COMMONWEALTH OF AUSTRALIA

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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1970 / 107

Annual Summary of Activities Geophysical Branch 1970

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METALLIFEROUS AND AIRBORNE SECTION

GROUND SURVEYS

VLF-EM Test Survey, Zeehan District, Tasmania (W. Langron, P. Gillespie)

During the period 11th-17th March test surveys were carried out over three areas near Zeehan, Tasmania (Plate 1). The areas were chosen because of the availability of drilling information, surface geological mapping and some geophysical data. In addition, the strike of the known conducting bodies is nearly ideal for the VLF method using the transmitting station, NWC.

In the Comet area the results are obviously affected by the extremely rugged topography but anomalies due to mineralization can be distinguished. A computer programme was written to filter and smooth the data, which were then contoured. Generally, there is good agreement between the contoured data and surface geology. Correlation with other geophysical results is variable, although it is felt that the SP results in particular are affected by the steep topography.

The Sylvester and Limestone areas are flat and in part swampy. Some VLF anomalies agree with previously located EM and/or SP anomalies, but there are marked exceptions. The VLF results suggest that some of the anomalies are due to a conductor lying beneath a highly conductive overburden. It was not possible to assess the effect of swamp on the results.

The results of the survey show that good quality data can be obtained with the VLF method where mineralization approaches near surface and the conductors strike approximately in the direction of the transmitting station. The study indicates that the depth penetration of the method is about 30 metres in the Zeehan district.

Astrolabe and Ormond River Surveys, T.P.N.G. (J. Gardener, P. Pollard, P. Gillespie)

The surveys were carried out between 9th July and 8th September with the primary aim of testing various geophysical methods. The methods used were electromagnetic (Turam and VLF), magnetic, self-potential, induced polarization, and radiometric (Plate 1).

In the Ormond River area, surveys were made over the Kakakaka Prospect, where A.O.G. Minerals Pty. Ltd. had done geological mapping and costeaning and had established the presence of three zones of geochemical copper anomalies.

The magnetic survey showed strong anomalies apparently due to magnetite within the outcropping ironstone. Several weak Turam anomalies were found and in general were confirmed by the VLF results. These anomalies coincide in places with the geochemical anomalies. Only very weak IP anomalies were observed.

The weak EM and IP anomalies may be due to minor sulphide mineralization or to magnetite and haematite which occur right across the surveyed area. No significant SP or radiometric anomalies were found.

In the Astrolabe Mineral Field, electromagnetic (Turam and VLF) surveys were made at the Laloki mine and electromagnetic (Turam and VLF) and IP surveys at the Mount Diamond mine. In both places, strong anomalies were present over known mineralised zones. The results were compared with those of earlier BMR surveys in which the main methods used were SP and magnetic.

In the areas surveyed, the EM and IP methods proved the most suitable for sulphide mineral exploration. The conducting bodies are all fairly close to the surface and produced recognizable EM anomalies. IP can be used selectively to obtain further information about the conductors. Previous SP surveys showed that an SP anomaly occurs at Mount Diamond but not at Laloki. The SP results were inconclusive, but it appears that localized anomalies may occur over some sulphide bodies in the area and the method has some application. The magnetic results showed that numerous anomalies due to basic rocks occur in the area; other anomalies are due to magnetite. It would be difficult to separate anomalies due to sulphides from other anomalies and the magnetic method has only limited application in the area.

Tennant Creek, N.T. (E. Sedmik)

Drilling targets based on the results of the 1969 ground magnetic surveys were finalized and supplied to the N.T. Mines and Water Resources Branch.

A study of the methods of magnetic anomaly interpretation applicable to the Tennant Creek field indicated the possibility of determining susceptibilities of the anomaly bodies and hence distinguishing between massive ironstones and disseminated iron oxides contained within igneous rocks and sediments. In order to follow up this investigation, which it is hoped will continue in 1971, arrangements were made with the Mines Branch to obtain representative drill core samples for susceptibility measurement.

Owing to the staff situation, little progress could be made on the general review and assessment of the available geophysical data, which was originally planned as the initial phase of a major point geophysical-geological project on Tennant Creek.

Darwin Uranium Group (J. Gardener, J. Williams, P. Bullock)

The areas in which geophysical surveys were made in 1970 by the Darwin Uranium Group are shown on Plates 2 and 3.

Rum Jungle Area

During the year several SP and EM anomalies in the Rum Jungle area were investigated by rotary drilling and geophysical logging. In Area 44 Extended four of the SP anomalies located in 1967 were drilled. The geological logs show that the SP anomalies coincide with local prominences of unweathered black slate. Geophysical logging verified that unweathered black slate at shallow depth (3 to 18 m) caused the anomalies. SP, EM and IP anomalies in the Coomalie Gap West area found in 1966 and 1967 were drilled and logged. The results showed that the anomalies are also due to unweathered black slate at shallow depth.

The 1969 airborne gamma ray spectrometer survey in the Rum Jungle area located many anomalies. Several of these were investigated on the ground in 1970 using a McPhar TV5 four-channel portable gamma-ray spectrometer. The anomalies investigated are shown on Plate 2. The TV5 and airborne results are in good agreement. Two anomalies, No. 16 in the Rum Jungle Complex and No. 29a, Flynns area, were drilled. Drill samples were assayed in the laboratory with the 256 channel gamma-ray spectrometer and the results verified the findings of the field equipment that the radioactivity is due mainly to the uranium series.

3/

Stapleton Area

Slingram and surface radiometric surveys were made in the Stapleton area on ten traverses 365 metres apart and approximately 4 km long. Four of the traverses were also surveyed with the Ronka VLF equipment. The results show no significant conductors in the area. The Slingram results show clearly some of the geological boundaries; similar correlation between Slingram results and geological boundaries have been observed elsewhere in the Rum Jungle area. The Ronka results were substantially different from the Slingram results; some areas with undisturbed Slingram profiles produced irregular Ronka profiles and the Ronka results may be influenced by surface effects. The radiometric results showed a high background over the Waterhouse Granite. An anomaly in the southwest of the surveyed area appears on three traverses and coincides with the Celia Dolomite-Crater Formation boundary; auger drilling showed that the radioactivity is confined to the near surface layer.

Mary River Area

A geophysical survey was made in Government Mining Reserve No. 275 in the Mary River area at the request of the Mines and Water Resources Branch, NTA, to assist in selecting diamond drilling targets on geochemical anomalies. The results of preliminary tests made in June using Slingram and Ronka VLF equipment and a vertical component magnetometer indicated a detailed survey was warranted and a grid was selected and pegged. The detailed survey started in August and lasted two weeks. Methods used were Slingram, Turam, and magnetic. Anomalies were found with each method. Magnetic anomalies are related to structure. The EM anomalies are related to structure and also to carbonaceous shale. As the mineralization is not directly related to structure and is not confined solely to carbonaceous shale, the geophysical results are of limited use in selecting drilling targets.

Coronation Hill

SP tests were made in April at Coronation Hill in the South Alligator River area at the request of United Uranium N.L. to locate carbonaceous shale beds. These beds are known to be associated with uranium mineralization in the South Alligator River area and surveys in the past have shown that many of these beds produce SP anomalies. The Coronation Hill tests revealed two anomalous zones southwest of the Coronation Hill open cut. The anomalies are in areas geologically favourable for uranium mineralization and pattern drilling has been recommended.

Mount Diamond

At the request of United Uranium N.L. tests were made over the Mount Diamond mine to determine whether the mineralization (pyrite and

chalcopyrite in a long thin quartz vein) could be detected by geophysical methods. Methods used were Slingram, Ronka VLF, and magnetic. Results showed that none of the methods used detected the mineralization.

