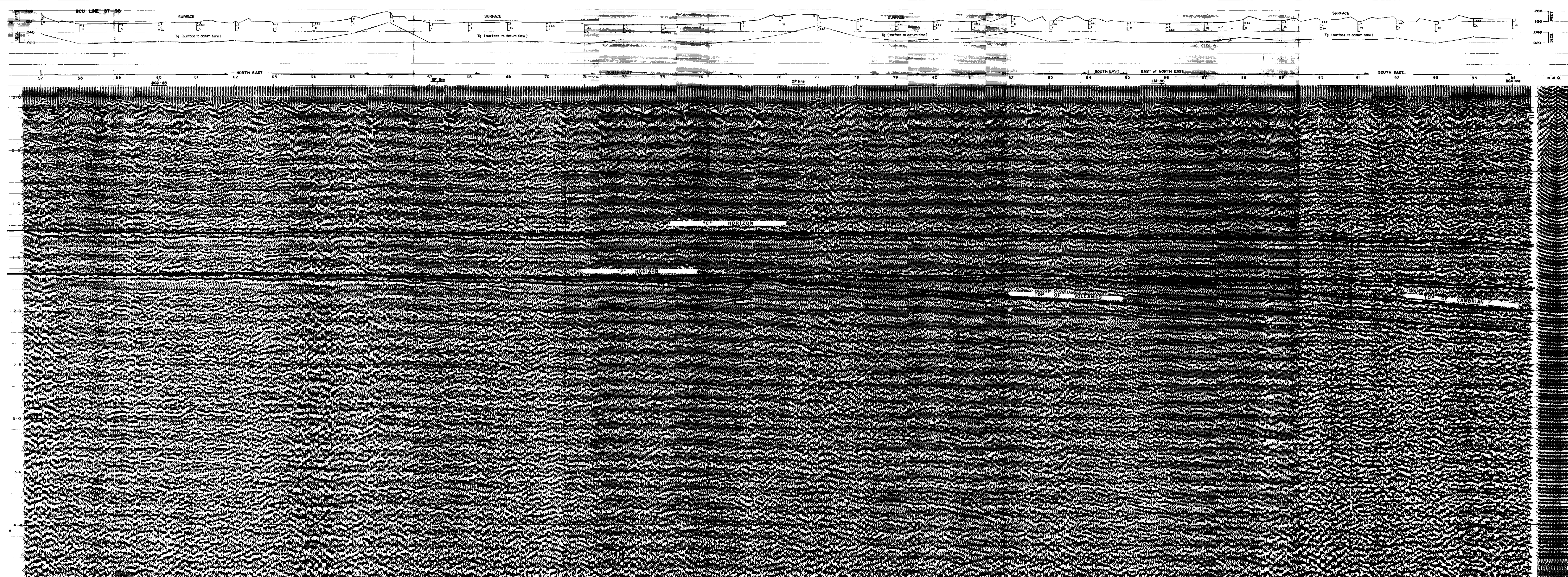
Vr = velocity in sub-weathering zone

tg = time correction from surface to datum

= algebraic sum of tuh & Tsd

TOTAL CORRECTION = Tsd ± tg





LINE BCU

- SHOT HOLE LEGEND
- C = Clay
 - G = Gravel
 - S = Sand
 - SC = Sandy Clay
 - SS = Sand Stone
 - SH = Shale
 - LS = Lime Stone
 - RK = Rock

1212-30

Records shot by
UNITED GEOPHYSICAL CORP
Party 131
Section by
RAY GEOPHYSICS (AUST) PTY LTD
Date JUNE, 1977

DETECTORS GROUP 24 GROUP INTERVAL 220'
SP INTERVAL 2640 DATUM Sea Level
FILTER W RECORDING NONE PLAYBACK
AVC MED RECORDING MED PLAYBACK
CORRECTION VELOCITY 6500/sec MIX NONE
SCALE 1" = 1760' HORIZONTAL 1sec = 4.2' VERTICAL

BRIDGE OIL N.L.
PATCHAWARRA CENTRAL SEISMIC SURVEY AREA
LINE BCU S.P.'s 95 - 57

LINE BCG

SHOT HOLE LEGEND

- C = Clay
- G = Gravel
- S = Sand
- SC = Sandy Clay
- SG = Sand Stone
- SH = Shale
- LS = Lime Stone
- RR = Rock

1212-31

Records shot by
UNITED GEOPHYSICAL CORP.
Party 131

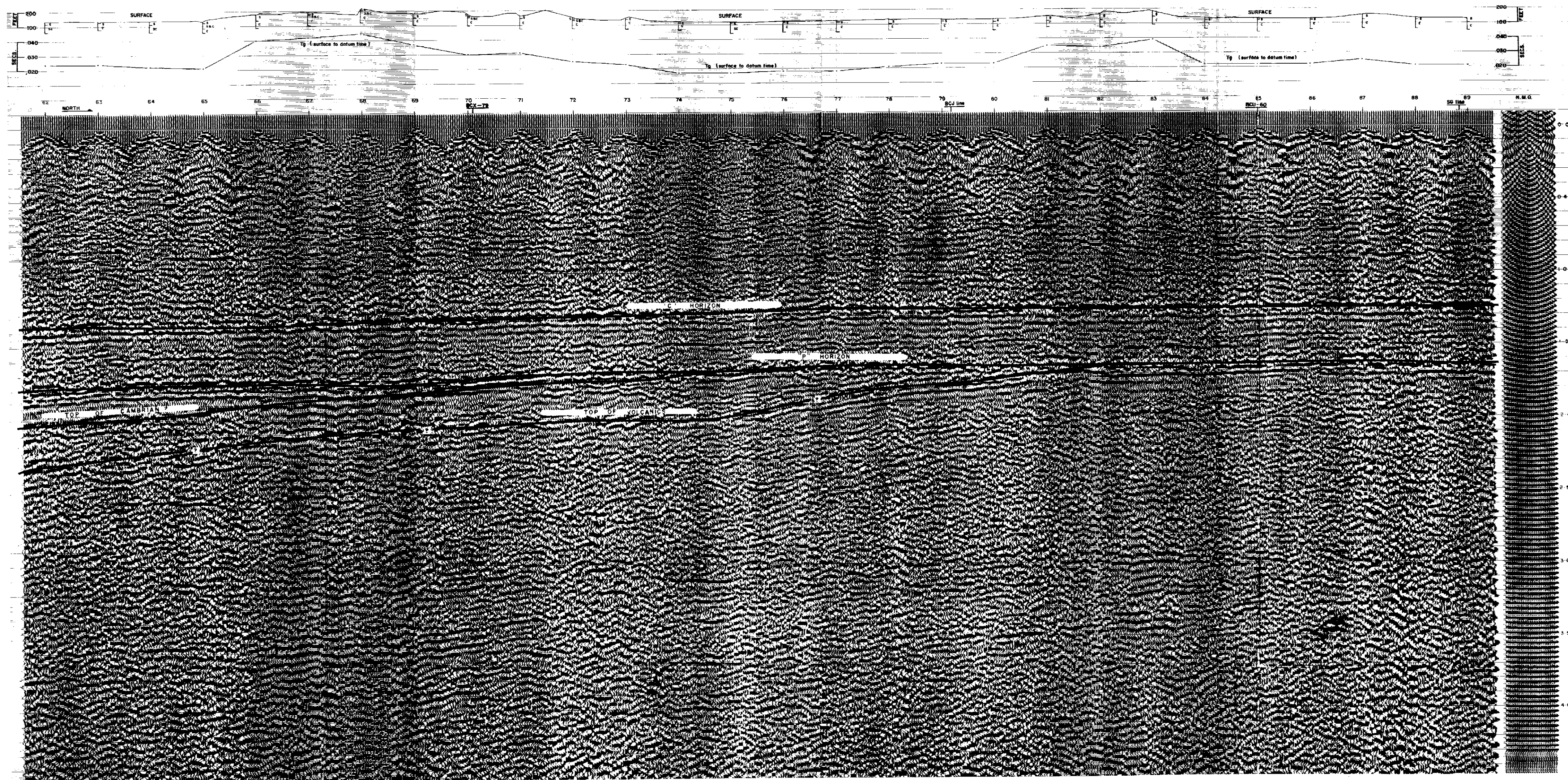
Section by
RAY GEOPHYSICAL (AUST.) PTY. LTD.
Date JUNE 1970