Radon Survey

Alpha particle counts were made in auger holes drilled every 8 km between Darwin and Pine Creek to test the method as a reconnaissance technique. The results outlined two known radioactive areas; however, surface gamma-ray counts also outlined these two areas. Some routine alpha counting was done in the holes drilled this year in Area 44 Extended. The results were similar to earlier gamma-ray surveys. Weekly measurements in a drill hole at Rum Jungle Creek South showed large seasonal variations. In all the projects poor control over geometry was a major problem.

Miscellaneous

Gamma-ray, SP and single point resistance logs were made of six holes in the Victoria River area for a Geological Branch field party.

Radiometric Laboratory

201 samples were assayed with the 256 channel gamma-ray spectrometer. 28 of these samples were for outside organizations, 82 for BMR projects and the remainder for calibration and demonstration purposes.

The Afmag station near Batchelor was kept in operation.

Routine maintenance and calibration of field equipment was carried out. Staff assisted with routine operations of the Darwin seismic station and with the installation of the new Benioff recorder at East Point.

Darwin Seismic Station

Prior to May, recording was not satisfactory due to repeated failures of the Wilmore recorder. In May a Benioff recorder was installed. Since then records have been satisfactory. Since July the main events have been cabled to Washington.

AIRBORNE SURVEYS

VH-MIN Eucla Basin Survey, South Australia (D. Waller, B. Grewal)

At the request of the South Australian Mines Dept. an airborne magnetic and radiometric survey was conducted over the 1:250,000 areas of Cook, Ooldea, and Barton lying within and adjacent to the Eucla sedimentary basin (Plate 4).

The survey operations took place between April and August 1970 and the survey data were partly interpreted by D. Waller, until he resigned.

In the areas of basement outcrop or near-outcrop in Barton, the magnetic interpretation took the form of zoning based on differences in magnetic intensity and in linearity of magnetic anomalies. Each zone was characteristic of a rock type. The zones were found to be partly correlatable with Bouguer gravity anomalies available from regional gravity surveys.

Depth estimates were made on anomalies within the basin and contours of magnetic basement depth were constructed. Several significant features are apparent in the basement topography. A north-striking trough about 3000 metres deep is interpreted to pass centrally through the Ooldea Sheet, the remainder of the area showing rather shallow basement. In the Cook area, a trough about 2500 metres deep strikes northwest across the central part of the Sheet. The above features have broadly corresponding gravity expression.

Contract Aeromagnetic Survey, East Papua

This contract, awarded to Compagnie Generale de Geophysique in October 1969, specified (i) a panel of flight lines covering the mainland at an altitude of 15,000 feet and (ii) a panel offshore north of the mainland at an altitude of 8,000 feet extending eastward to longitude 151° 50' and northward to latitude 8° 00' (Plate 5).

The latter panel was surveyed promptly and the magnetic contour maps with preliminary interpretation of basement depth and topography delivered to BMR. Adverse weather has prevented the completion of the mainland panel despite efforts over many months, and several thousand kilometres of survey lines remain to be flown.

The interpreted basement contour map offshore shows surface or shallow basement in the island areas. An elongate trough extends eastward from the coastline at latitude 9° 00'. It is estimated to be 3000 metres deep. There is also a deepening of basement to 3000 metres on the eastern margin of the area (longitude 151° 50'). Basement deepens rapidly along latitude 8° 00' on the northern margin of the area, but here the sea floor deepens correspondingly.

Eromanga Basin, Qld, Data Interpretation (K. Horsfall)

The review and interpretation of aeromagnetic data were required for inclusion in proposed joint geological-geophysical bulletins on the Eromanga Basin. The existing aeromagnetic coverage in the Eromanga Basin was examined. One BMR survey (Central Great Artesian Basin, 1968) and three subsidized surveys by oil companies provide extensive coverage of the eastern part of the area. However, owing to staff shortage no work was done on data compilation or interpretation.

Northern Great Artesian Basin, Queensland (B. Grewal)

The interpretation of the aeromagnetic data was commenced but could not be continued beyond the preliminary stage because of Grewal's resignation.

Ngalia Basin Project (P. Shelley)

Copies of the magnetic profiles of the Pacific American aeromagnetic survey have been supplied by the subsidy section of P.E.B. and approximately 25% of these data has been re-interpreted to date. Progress has been hampered by staff resignations but it is hoped that this joint project will be completed by mid-1971 as planned to

VH-BMR Cloncurry Survey, Queensland (R. Beattie, J. Rees, K. Horsfall)

A detailed airborne magnetic and gamma spectrometer survey was carried out in the Cloncurry 1:250,000 sheet in co-operation with the Geological Branch mapping party. The work started in April, continued through until early July, and covered an area consisting of two strips approximately 110 x 6 Km (Plate 6). East-west flight lines were spaced at 300 metres and this resulted in 4825 kms of survey flying.

Most of the area was magnetically disturbed and anomalies are largely attributed to basalt members of the Soldiers Cap Formation and dolerite dykes. The basalt-free member of this formation corresponds to a broad magnetic 'low'. The basic members of the Soldiers Cap Formation appear to shallowly underlie the sediments (mainly the Corella Formation) west, south and southwest of Cloncurry. One small transcurrent fault has been delineated.

The anomalies in Area I are attributed to basic rocks, primarily in the Leichhardt Metamorphics/Kalkadoon Granite Complex and to a lesser extent in the Argylla Formation. The Corella Formation and the Wonga Granite are magnetically flat except for anomalies over the amphibolites, gabbros, and dolerites in the Corella Formation in the east of the area. The metamorphic zone, which includes the Mary Kathleen Uranium deposit, gives rise to a broad elongate N-S anomaly of 300 to 400 gammas.

The radiometric data have been zoned on the basis of anomaly character and amplitude. The granites give rise to high thorium anomalies with a lesser potassium contribution and only a small uranium component. There appears to be no difference between the western and eastern Wonga Granite intrusions with which the Mary Kathleen deposit is believed to be associated.

In the areas 1 and 4 it is possible to distinguish between the Leichhardt Metamorphics/Kalkadoon Granite and the Argylla Formation as the latter has generally 50% greater mean Th content. Basic dykes in the Argylla Formation and Ballara Quartzite appear as 'lows' in all channels.

Tennant Creek Aeromagnetic Data Review (P. Shelley)

The regional aeromagnetic data in the eastern and southern parts of the TENNANT CREEK 1:250,000 map area have been re-contoured at 10 gamma intervals.

A number of anomalies which appeared in the original contouring as inflexions and embayments are now more definite due to the smaller contour interval. Also some additional anomalies of low amplitude have been delineated. Several anomalies have been analysed.

It is intended to integrate the data of all the airborne surveys in the Tennant Creek area but this project is at present in abeyance due to lack of staff.

VH-BMR Tennant Creek, N.T., 1970 (J. Rees)

Two surveys were flown in the TENNANT CREEK area from 15.6.70 to 29.6.70. J. Rees was party leader.

Area 1: Bonneywell Regional Magnetic and Spectrometer Survey

Approximately 1450 sq. km was flown (Plate 7A) at an altitude of 180 m above ground level along north-south lines with a spacing of 1.5 km. Magnetometer and four channels (Total, Potassium, Uranium, and Thorium) of spectrometer data were recorded.

The survey aimed at delineating the structure of the Warramunga Geosyncline beneath the Cainozoic cover.

No detailed interpretation has been possible. The area is magnetically very flat, suggesting that structures relating to susceptibility contrasts are either generally absent or that the contrasts are generally small. One large isolated anomaly in the centre of the area provides the only strong magnetic feature which may be attributable to major geosynclinal structure.