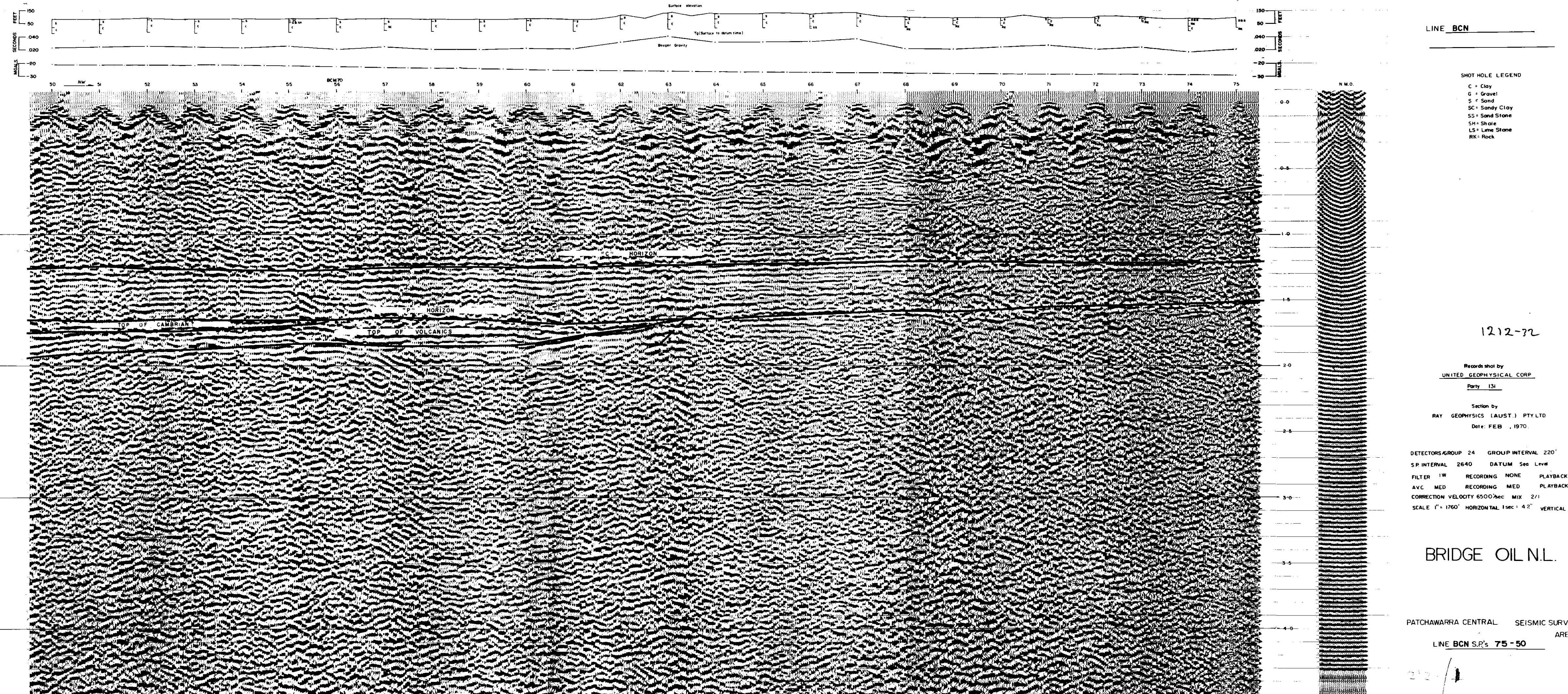
DETECTORS GROUP 24 GROUP INTERVAL 220'
SP. INTERVAL 2640' DATUM Sea Level
FILTER W RECORDING NONE PLAYBACK
AVC MED RECORDING MIX PLAYBACK
CORRECTION VELOCITY 6500' SEC. MIX NONE
SCALE 1" = 1760' HORIZONTAL 4" = 40' VERTICAL

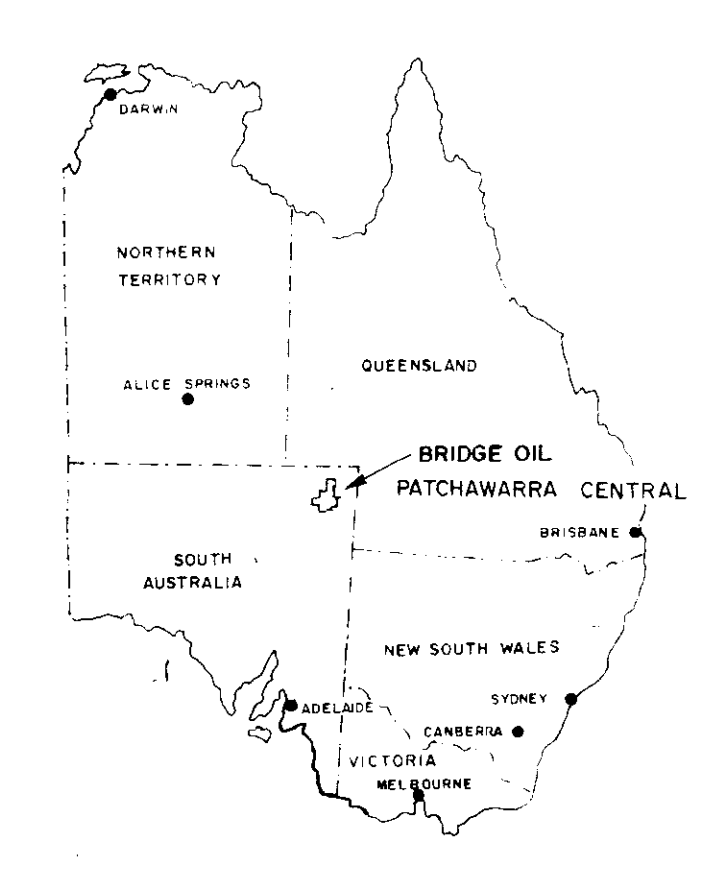
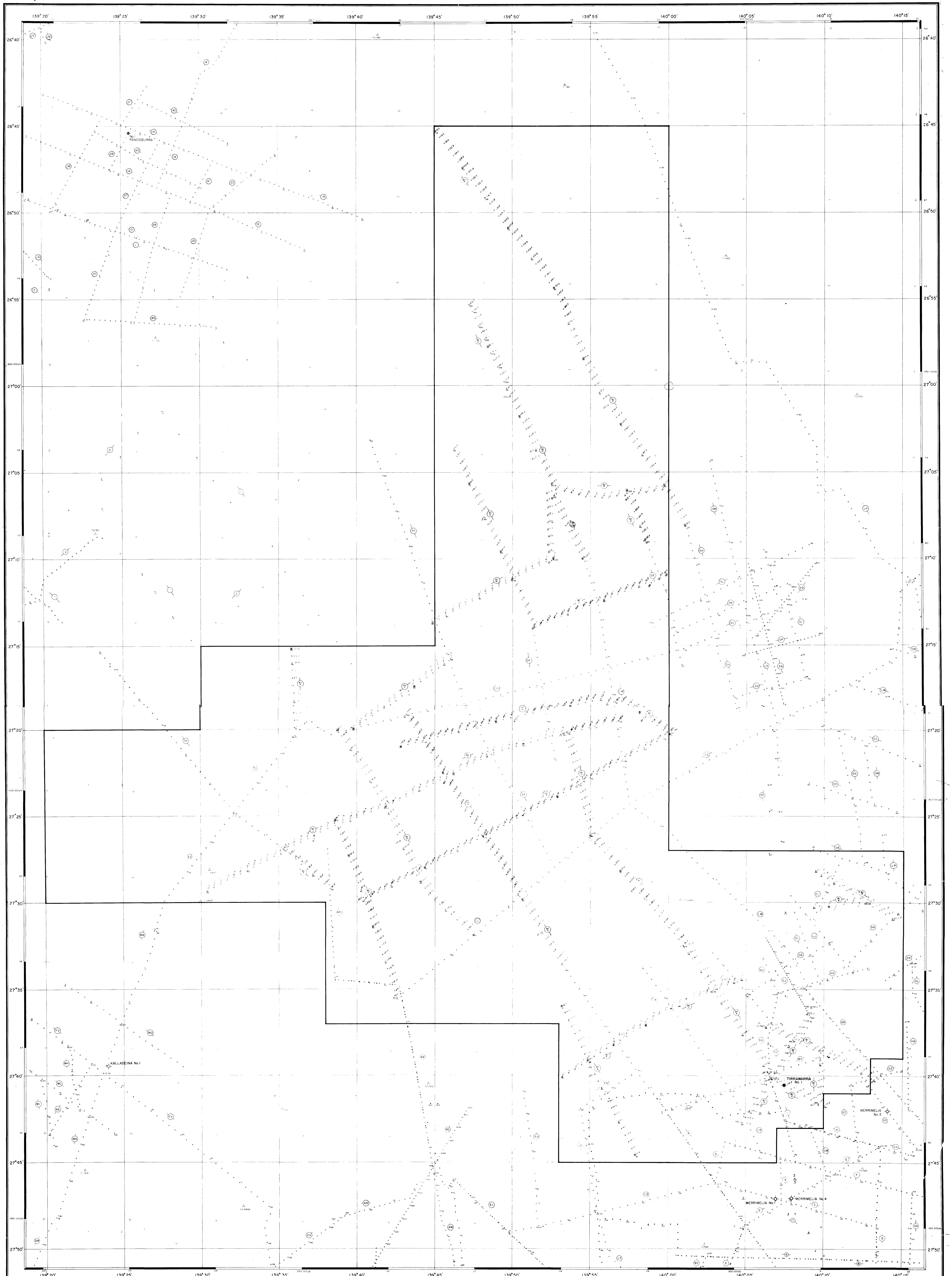
BRIDGE OIL N.L.

PATCHAWARRA CENTRAL SEISMIC SURVEY
AREA A
LINE BCG S.P's 62-89

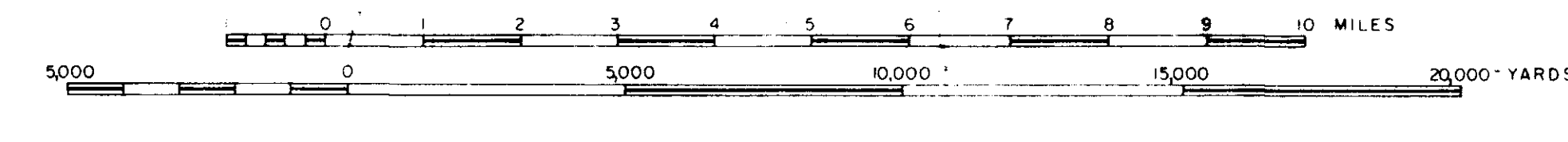
1212/1







LEGEND
* REFLECTION SHOT POINT (UNITED)
• OTHER SHOT POINT
s REFRACTION SHOT POINT
△ TELLURIMETER STATION
□ PERMANENT MARKER
SCALE 1:100,000

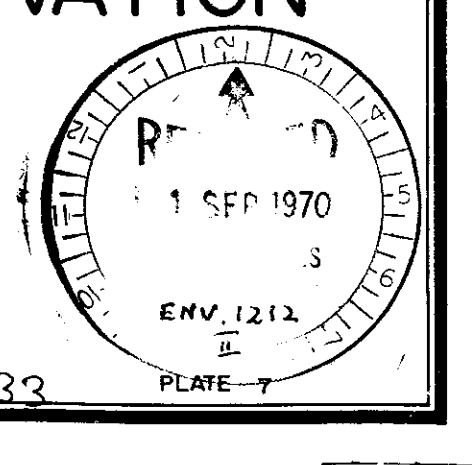


TRANSVERSE MERCATOR PROJECTION
Block crosses indicate the 10,000 yard Transverse Mercator Grid,
zone 5 (Australia series), CLARKE 1858 SPHEROID.