Spectrometer results confirm that outcrop is generally absent.

Area 2: Detailed Spectrometer Survey

The area (Plate 7B) was about 150 sq. km and was flown at 85 m above ground level with east-west line spacing of 300 m. Only spectrometer data were recorded, three channels with energy bands covering the main Potassium, Uranium, and Thorium peaks and one covering the complete energy range.

It is intended to use the data to investigate the radioactive content of rock-types found in the Tennant Creek Field, especially the quartz-magnetite bodies and rock-types associated with known areas of Cu/Au mineralization.

No detailed systematic interpretation has been possible, but indications are that it may be possible to differentiate between the various rock-types from their relative spectral content. Anomaly continuity is good and the granites of the Tennant Creek Granite Complex have relatively high potassium content. Members of the Warramunga Group generate a low background in all channels and elementary anomalies generated by the numerous dykes, veins, and beds of haematite shale may allow spectral classification and resolution of these sources.

Contract Aeromagnetic Survey, Western Australia

A contract for the aeromagnetic survey coverage of Glengarry, Wiluna and Kingston 1:250,000 areas (Plate 8) was awarded to Geophysical Resources Development Co. in July 1970. Survey operations based at Meekatharra commenced in early October and were completed by the end of October.

The survey results are to be presented in the form of preliminary total magnetic intensity contour maps. These maps should be delivered to BMR by April 1971.

This survey is part of a continuing programme to provide regional aeromagnetic coverage of the Precambrian shield in Western Australia to assist geological mapping in the delineation of important rock types by their magnetic character.

Victoria River, N.T., Data Interpretation (J. Rees)

The Victoria River Basin was flown as two contract aeromagnetic surveys between 1966 and 1968 and covered the sheets AUVERGNE, DELAMERE, WATERLOO, VICTORIA RIVER DOWNS, LIMBUNYA, WAVE HILL and BIRRINDUDU. A total of 73,130 line km was flown at a nominal altitude of 150 m. agl with N-S line spacing of 1.6 km. Interpretation of the aeromagnetic data was planned as part of a joint project with the Geological Branch.

At this stage preliminary interpretation only is available. Structurally the region is part of the Sturt Tectonic Block, which is bounded to the northwest by the Halls Creek Mobile Zone (Victoria River and Cockatoo fault systems and outcrops of Lamboo Complex and Halls Creek Group), and to the south and southeast by the Warramunga Mobile Zone. The basin contains mainly Proterozoic sediments with extensive flows of Lower Cambrian Antrim Plateau Volcanics, some areas of Palaeozoic sediments and Lower Cretaceous sediments to the east.

Magnetic features can be related to three primary source associations; strong lineations along basin extremities, broader features associated with intrabasin and/or basement structure, and high frequency anomalies attributable to the volcanics. The dominant trend direction is northeast with less intense features striking northwest and more common in the southeast of the survey area (Plate 9).

Northeast trends parallel the Victoria River and Cockatoo Fault Systems in AUVERGNE with complex termination in the central east of the sheet.

The magnetic basement appears to be very close to the surface in LIMBUNYA with well defined lineations in the centre and west correlating with mapped surface faulting. Zones in the central south of LIMBUNYA and north of BIRRINDUDU are possibly related to anticlinal structures mapped in the Proterozoic sediments in that area. The basin appears to deepen in the central west of VICTORIA RIVER DOWNS.

Where the Antrim Plateau Volcanics outcrop, their magnetic character can be used to confirm photogeological mapping even though line spacing is too coarse to allow adequate structural definition. This response has been used to delineate areas where sediments overlie the volcanics (Plate 9). In WAVE HILL there is evidence that tectonics associated with the northeast lineations may have influenced the structure of the volcanics.

VH-BMR Upper Shoalhaven River Catchment Area Spectrometer Survey (P. Shelley)

This survey was requested by the Division of Plant Industry, CSIRO, to test whether broad variations in soil type were detectable by an airborne gamma-ray spectrometer. The spectrometer was set up to measure total count and the contributions of potassium, uranium, and thorium.

An area of 80 km x 15 km was flown at an altitude of approximately 90 m along north-south lines spaced at 800 m from mid-March to mid-April. The survey was completed by flying a part of this area in detail with a line spacing of 300 m in early November. These areas are shown on Plate 10.

All the data have been sent to CSIRO for processing and analysis.

VH-MIN Infrared Photography, Northern Victoria (P. Shelley)

During the period 17 to 25 February, infrared colour and ektachrome MS photography was obtained of irrigation channels in Northern Victoria, to assist the State Rivers and Water Supply Commission of Victoria in investigating water seepage and salinity problems. Two 70 mm Vinten cameras were used.

A set of contact prints has been supplied to the Commission for analysis. Enlargements of selected frames are being assembled by the Photogeological Group to provide a reference collection of colour photographs illustrating the various conditions which are present in an irrigation area.

The photography was very useful in delineating problem areas.

VH-BMR Remote Sensing Survey, W.A. (P. Shelley)

This survey was flown from 10 September to 6 October and comprised multispectral photography and detailed aeromagnetic and gamma-ray spectrometer coverage of two areas near Leonora and Laverton as shown in Plate 11. The multispectral photography was flown at 3000 m above sea level with two 70 mm cameras and consisted of panchromatic, infrared black and white, colour and infrared colour photography of both areas. In addition, in Area 2, some runs were flown with panchromatic film using yellow, red, green and magenta filters.

The geophysical data were recorded at 85 m above ground level and flown along east-west lines 400 m apart and north-south lines 1500 m apart.

The processed multispectral photography was satisfactory except for the infrared black and white which is badly fogged although still usable. All the film has been passed to the Photogeological Group for evaluation and interpretation. The geophysical interpretation has not yet been commenced.

Airborne Reductions and Contracts Group (C. Leary, J. Rees, D. Downie, L. Crain)

1. Manual Processing of Analogue Records

The map areas of Sir Samuel and Duketon W.A. (1967) and Herberton Qld (1966) were completed. This completed all analogue data waiting processing.

2. Computer Processing of Digital Magnetic Data

Sandstone and Youanmi W.A. (1968) are processed and wait contouring.

Central Great Artesian Basin (1968) is processed and waits contouring.

Western Australia (1969) datum analysis process completed and final correction process parameters are being prepared.

Southern Cape York Peninsula Qld (1969) datum analysis process cards are being prepared.

Eucla Basin (1970) stacked profiles on 1:500,000 extended sheets have been plotted.

3. Map Data Digitising and Processing

Sandstone 1968, 12 sheets digitized, 9 sheets processed.

Youanmi 1968, 12 sheets digitized, 2 sheets processed.

Central Great Artesian Basin 1968, 18 sheets digitized, 16 sheets processed.

Western Australia 1969, 18 sheets digitized, 5 sheets processed.

4. Program Development

Tapecard: For map digitization using the Observatory Group's scaler. Outputs punched cards from papertape input (P.L. Crain).

DMA Coord: For map digitization using the CSIRO DMAC digitiser. Outputs punched cards from papertape input. Still in preparation (J.E. Rees).

Digit: For digitization of analogue records using the CSIRO DMAC digitiser. In preparation (J.E. Rees).

Datum: For least squares adjustment of miscloses which data are generated by the main datum analysis program. In preparation (J.E. Rees and P.L. Crain).

X-Y and LAT-LØNG: For conversion of digitized map data into T.M. coordinates and geographic coordinates (R. Whitworth and D. Downie).

Contours: For contouring aeromagnetic data not sampled on a regular grid. This is a development of the gravity contouring program (I. Briggs and C. Leary).