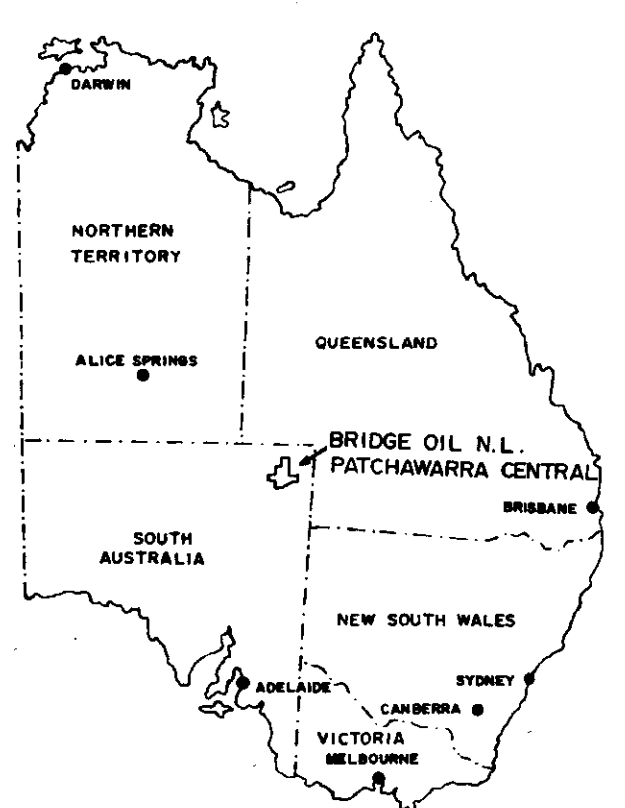
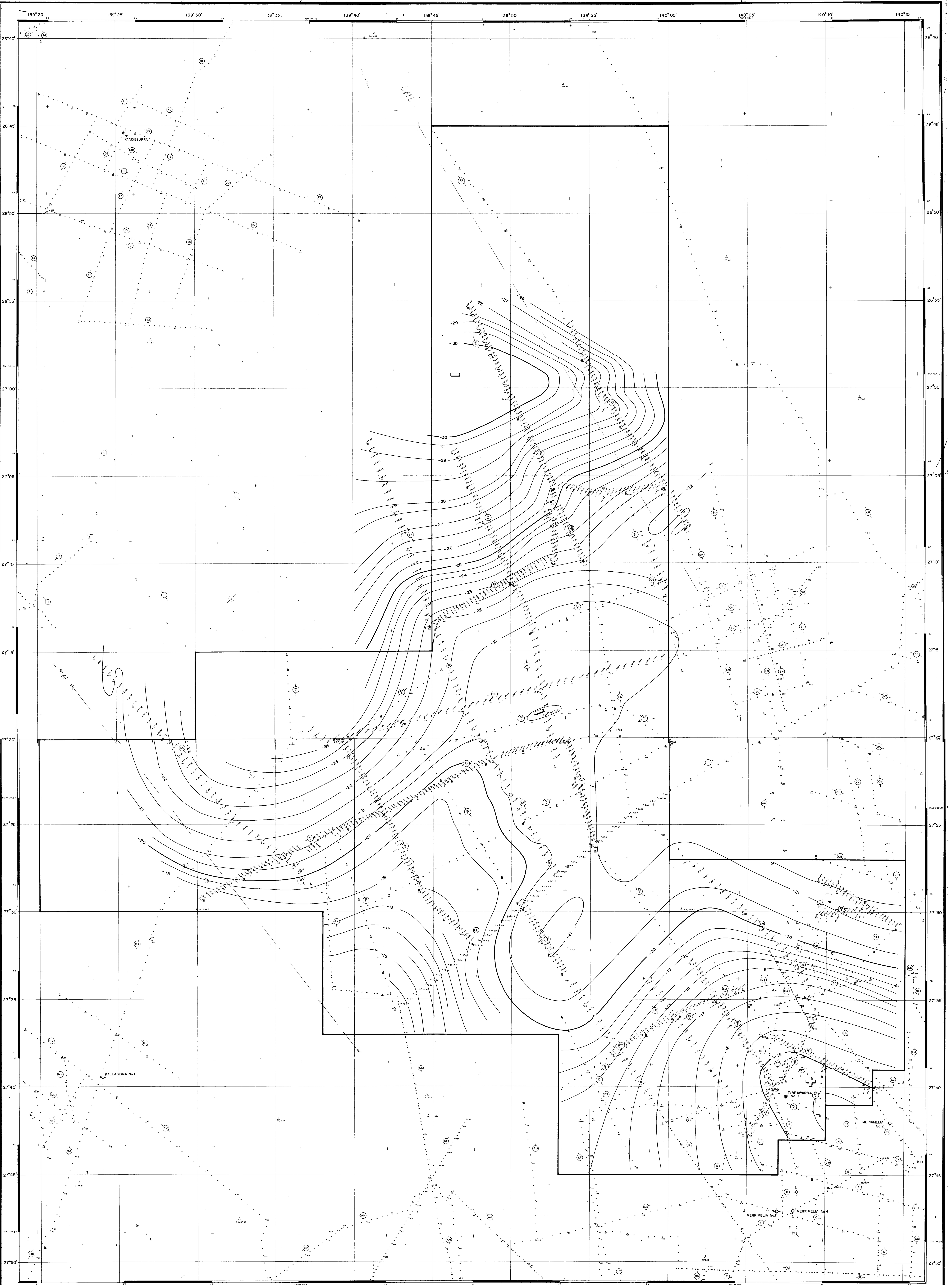
SHOT POINT LOCATION & ELEVATION

BRIDGE OIL N.L.
BY
UNITED GEOPHYSICAL CORPORATION
**PATCHAWARRA CENTRAL
SEISMIC AND GRAVITY SURVEY**

PARTY 121. DATE: AUGUST 1970
DATUM: SEA LEVEL

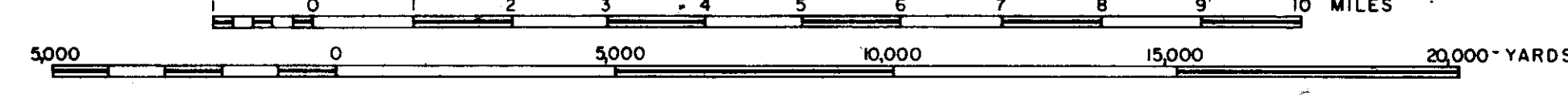






- SHALLOW BASEMENT (?)
- DEEP BASEMENT (?)
- REFLECTION SHOT POINT (UNITED)
- OTHER SHOT POINTS
- REFRACTION SHOT POINT
- TELLURIMETER STATION
- GRAVITY BASE STATION

SCALE 1:100,000



TRANSVERSE MERCATOR PROJECTION
Black crosses indicate the 10,000 yard Transverse Mercator Grid,
zone 6 (Australia series), CLARKE 1858 SPHEROID.

BRIDGE OIL N.L.
BY
UNITED GEOPHYSICAL CORPORATION
**PATCHAWARRA CENTRAL
SEISMIC AND GRAVITY SURVEY**

BOUGUER GRAVITY

CONTOUR INTERVAL 0.5 mgals
DATUM SEA-LEVEL
INTERPRETATION BY R. ANGELO & B. MATTHEWS
PARTY 131
DATE AUGUST 1970



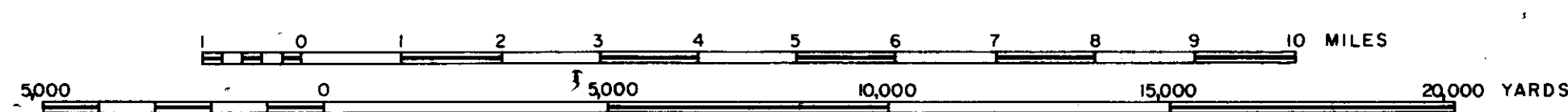




LEGEND

- REFLECTION SHOT POINT (UNITED)
- OTHER SHOT POINTS
- △ REFRACTION SHOT POINT
- △ TELLURIMETER STATION
- ⊕ HIGH AREA
- ⊖ LOW AREA
- FAULT
- - - APPROXIMATE LIMIT OF UNIT

SCALE 1:100,000



TRANSVERSE MERCATOR PROJECTION

Block crosses indicate the 10,000 yard Transverse Mercator Grid, zone 6 (Australia series), CLARKE 1858 SPHEROID.

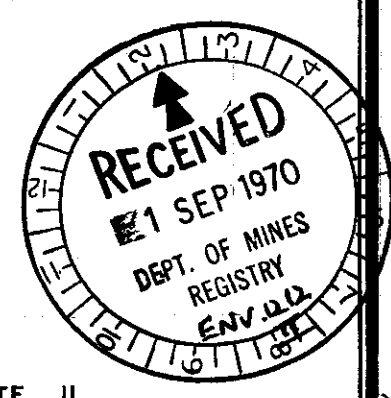
BRIDGE OIL N.L.

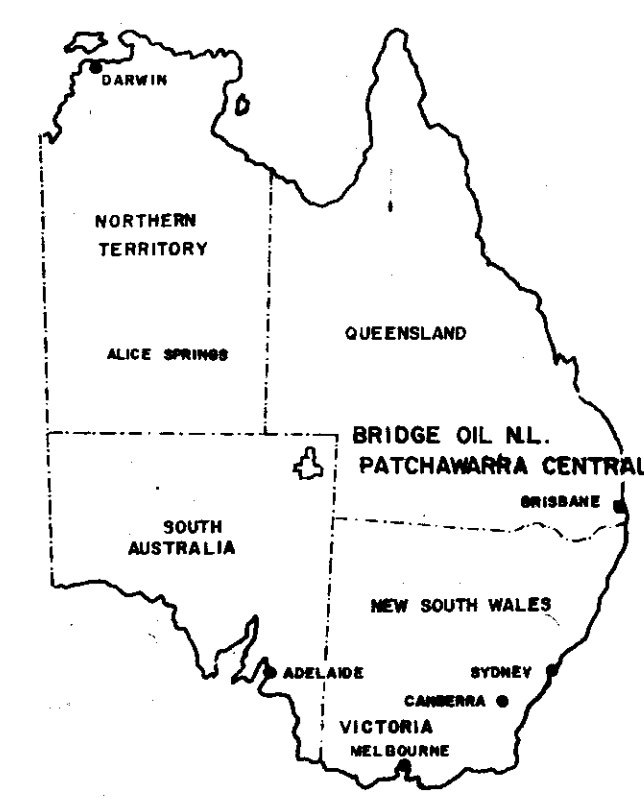
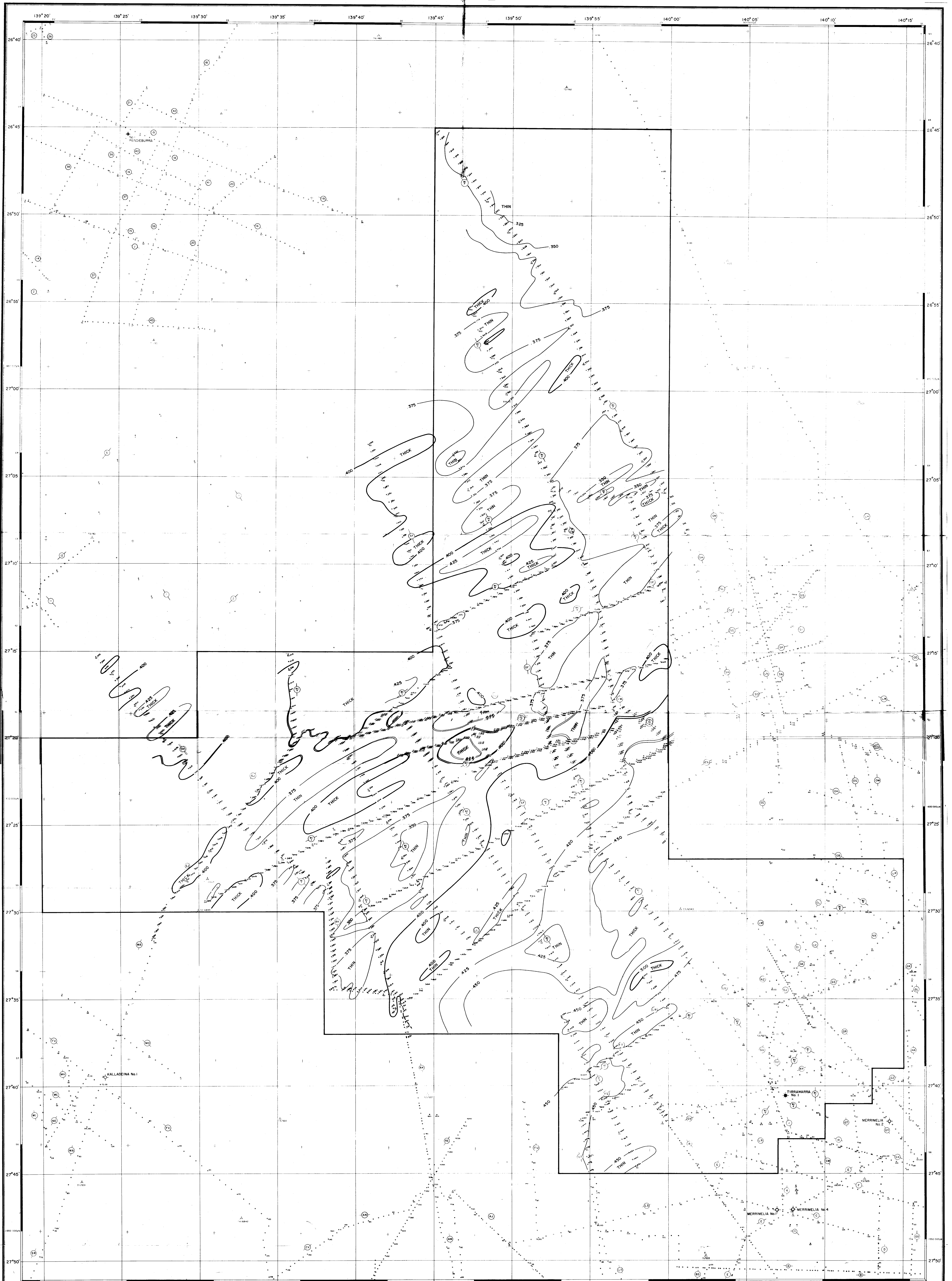
UNITED GEOPHYSICAL CORPORATION
PATCHAWARRA CENTRAL
SEISMIC AND GRAVITY SURVEY

"P" HORIZON
(BASE OF MESOZOIC)

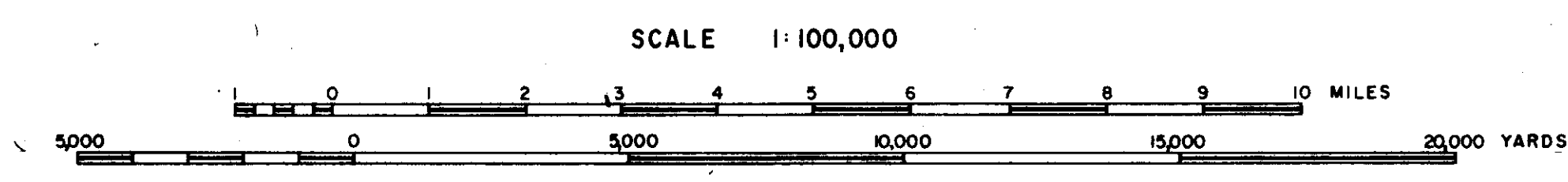
CONTOUR INTERVAL 625 METERS
DATUM: SEA LEVEL
INTERPRETATION BY S.D. BLACKIE & R. ANGLADE

PARTY 131
DATE: AUGUST 1970





- LEGEND
- REFLECTION SHOT POINT (UNITED)
 - OTHER SHOT POINTS
 - △ REFRACTION SHOT POINT
 - △ TELLURIMETER STATION
 - ⊕ HIGH AREA
 - ⊖ LOW AREA
 - FAULT
 - APPROXIMATE LIMIT OF UNIT