Stak Plot: For stacking profiles of digital data on map areas (D. Downie).

Twin Otter Modification and Testing (R. Wells, D. Downie)

The BMR's new Twin Otter aircraft VH-BMG, purchased from Hawker de Havilland Pty Ltd, was delivered early in the year. It is required as a replacement for the DC3 aircraft VH-MIN, which is being withdrawn from service this year.

A contract for modification of the aircraft to BMR requirements for geophysical surveying was let to Trans Australia Airlines in April, who sublet some aspects of the rework to Hawker de Havilland Pty Ltd, Bankstown. All of the fabrication was done at Hawker de Havilland Pty Ltd hangar at Bankstown, N.S.W.

Modifications required by the BMR consisted of a magnetometer boom, two camera wells, an operator's seat and table, storage drawers, electrical ducting, installation of a doppler navigator, radioaltimeter, 115 V 400 Hz power inverter, and provision for mounting gamma ray detector heads and survival equipment in the baggage area. Other modifications were called for by Trans Australia Airlines to achieve compatibility with their Otter fleet for ease of maintenance.

The modification contract was almost completed by 28th October, when the aircraft was formally handed over to the Minister, Mr Swartz, at Canberra Airport. At that date further work was required on the doppler navigation system.

During November and December BMR will install and test geophysical equipment in the aircraft with a view to using it for survey work in 197

VH-BMR Testing and training programme

While in Canberra this year the Aero Commander aircraft has been used to train new technical staff and test new equipment, particularly the MNS-2 proton magnetometer.

Publications

Bulletins

118	D.B. TIPPER	Laverton-Edjudina airborne magnetic and radiometric survey, W.A.	In press
119	J. HAIGH	Standard Curves for magnetic anomalies due to spheres	In press
120	E.N. EADIE	Magnetic Survey of the Savage River and Long Plains Iron Deposits, N.W. Tas.	Published
	J.E.F.GARDENER	Dobbyn-Kamileroi geophysical surveys, Qld.	In preparation
	J. HAIGH	Standard Curves for magnetic anomalies due to finite dykes	With Editor

Reports

136	D. TIPPER	Strangways Range detailed aeromagnetic survey, N.T.	Published
139	E.P. SHELLEY	Daly River detailed aeromagnetic survey, N.T.	Published

139	G.A. YOUNG and E.P. SHELLEY	Amadeus Basin airborne and radiometric survey	With Editor

Maps

The following is a list of maps printed during 1970 (up to 6/11/70).

Victoria River Survey, N.T., Magnetic 1:126720 (2M to 1") 1966-7

Auvergne	- 4 sheets - NE, NW, SE, SW	
Delamere	" "	
Victoria River Downs	" "	
Wave Hill	" "	16

W.A. 1964 and 1966, Magnetic and Radiometric 1:126720(2M to 1")

Edjudina	- 4 sheets - NE, NW, SE, SW	
Laverton	" "	
Leonora	" "	
Menzies	" "	16

Nth Great Artesian, Magnetic, 1966, 1:250,000

Boulia	Richmond	
Springvale	Manuka	
Julia Creek	Hughenden	
McKinlay	Tangorin	
Mackunda	Muttaburra	10

Papuan Gulf Basin Basic Belt, Magnetic, 1966, 1:250,000

Aworra River	Yule	
Kikori	Buna	
Wau	Daru	
Salamaua	Maer Island	
Kiwai	Aroa	
SC-55-1		11

Amadeus Basin, Magnetic and Radiometric, 1965, 1:250,000

Kulgera	Hermannsburg	
Henbury	Ayers Rock	
Rodinga	Bloods Range	
Lake Amadeus	Alice Springs	
Mt Liebig		9

Georgina Basin, Magnetic, 1964, 1:250,000

Illogwa Creek		1
	Total Printed	63

The following are proposed for printing by December 31st, 1970.

Astrolabe (P.N.G.) Magnetic, 1966, 1:50,000

Laloki River	Gaile	
Goldie River	Cea	
Port Moresby	Urogolo	
Sogeri	Round Point	
Tupuseleia	Kemp/Welch River	10

Sir Samuel-Duketon W.A., Magnetic and Radiometric, 1967, 1:126,720

Sir Samuel	- 4 sheets, NE, NW, SE, SW	
Duketon	" "	8

Victoria River, Magnetic, 1966/67, 1:126,720

Waterloo	- 4 sheets, SW, SE, NW, NE	4

Amadeus Basin, Magnetic and Radiometric, 1965, 1:250,000

Mt. Rennie and Petermann Ranges	2

Reprints of Maps now out of print

Chillagoe-Einasleigh-Gilberton Radiometric, 1957, with photo surround - 2 sheets	
Pilbara 1956 "	
Wyndham-Halls Creek 1955 "	6
Kalgoorlie, Magnetic and Radiometric, 1957 - 1:126,720 NE, NW, SE, SW	4
Total	34

SEISMIC GRAVITY AND MARINE SECTION 1970

SEISMIC SURVEYS

Gosses Bluff Seismic Survey, N.T., 1968. Processing and analysis of the data has proceeded through the year. The preliminary report was passed to the Editor in February. Final interpretation is currently underway preparatory to writing the final report.

Analogue, digital, and LaserScan processing have been used to improve data quality. Extraction of vertical velocity information has occupied substantial digital processing and computer programming effort. The low velocity anomaly revealed implies major doming under the disturbed zone affecting the formations down to and perhaps even including basement. Seismic model studies are now in progress to determine the extent of doming consistent with the available data and known geology.

A study of shallow seismic velocities has revealed low velocity regions approximately coincident with the shallow mass defect deduced from gravity data. A model of a bedrock-breccia contact zone has been deduced from seismic refraction and gravity studies.

Contract digital processing. The major amount of digital processing this year has been of Gosses Bluff data by Geophysical Service International. It has been used to:

(i) Dynamically correct very long offset data, impracticable to do accurately in the analogue playback centre,

(ii) Improve signal-to-noise ratio and pulse shape by deconvolution,

(iii) Deduce vertical velocity information from poor quality multiple coverage data by Moveout Scan.

Trace summation processing of Controlled Directional Reception in the analogue playback centre has not revealed information additional to the normal analogue record section. However, use of deconvolution and pie-slice velocity filtering during digital processing has improved and extended reflection continuity. Migration stack is now being applied to the data. Preliminary results indicate that this is further improving data quality as well as migrating the reflections to their true sub-surface positions.

Some trial digital processing of Gosses Bluff and Timor Sea marine data was conducted gratis by Digital Technology Pty, a company recently established in Sydney.

Hawaii Institute of Geophysics' Oceanographic Investigations in Melanesia, 1970. During August and September 1970, BMR and the University of Queensland participated in a two-ship seismic refraction exercise conducted by Hawaii Institute of Geophysics. Thirteen refraction profiles aimed at improving knowledge of crustal structure were recorded in the Solomon Sea, the Bismarck Sea, and the Pacific Ocean north and northeast of New Ireland.

Other oceanographic measurements made were: continuous bathymetric and seismic profiling using pinger, sparker, and air cannon, magnetic profiling, continuous gravity recording, intermittent sonobuoy wide-angle reflection/refraction profiles, water temperature measurement, meteorological observations, piston coring, heat flow measurement, surface water samples, ocean bottom photographs, and dredging for hard rock samples.

Deep Crustal Reflection Surveys

Preliminary feasibility tests to obtain deep crustal reflections were carried out, in 1968, at Mildura, Victoria, and at Broken Hill, N.S.W., and, early in 1969, at Tidbinbilla, A.C.T., and Braidwood, N.S.W. A six months' crustal reflection survey on the "Geo-Traverse" across the West Australian Precambrian Shield was carried out between June and December 1969. During the first half of 1970 the reflection sections of the Mildura feasibility study were reviewed and prepared for publication. This revealed a two-layer crust with a 22 km thickness of granitic material overlying a 7 km thickness of intermediate velocity material (7.0 km/s). From these cross sections it would appear that this lower crustal layer is of variable thickness, thinning from 7 kms to 4 kms over a distance of 10 kms. Both the Mildura and Broken Hill sections show deep reflections occurring at times too late to be considered as near the Moho discontinuity. These reflections are considered to be returning from within the mantle and are estimated to be at a depth of about 50 kms.

Analysis and display of the deep crustal reflection results from Western Australia in the five areas selected along the Geo-Traverse followed analysis of some of the Eastern Australian work. The poorer quality results obtained in Western Australia, especially compared with the Mildura work, has delayed analysis pending digital processing of the magnetic recordings.

A series of LaserScan sections shows some improvement with velocity filtering but little or no improvement with frequency filtering. CDP records show no improvement in the continuity of reflected events later than 7 seconds, i.e. deep in the section.

Record events below 3 to 4 seconds are of such poor quality that timing is inaccurate and consequently velocity analyses give erratic results.

The computer program VELSPRED has been used to evaluate the quality of the reflection events and where possible compute interval velocities. Models for the crust computed from these results indicate low velocity material in the upper crust in two areas of Western Australia. The analysis is continuing.

A supplementary refraction recording programme utilized large explosions from the reflection recordings in three probe areas between Kalgoorlie and Mundaring. Analysis of these results also is continuing. A high mantle velocity, 8.4 km/s, was recorded along most of the Geotraverse between Kalgoorlie and Mundaring. This value is higher than the 8.1 km/s previously assigned to the mantle in this region but is consistent with high values detected from regional crustal studies carried out by the Mundaring Geophysical Observatory staff on the southwest shield.

Northern New Guinea Airborne Seismic Survey (Plate S1)

An experimental airborne seismic refraction and reflection survey was commenced in the Ramu - Sepik plains area of the Northern New Guinea Basin late in 1970. The major purpose of the survey was to establish a practical method for application of reconnaissance or detailed seismic exploration to swamp, jungle and other areas which are inaccessible for conventional land seismic operations. It was hoped also to gain information which would assist in resolving geological problems arising from the interpretation of aeromagnetic and helicopter gravity reconnaissance survey data previously obtained in the basin.

The technique employed (together with a block diagram of the recording equipment) is shown schematically in Plate S2. A helicopter was used to place into position on the ground explosives, shooting equipment, and geophones connected to sonobuoy radio transmitters. Seismic signals from the sonobuoy transmitters were received and recorded in a conventional recording system mounted in the DC3 aircraft VH-MIN flying over the seismic field set-up at the time of each shot. Preliminary feasibility tests were carried out between June 1969 and June 1970.

Comprehensive testing of the recording equipment and operational systems was effected in the Madang area before the party moved to Angoram to carry out the main programme. The time needed to complete these tests and ensure satisfactory system operation was longer than anticipated, and recording in the Madang Gravity Low, to determine depth of sediments, was curtailed.

In the Angoram area an effort to shoot a refraction traverse close to the Sepik River (Plate S1) had to be abandoned because tall vegetation (Pit-pit, kunai), chopped by the rotor blades, blocked up the air intake and gave rise to overheating in the helicopter engine. The decision was made to concentrate all efforts in obtaining results in the area of the Potter Gravity Low between the Sepik and Ramu Rivers (Plate S1). Initial results in this area were not good. Improved preamplifiers have been installed in the sonobuoys. Efforts are currently being made to improve ground coupling of both charge and geophones.

Seismic data processing

The group is concerned currently in the operation of the following equipment:

(1) MS-42 analogue processing and display system for high-quality sequential processing of seismic records.

(2) LASERSCAN optical filtering apparatus for rapid evaluation of frequency content and production of frequency- and dip-filtered diagrams.

(3) SINCLAIR dip-plotting machine for migrating seismic reflection data in cross-section form.

(4) Complete seismic recording and playback system, including 24 type 7000B amplifiers, DS7 magnetic recorder, and ER66 oscillograph camera, for simultaneous playback of 24-trace seismic magnetic tapes.

(5) Strip chart analogue-to-digital conversion unit for producing punched paper tapes from continuous analogue data such as single seismic traces, sonic logs, ship-borne gravity and magnetic records.

(6) Computer programs for the CDC 3600 computer, to assist in analysis of seismic records.

The monthly average production of seismic record sections on the MS-42 equipment was 23. Personnel of the group carried out maintenance on the equipment and supervised the preparation of field seismic recording equipment for survey work. Instruction in operating the analogue-to-digital strip chart converter was given as well as assistance and advice on use of the CSIRO computer at Black Mountain to edit the digital data and transfer to magnetic tape for permanent storage. An Operator's manual was written for the strip chart converter. The manual incorporates published information by CSIRO Division of Land Research and recent alterations to the CSIRO computer system. The LaserScan apparatus was used to test filtering techniques on data from a number of seismic projects including Gosses Bluff 1968/69, Deep Crustal studies 1968, Ngalia Basin 1968/69, Moora Coalfield 1970, and Geotraverse, 1969. A new optical filter has been developed for photogeological purposes.

The projects for which record sections were produced on the MS-42 equipment are as follows:

Ngalia Basin 1968 and 1969	1 section
Deep Crustal Reflection Survey 1968/69	11
Geotraverse 1969	75
Gosses Bluff 1962 and 1969	82
Roma Shelf 1967/68	19
East Otway Basin 1967	6
Moora Coalfield 1970 (for Engineering Section)	20

Sections produced from subsidized survey data and other work outside BMR are:

Westborne	3 sections
Newcastle - Maitland	16

Two more computer programs have been developed during the year. The expanded spread program VELSPRED is designed to give average vertical velocities, interval velocities, and depths to reflection events taken from normal expanded spread sections. A statistical analysis of the scatter in the reflection observations assists in determining errors in depth and velocity. The computer program DIPLOTA creates automatic dip migrated sections in both time and depth. Both continuous and discontinuous velocity functions can be used with this program.

GRAVITY SURVEYS

As in 1969, one reconnaissance gravity survey and one detailed gravity survey were completed in 1970 on the continent. In New Guinea the reconnaissance gravity network was extended farther into the highlands. Other projects were continued in the office in Canberra, in particular the Gravity Map of Australia, the formation density data storage and retrieval system, and continued development of computer programs for gravity data processing, display, and interpretation.

Contract helicopter gravity survey, S.A. (Plate G1). This survey departed from the standard practice in other states and territories in using a nominal grid spacing of about 4¼ miles. This was adopted at the request of the S.A. Department of Mines, who wished a spacing of 4 miles but compromised on the slightly larger figure to accommodate Division of National Mapping in the use of RC9 photo centres as gravity stations. In this way the barometric heights measured during the gravity survey may be used conveniently for height control of 1:100,000 scale topographic maps. The more usual grid spacing in this type survey by BMR is 7 miles.

The survey commenced on 26 April in the TARCOOLA 1:250,000 Sheet area and proceeded reasonably steadily to the northwest corner of the State, covering the area up to the West Australian border not previously surveyed by the S.A. Department of Mines or private industry (Area A). A smaller, unsurveyed area in the Flinders Rangers was then covered (Area B). South Australia has thus become the second State in Australia after Queensland to be entirely covered by a regular grid of reconnaissance gravity stations. The survey proper ended on 27 October when approximately 7300 gravity stations had been established. A few additional stations will be added by follow up readings to give better definition of some unusual trends.