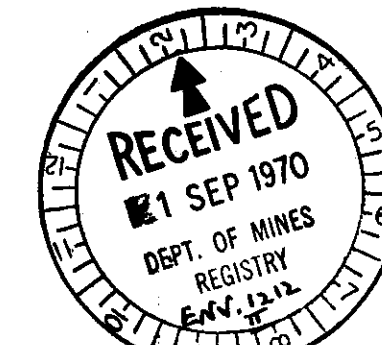
TRANSVERSE MERCATOR PROJECTION

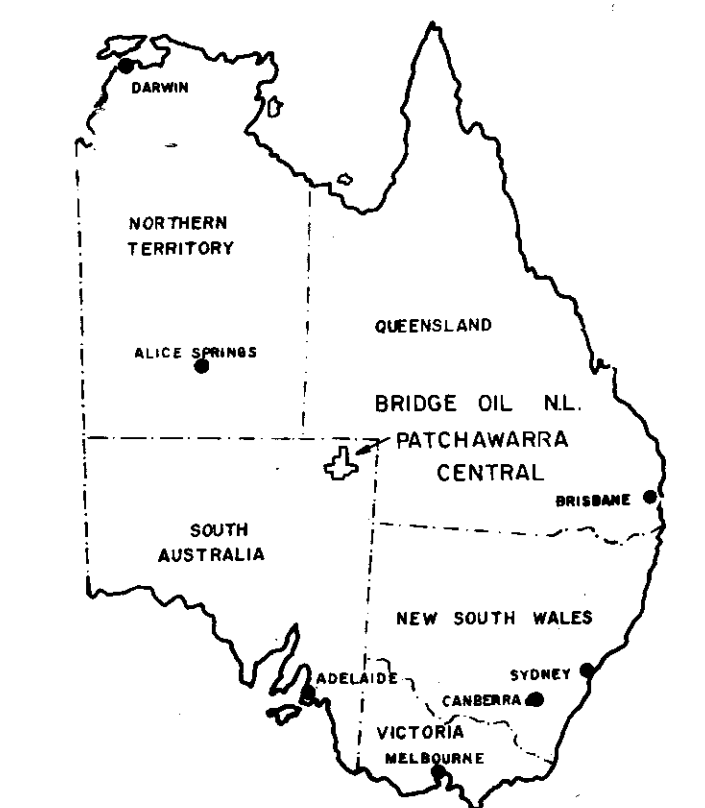
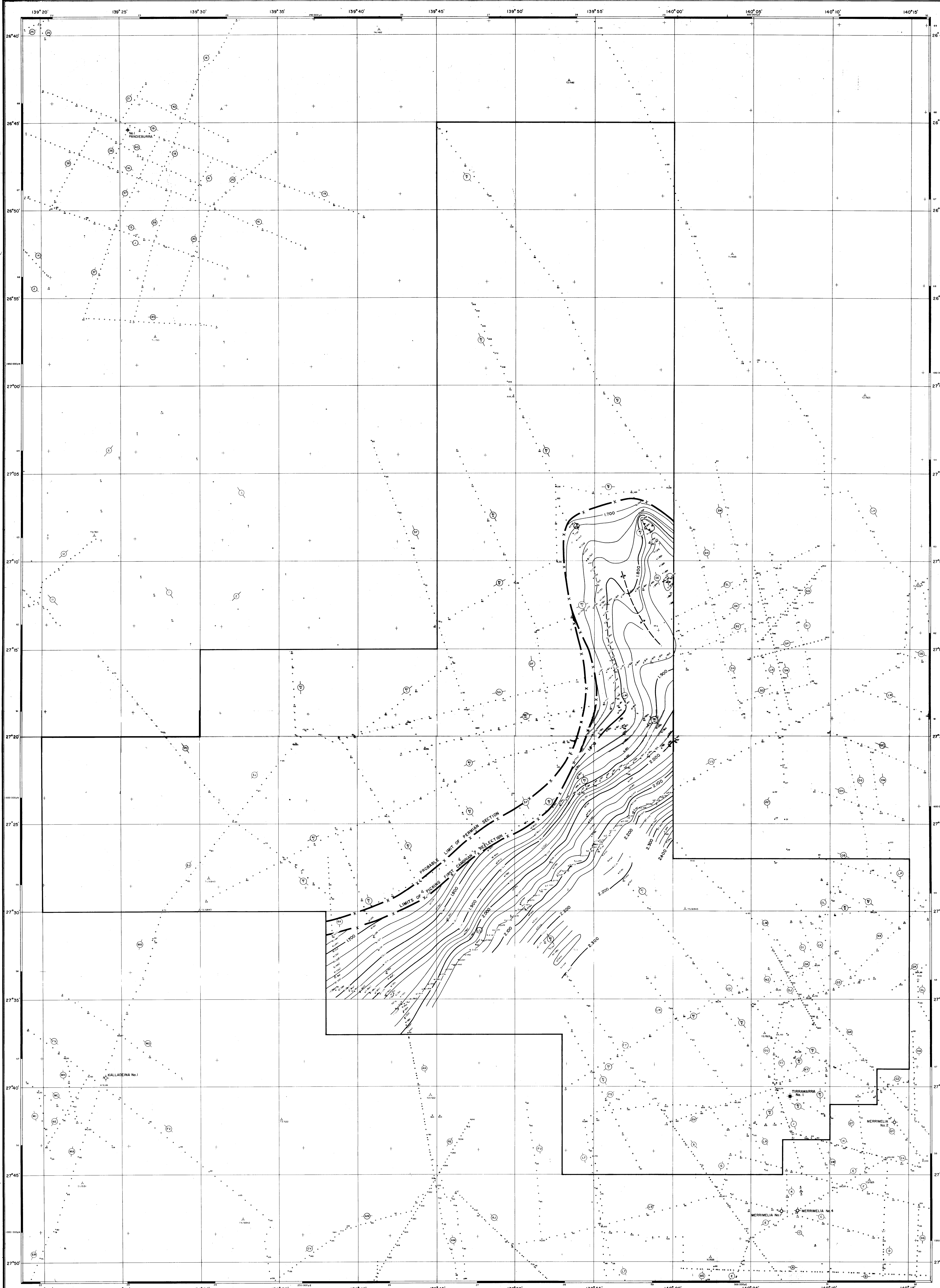
Black crosses indicate the 10,000 yard Transverse Mercator Grid, zone 6 (Australia series), CLARKE 1858 SPHEROID.

FOR
BRIDGE OIL N.L.
BY
UNITED GEOPHYSICAL CORPORATION
PATCHAWARRA CENTRAL
SEISMIC AND GRAVITY SURVEY

"C-P" ISOPACH

CONTOUR INTERVAL: 25 METERS
DATUM: SEA LEVEL
INTERPRETATION BY: B.D. BLACKIE & R. ANGOVE
PARTY: ISI
DATE: AUGUST 1970
REGISTRATION NO.: 101/101





LEGEND

- REFLECTION SHOT POINT (UNITED)
- OTHER SHOT POINT
- ⦿ RETRACTION SHOT POINT
- △ TELLURIMETER STATION
- ⊕ HIGH AREA
- ⊖ LOW AREA
- FAULT
- - - APPROXIMATE LIMIT OF UNIT