The preliminary results for area A are shown on Plate G1, with the BMR survey area outlined. The results have been integrated with other work in adjoining areas. The results from the Flinders Ranges are still being computed at the time of writing and no contours are available. It is clear from the contours of Plate G1 that a major gravity minimum corresponds to the mainly Palaeozoic sedimentary Officer Basin while areas of higher gravity flanking it to the north and southeast show correspondence respectively to the Musgrave and Gawler Blocks of Precambrian Shield rocks. More detailed interpretation and correlation with geological and other geophysical information will be undertaken during the remainder of the year.

Kalgoorlie detailed gravity survey, W.A. The reconnaissance helicopter gravity survey in 1969 revealed noteworthy correspondence between mineralized greenstone belts and gravity maxima. This year's detailed survey was carried out to obtain a series of gravity profiles across distinctive anomalous highs using spirit-level elevation control and ground transport. The intention is to use these profiles coupled with available geological and other geophysical knowledge to construct and test interpretative models.

The survey began early in June and ended early in September. Ten gravity anomalies were covered by 17 profiles with a total of 2100 gravity stations mostly spaced ½ or ¼-mile apart along the traverses. The locations are shown on Plate G2, superimposed on the Bouguer anomaly contours derived from the results of the 1969 reconnaissance survey. The intention in placing these traverses was to cross anomalies centrally at right angles to their strike, attempting to intersect the corresponding maxima and minima so that simple two-dimensional models can be assumed adequate for interpretation. In practice, roads and tracks were used because the growth was generally too thick for safe passage of light trucks. This compromise was unavoidable but it is considered the actual traverse locations are still sufficiently good for useful interpretation.

Preliminary Bouguer anomalies were calculated in the field. Final computation is proceeding in Canberra, based on final level and position data. There are no radical departures from the results obtained previously from the reconnaissance work but some profiles show noteworthy amendment to the degree of maxima, minima and gradient of anomalies. Even where the detail work simply confirms the reconnaissance results, the more accurate method of obtaining elevations establishes a more valid basis for applying interpretative techniques which assume high accuracy in the data.

Helicopter Gravity survey, New Guinea Highlands. This survey was executed in conjunction with a geological survey in the New Guinea Highlands, utilizing the spare time for a helicopter contracted to transport the geological party. The gravity reconnaissance survey of the Sepik River area of New Guinea in 1968 left a gap between the major belt of cover along the northern one-third of the Island and an isolated area around Mt Hagen. This gap was closed by this year's work thereby providing a continuous band of reconnaissance cover from the coast to Mt Hagen. Plate G3 shows the location of new stations in relation to old.

The survey commenced early in July and ended early in August when 120 gravity stations had been established.

The results of this work are being computed. A brief record updating the Sepik River gravity record is in preparation.

Gravity Map of Australia. This is a Bouguer anomaly contour map on a scale of 40 miles to 1 inch which currently includes all BMR helicopter reconnaissance results up to the end of 1968. In addition separate sheets at the same scale have been made available through the Government Printer showing the results of the 1969 survey in Western Australia. These results are being added to the main map. Plate G4 illustrates the progress of the helicopter gravity reconnaissance of the Australian continent. Although South Australia now has complete coverage, much of the data has still to be added to the Gravity Map of Australia.

During the year there has been progress in the preparation of a corresponding Bouguer Anomaly map in 18 shades of colour which it is intended to release early next year. It will include all BMR helicopter gravity results up to the end of 1969.

Formation Density Project. Programs for automatic storage and retrieval of density data from well cores, surface specimens, and density logs have been under development much of the year. The densities already compiled from BMR determinations of surface and core specimens are being used to test and debug individual routines. When the system is complete, it is proposed that many rock specimens collected by geological parties on an organized basis will be tested for density, which will be catalogued by geographical location and rock type and incorporated in the data bank on magnetic tape. The catalogue will be sufficiently general that additional properties can be readily incorporated as the need arises. Listings, plots, or contours can be produced automatically by interrogating through the retrieval program.

Other computer programs. Automatic plotting of gravity loops and network diagrams was programmed to assist in checking field work and punched data input prior to computation. A routine is under development to provide latitudes and longitudes from the positions of points on a map relative to the map's geographical grid, using the CSIRO digitizing table.

There are many useful applications in the Gravity Group for this facility, amongst them the collection and storage of photo-centre co-ordinates, automatic derivation of co-ordinates direct from large scale maps and aerial photography and determination of geographical co-ordinates of Company gravity survey stations from Company maps. The latter is of great immediate interest because latitudes must generally be obtained before this work can be computed for addition to the Gravity Map of Australia. Manual scaling of co-ordinates and transferring to punch cards are error-prone procedures which will be eliminated.

Mr Ian Briggs has extended and improved his automatic contouring program, particularly in its application to aeromagnetic data and in the provision of an ancillary, non-linear interpretation routine. He has written a paper about his contouring method and is currently documenting the program.

MARINE SURVEYS

The principal activity of the marine group involved the preparation, planning, and supervision of the contract marine geophysical survey in New Guinea waters. This survey will be completed at the end of November.

A requirement revealed by the Minister in March for bathymetric, gravity, seismic, and magnetic data around the Australian coast between the 200-metre and 4000-metre isobaths led to preparation for a 75,000 mile survey to proceed at the end of the current survey.

Otherwise the group continued processing marine data from the BMR surveys in 1965, 1967, and 1968, extended the compilation of marine data progress map for the Australian area, continued development of data processing techniques, and held discussions with representatives of industrial and other organizations interested in marine geophysics.

1970 Marine Survey

This survey will cover about 13,500 miles of traverse in the Bismarck Sea, western Solomon Sea, and the Gulf of Papua (Plate M1). A preview report in which geological and geophysical information was collated and traverse locations determined was completed in June.

The contract vessel M.V. HAMME arrived in Sydney on July 21 and departed for Port Moresby on August 15 after installation of BMR equipment on board. Recording systems were tested during the positioning voyage to Port Moresby. The HAMME left Port Moresby on September 4 to commence the survey proper. Work in the Bismarck Sea was completed on November 4.

Instrumentation and techniques employed represent an advance on methods used in the previous (1968) survey. The data acquisition system, schematically shown in Plate M2, was developed for the survey and provides a digital recording system which samples data from gravity, magnetic, and several navigation aids at 10 second intervals using a Hewlett Packard 2116B computer.

As in the 1968 survey reflection seismic recordings from two cables provide data on shallow and deep sub-bottom structure. Refraction profiles are shot using sonobuoys recording energy from the 120 kilojoule sparker source. A second 2116B computer is used to sample and process reflection seismic data on-line (see BMR Record 1969/140, p. 16).

The programming for this operation was undertaken early in 1970 and tested in May and June. Various other equipment trials were also carried out in May.

Areas of thick sediments were encountered at various locations in the Bismarck Sea, notably to the east of Manus Island and in the area around Kimbe Bay on the north coast of New Britain. Contoured maps of Bouguer gravity anomalies, magnetic total force anomalies, and bathymetric as well as seismic horizon cross-sections are in preparation at the time of writing.

Marine Data progress maps

Compilation of data from marine geophysical surveys undertaken by oceanographic institutes and agencies other than oil exploration companies was continued. A BMR Record is in preparation which will provide location maps of seismic, gravity, and magnetic traverses in the seas and oceans surrounding Australia.

Publications

Records, etc. published during 1970

1970/15 Reconnaissance Gravity Survey of parts of Northern Territory and Western Australia by R. Whitworth.

1969/109 Reconnaissance Helicopter Gravity Survey, Northern New South Wales and Southern Queensland, 1968 by F. Darby.