SCALE 1:100,000

0 1 2 3 4 5 6 7 8 9 10 MILES

0 1 2 3 4 5 6 7 8 9 10 KILOMETERS

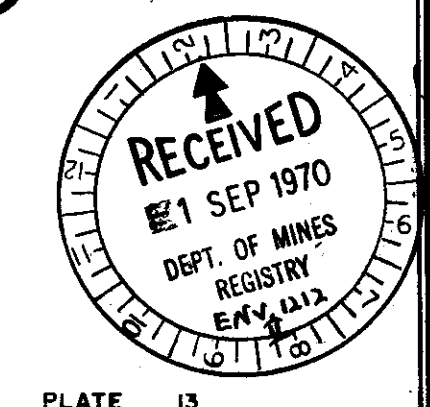
TRANSVERSE MERCATOR PROJECTION

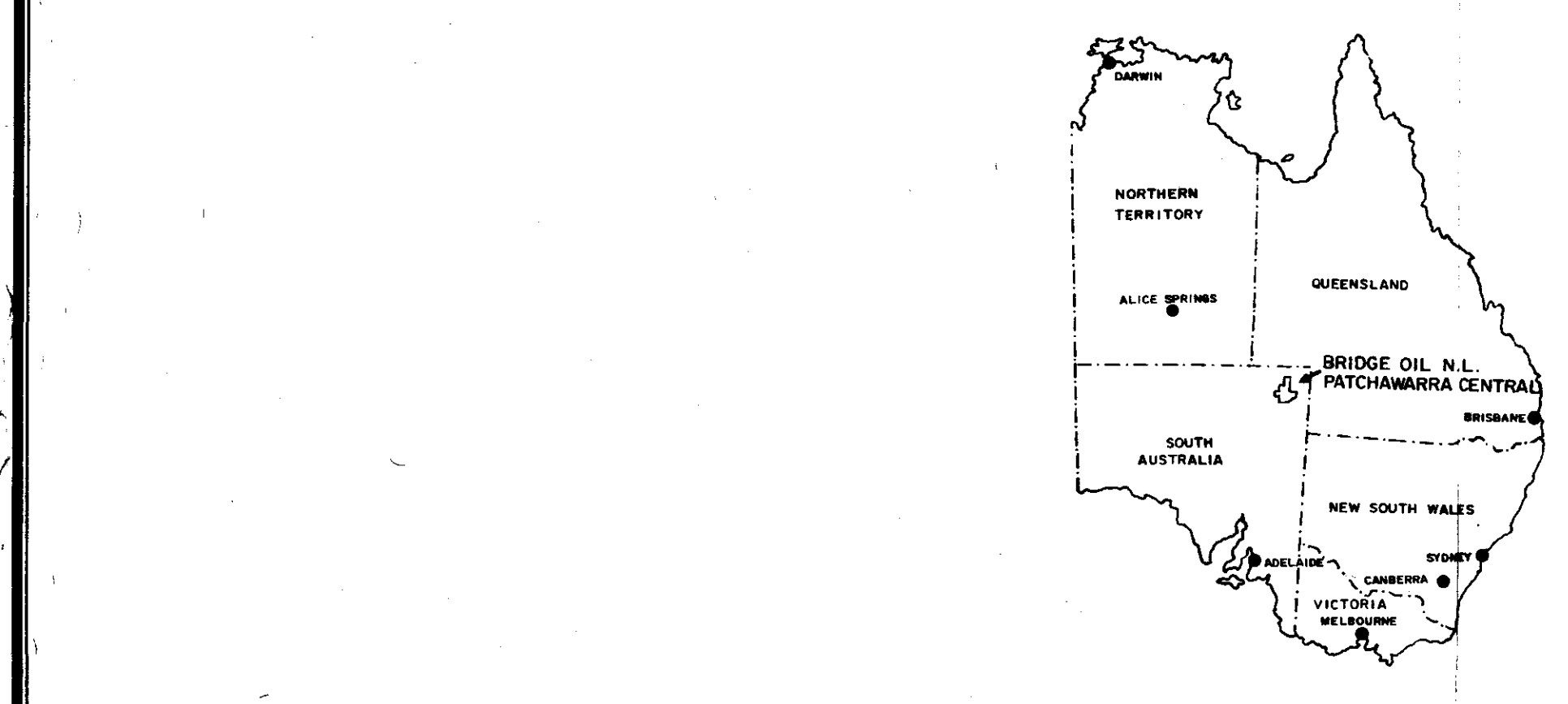
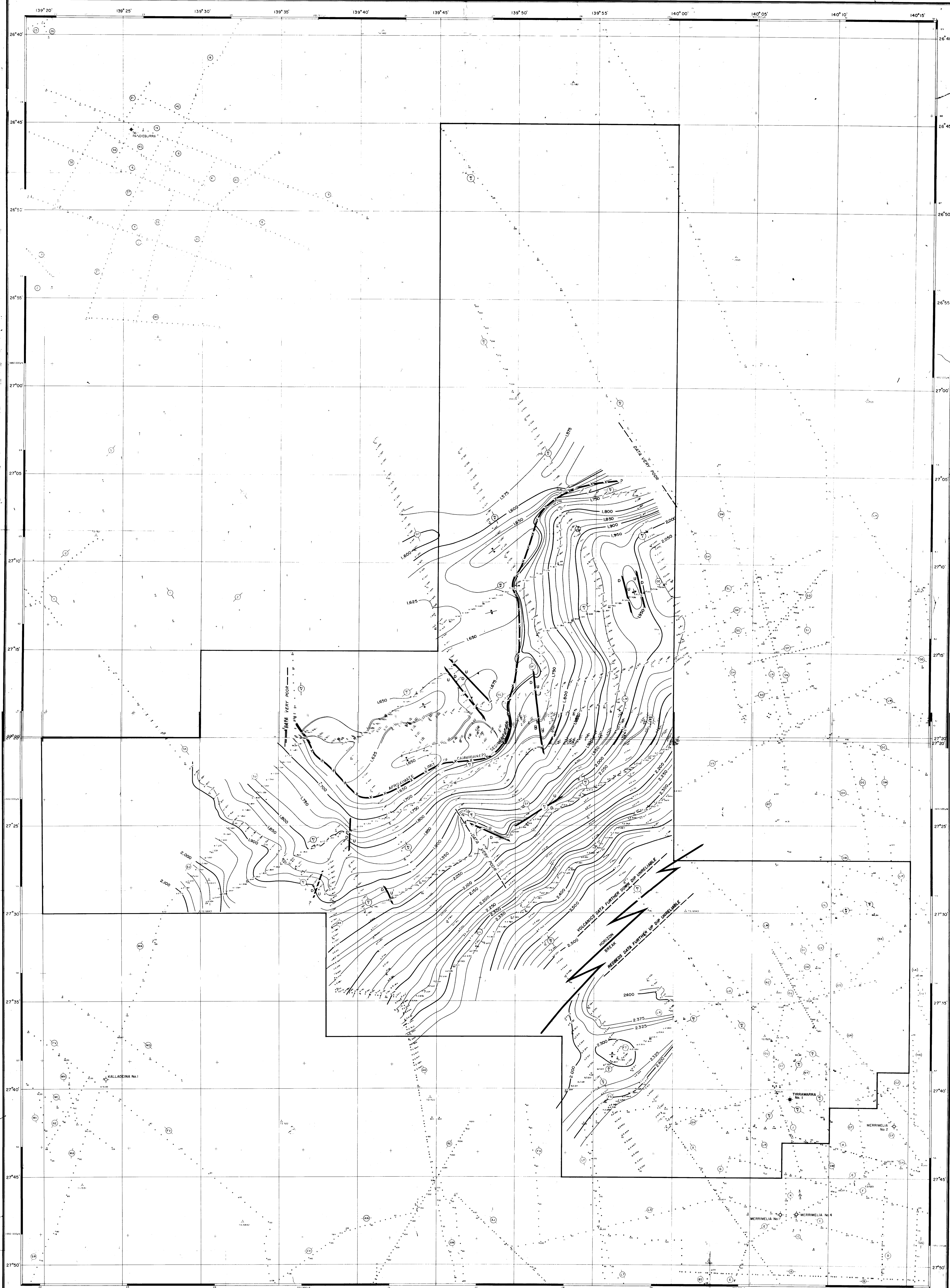
Black crosses indicate the 10,000 yard Transverse Mercator Grid, zone 6 (Australia series), CLARKE 1858 SPHEROID.

BRIDGE OIL N.L.
UNITED GEOPHYSICAL CORPORATION
PATCHAWARRA CENTRAL
SEISMIC AND GRAVITY SURVEY

TOP OF CAMBRIAN ?

COUNTY INTERVAL 200 MILES
DATUM SEA LEVEL
INTERPRETATION BY S.D. BLACKIE & R.V. ANDERSON





LEGEND

- REFLECTION SHOT POINT (UNTESTED)
- OTHER SHOT POINTS
- △ TELLURIMETER STATION
- ⊕ HIGH AREA
- ⊖ LOW AREA
- FAULT
- - - APPROXIMATE LIMIT OF UNIT

SCALE 1:100,000

TRANSVERSE MERCATOR PROJECTION

Black crosses indicate the 10,000 yard Transverse Mercator Grid, zone 6 (Australia series), CLARKE 1858 SPHEROID.

SURVEY FOR
BRIDGE OIL N.L.
BY
UNITED GEOPHYSICAL CORPORATION
PATCHAWARRA CENTRAL
SEISMIC AND GRAVITY SURVEY

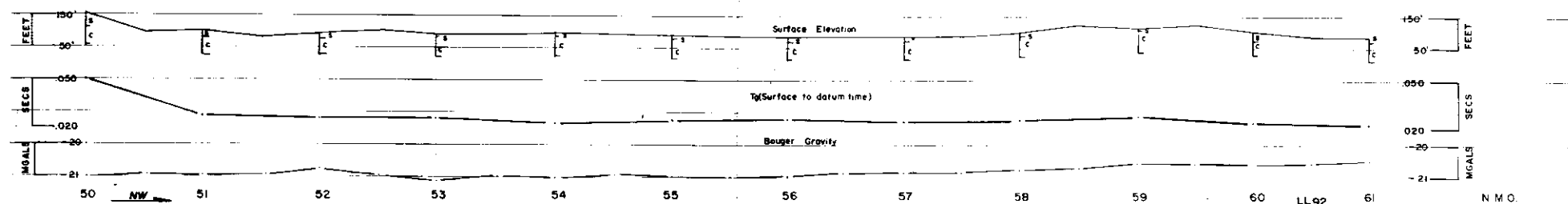
TOP VOLCANICS / TOP REDBEDS

CONTOUR INTERVAL: 200 FEET
DATUM: SEA LEVEL
INTERPRETATION BY: B.D. BLACKIE & R. ANSOVE

PARTY 131
DATE: AUGUST 1970

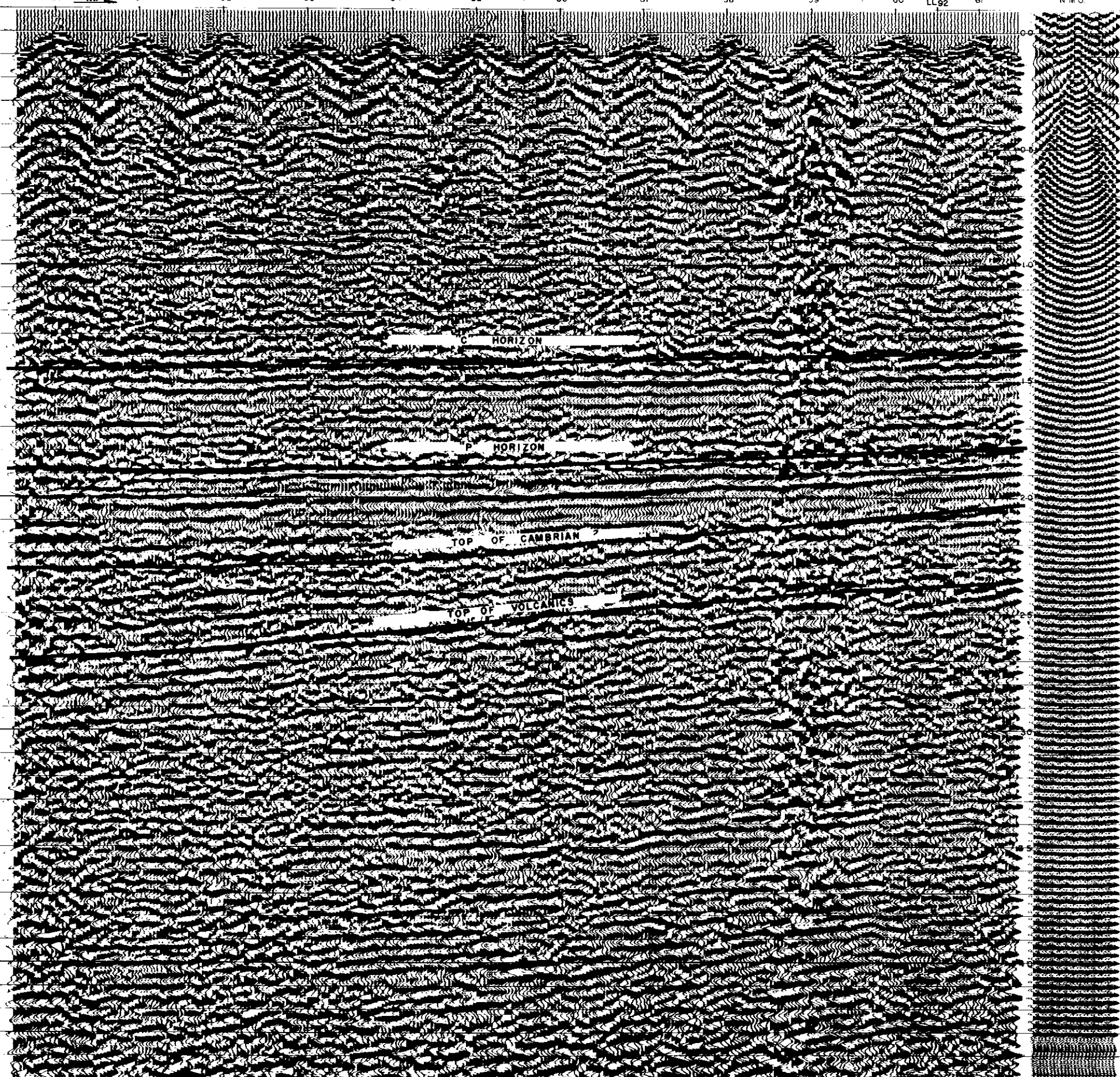
RECEIVED
21 SEP 1970
DEPT. OF MINES
GEOSURVEY

1212-90

LINE **BCG****SOUTHERN EXTENSION**

SHOT HOLE LEGEND

C = Clay
 G = Gravel
 S = Sand
 SC = Sandy Clay
 SS = Sand Stone
 SH = Shale
 LS = Lime Stone
 RK = Rock



Records shot by
UNITED GEOPHYSICAL CORP.

Party 131

Section by
RAY GEOPHYSICS (AUST) PTY. LTD.

Date: FEB , 1970.

DETECTORS/GROUP 24 GROUP INTERVAL 220'
 S.P. INTERVAL 2640 DATUM Sea Level
 FILTER 1W RECORDING NONE PLAYBACK
 A.V.C. MED RECORDING MED PLAYBACK
 CORRECTION VELOCITY 6500/sec MIX 2/1
 SCALE 1" = 1760' HORIZONTAL 1sec = 4 2" VERTICAL

BRIDGE OIL N.L.

1212-41

PATCHAWARRA CENTRAL SEISMIC SURVEY
AREA

LINE BCG S.P.'s 50-61