Flinders River Seismic Survey, 1966 - P. Jones.

Records passed to Editor during 1970

Gosses Bluff Seismic Survey, 1969 (preliminary) - A.R. Brown
Deep Crustal Reflection Studies, Amadeus and Ngalia Basins, N.T. 1969 - A.R. Brown

Records commenced and in preparation, 1970

Gosses Bluff Seismic Survey 1969 (final) - A.R. Brown
Experiments with controlled directional reception seismic method and digital processing - A.R. Brown

Hawaii Institute of Geophysics Oceanographic Investigations in Melanesia, 1970 - A.R. Brown

Ngalia Basin Seismic Surveys, 1967-69 - P. Jones and D.G. Townsend
New Guinea Airborne Seismic Feasibility Study - P. Jones and F.J. Moss
Deep Crustal Reflection Surveys in Eastern Australia, 1968-1969 - J.C. Branson and F.J. Taylor

Deep Crustal Seismic Investigations along the Geotraverse, W.A., 1969 - J.C. Branson

East Otway Basin Seismic Survey, 1967 - J.C. Branson

Roma Shelf Seismic Survey, 1967-68 - J.S. Davies, A.R. Brown and J.B. Willcox

A Computer Programme to calculate seismic velocities from expanded spread data - G.R. Pettifer

Preliminary report on a reconnaissance helicopter gravity survey in W.A., 1969

Area A	A.R. Fraser, F.W. Brown
Area B	A.R. Fraser, F.W. Brown

Preliminary report on detailed gravity traverses in W.A., 1970 - A.R. Fraser, F.W. Brown

Report on a reconnaissance helicopter gravity survey in the New Guinea Highlands, 1970 - I. Zadoroznyj, D.A. Coutts

Interpretation of detailed gravity traverses in south-western Australia, - W. Anfiloff

Preliminary Report on a reconnaissance helicopter gravity survey in S.A. - G.R. Pettifer

Report on a computer-oriented system for storage and retrieval of rock density data - W. Anfiloff

Geological Interpretation of the Bouguer Anomaly of the Surat and Dalby 1:250,000 Areas, Queensland

Lectures delivered outside BMR

To the Geological Society of Australia, Territories Branch:

"Deep Crustal Reflection Studies in Australia" - J.C. Branson

To Flinders University of S.A. and University of Western Australia:

"Gosses Bluff Astrobleme" - A.R. Brown

To the International Conference on Geophysics of the Earth and the Oceans, Sydney:

"Geophysical Survey of the North-west continental shelf of Australia" - R. Whitworth

"Instrumentation and data processing of a marine geophysical survey" - A. Turpie

"The gravity map of Australia" - F. Darby

"A gravity survey over difficult terrain in New Guinea,"- M.D. Watts

To the Geological Society of Australia, W.A. Branch, Archaean rock Symposium, Perth:

"Regional gravity anomalies of south-western Australia" - A.R. Fraser and I.B. Everingham

To University of Melbourne and James Cook University of Northern Queensland:

"Marine Geological and Geophysical Surveys" - R. Whitworth

"The Ngalia Basin" - R. Whitworth.

OBSERVATORIES AND REGIONAL SECTION

OBSERVATORIES SUB-SECTION

Geomagnetism. Standard programmes were maintained at Gnangara (WA), Port Moresby (T.P.N.G), Toolangi (Vic.), Macquarie Island and Mawson (Antarctica). At Canberra Headquarters, the monthly Geophysical Observatory Report was prepared and issued, magnetograms were digitized (59 observatory-months), and mean hourly values were derived (96 observatory- months). Non-standard data and magnetogram copies were supplied to several prospecting companies and other organisations.

Little progress was made on the joint project (with the Systems Development Group) to develop an automatic digital variograph; neither was any progress made to map the morphology of transient variations.

Seismology. Stations were operated in WA at: Mundaring, Kalgoorlie, Meekatharra, Kununurra (with WA PWD), Meckering (from September, with Shire Council); in TPNG at: Port Moresby, Lae, Goroka, Wabag and Momote; and at Toolangi (Vic.), Darwin (NT), Norfolk Island (with IPSD), Macquarie Island and Mawson (Antarctica). The station at Norfolk Island was improved by using a visual recorder (Helicorder) and that at Darwin by using a standard photodrum and galvanometer. Timing at all stations was brought to first class level by the addition of EMI digital clocks. Calibrators were fitted to the Darwin and Mawson Benioffs and to all Mark II Willmore seismometers. A less noisy site was selected on Macquarie Island and arrangements begun to provide a telemetry system to utilise it.

After the damaging earthquake at Madang on 31 October, two temporary stations were set up in the vicinity to record the aftershock sequence. Field stations had previously been set up in the region as part of the Seismic Group's experimental airborne survey.

In June the WA PWD organized a 500,000 kgm explosion at the main Ord River damsite. The Group co-ordinated efforts to field portable recording stations and time the shot instant. Parties were put into the field from HQ, Mundaring, ANU, and Adelaide University. Valuable travel-time data were obtained, and plans made to adequately record a similar explosion in 1971.

Preliminary data from all fixed stations were distributed by Mundaring, Port Moresby, or Toolangi Observatories. Final data (for ISC, Edinburgh) were processed in Canberra; this involved the preparation of 15,500 punch cards. From July, ISC data were transmitted on magnetic tape instead of punch cards.

Negotiations were continued with the authorities concerned, for the establishment of a seismograph at Alice Springs and the design of a vault at Manton Dam (NT). BMR's participation in the Alice Springs project was publicly announced in October. Technical advice on matters connected with the nuclear test ban treaty was given to Department of Foreign Affairs.

A strong motion data centre was established in Canberra, after enthusiastic support had been given by owners of accelerographs in TPNG and Australia. This involved the setting up of schemes for copying and enlarging the records, digitization of the copies, and computer derivation of ground accelerations, velocity, and displacement.

Preliminary steps were taken to establish an earthquake data file for the Australian region (latitudes 0-90°S, longitudes 75-165°E).

Officers from Headquarters and Port Moresby constituted a committee to review seismological operations in TPNG. After inspecting establishments in May, the committee made recommendations aimed at streamlining and co-ordinating efforts in regional seismology.

Ionospheric recording. Standard programmes continued at Port Moresby and Mundaring; data were published by IPSD. Mundaring was selected by CCIR as one of a world network of stations to provide the ionospheric index; partly for this reason IPSD installed a modern more powerful ionosonde there in March.

Regional magnetic surveys

The first-order survey of the Australian region was completed with the occupation of remaining continental stations and Cocos Island. Altogether, 70 stations were included in this survey. All results were adjusted to epoch 1970.0, and isomagnetic maps for the seven elements D, I, X, Y, Z, H and F were drawn, and accompanying text for presentation as a Report was completed.

Two third-order surveys were made, in northern Queensland and eastern South Australia. This completed the coverage of Australia east of the 138°E meridian (except for Tasmania). The results of earlier surveys (in southern Queensland and NSW) were updated to epoch 1970.0 and included as background to the first-order isomagnetic maps.

Observations in Antarctica were confined to the Amery Iceshelf area, the Prince Charles Mountains, and Davis, where an ANARE physicist made several measurements during the year.

Testing of sites for a compass swinging base at Tullamarine airport was initiated at the time of writing (November.)

REGIONAL SURVEYS SUB-SECTION

INTRODUCTION

The Regional Sub-Section is subdivided into three Groups: Regional Gravity, Regional Structural and Palaeomagnetic Groups.

In the Regional Structural Group, work this year consisted mainly of processing and interpreting seismic, gravity and magnetic data collected in 1967 and 1969; and of developing seismic equipment for a seismic survey in New Guinea, planned for early 1972. As on previous surveys, invitations for participation will be forwarded to the ANU, University of Queensland, the Hawaii Institute of Geophysics, and this time also to the Japanese Earthquake Research Institute in Tokyo.

The Regional Gravity Group is involved in various international projects and commitments, such as: the Western Pacific Calibration Line, the Australian Calibration Line, fitting the Australian gravity net into an international gravity net, tidal measurements, absolute gravity determinations and special projects such as the structure of Gosse's Bluff. The work of this Group is described in the National Report on Gravity in Australia, BMR Record 1970/62.

During the year losses of professional and sub-professional personnel have seriously restricted the working programme, and more losses are expected. There is a large backlog in report writing.

Regional Gravity Group

Base Station Network and Calibration System

All ISOGAL NETWORK data existing at early 1970 were checked and revised in preparation for publication of the provisional ('May 1965') gravity values. These results will be updated by incorporation of the data obtained by the major AUSTRALIAN CALIBRATION LINE SURVEY, which was carried out using light aircraft transport in May-June 1970. This calibration line consists of 25 stations extending in latitude from Laiagam (TPNG) to Hobart (Tasmania) (see Plate R1) and spans a range of about 2950 mgal. Nine gravity meters were employed, three La Coste-Romberg and six quartz type, to measure gravity intervals along this line to the greatest possible accuracy in terms of the Australian milligal (established by the Cambridge pendulum gravity network in 1950). Scale correction factors to the manufacturer's calibration tables supplied with La Coste-Romberg gravity meters were determined for two of these meters, relative to the Australian milligal. The six CALIBRATION RANGES in Eastern Australia were checked by this large group of gravity meters, and only the Hobart calibration range was found to be in error. A new calibration range was established in Port Moresby (TPNG) during this work, and some minor Isogal follow-up work was carried out. A few new Isogal station excentres were also established.

A paper presenting the results of the Australian Calibration Line and the 1969 Western Pacific Calibration Line surveys has been prepared for publication.

Gosses Bluff Gravity Survey

During the first half of the year the reduction of field data and the production of terrain corrected Bouguer anomaly maps of the area occupied considerable time. A preliminary interpretation was included in a draft summary paper of all aspects of Gosses Bluff geology and geophysics.

From September a residual Bouguer anomaly map of the area was prepared, and two computer modelling programmes, which greatly assisted interpretation, were produced. Density measurements were made on core material from all BMR drill-holes in the area to assist in the detailed gravity interpretation.

Various alternative models were produced which fitted the observed data and the merits of these various models had still to be assessed.

Drafting of final geological and geophysical maps of the area continued throughout the year but was held up considerably by non-uniform map scales and the low priority given to the geological map by the U.S. Geological Survey.

All aspects of the Gosses Bluff project were discussed throughout the year with the other participants.

Canberra Gravity Survey

This project was continued during university long vacations 1969/70 and 1970/71 by four temporarily employed university students under the supervision of a geophysicist. Detailed gravity coverage of the city was extended to the eastern Belconnen suburbs in 1969/70, supplemented by work in the Black Mountain Reserve and round the shore of Lake Burley Griffin. Gravity work in 1970/71 vacation is intended to cover a block westward from the lake to the Mt Stromlo area.

Gravity Work in Antarctica

Sixteen gravity stations were occupied by BMR geologists in Antarctica in January-February 1970, four in the vicinity of Mawson station and twelve in the northern Prince Charles Mountains. All stations were tied to the world network base station at Mawson. This was the continuation of a project commenced in summer 1968/69 to obtain reconnaissance gravity information in these areas during the course of a programme of geological, glaciological, and surveying work organized by ANARE. Further gravity results are expected from the 1970/71 season.

Tidal Gravity Project

Work continued on the development of the NORTH AMERICAN TIDAL GRAVITY METER system. In 1970, this was chiefly carried out by members of the Systems Development Group, with a minor contribution from the Regional Gravity Group.

In the latter part of 1970, the two VERBAANDERT-MELCHIOR HORIZONTAL PENDULUMS were repaired and tested in anticipation of their installation in 1971 for earth-tide recording at a site near Armidale (N.S.W.). Later phases of this project will be carried out in co-operation with University of New England.

Equipment Testing and Development

The BMR RELATIVE GRAVITY PENDULUM SET (GSI pattern) was not used during 1970, although some further analysis was done on earlier results in the search for explanation of its strange behaviour. However, work on a completely new system of period measurement was far advanced during 1970

Members of Systems Development Group have completed construction of most of the units of this system, and it is hoped to test it early in 1971. Construction and synchronization of a new set of low profile knife-edged quartz pendulums, by Division of Applied Physics (CSIRO), was completed late in 1970, and these pendulums will be tested in early 1971 also.

New information on GRAVITY METER PERFORMANCE was obtained by analysis of the results of the Australian Calibration Line Survey, and laboratory tests of some aspects of performance are continuing.

Computing System

The programme system was almost completely rewritten to allow more efficient handling of tapes and data. Buffered blocks were introduced instead of the earlier card image system, thus eliminating many format and parity errors, as well as speeding up the input and output of data. The format of data input for updating runs was made much more free and many more conversions could be done. The plotting programmes were streamlined, and Bouguer anomalies can now be located and extracted much faster. The capacity of the data blocks able to be handled was greatly increased, as was the sorting ability during an updating run. By the end of the year the programme development was nearing completion and 1971 should see a start to a faster throughput of data to the final values and Bouguer Anomaly contour maps.

1961 and 1964 gravity surveys in eastern Victoria were recomputed, unified, and transferred to magnetic tape.

Overseas Visit, B.C. Barlow

B.C. Barlow spent four weeks overseas during September-October 1970. He attended the meeting of the International Gravity Commission in Paris and presented the Australian National Report covering all gravity work carried out in Australia during the five years to 30 June 1970. He conferred with overseas authorities on a number of aspects of gravity relevant to Australia. He visited an earth-tide recording station in Belgium, and spent a number of days in discussions on particular topics at United States Geological Survey, Menlo Park, California, and at University of Hawaii.

Gravity Measurements by Overseas Organizations

Regional Gravity Group co-operated with the Geographical Survey Institute (Japan) in a pendulum gravity tie Tokyo-Brisbane. Measurements in Brisbane were carried out during three weeks in February 1970, by two Japanese geophysicists, assisted during the first week by a BMR officer.

General

The comprehensive filing system covering all known gravity work in Australia, and the associated set of key maps (1:250,000 series), were progressively updated during the year.

The Kowen Forest geophysical test hut was completed during the year. This includes a specially designed gravity room with piers for tidal recording and relative pendulum measurements.

Training of observers in use and care of gravity meters and survey techniques was undertaken by Regional Gravity Group staff during 1970. These observers included BMR staff from other groups, ANARE and ANU geophysicists, and Colombo Plan Fellows.

Gravity meters were provided when available for use by other organizations under loan or hire arrangements. Gravity meters belonging to other organizations were evacuated as required.

Regional Structural Surveys Group

Data preparation, New Britain/New Ireland 1969 Crustal Survey

During 1969 BMR conducted a multidisciplinary survey in the New Britain/New Ireland region aimed at determining as much information as possible about the crustal structure and composition of the region.

During the first half of 1970 the group put a considerable effort into co-ordinating the data presentation crom the various geological, gravity, seismic, and magnetic surveys. The group was responsible for the data preparation of the seismic and magnetic work which involved over 4000 seismic arrivals to be read and checked, and 2500 km of marine sparker profiles and 1650 km of marine magnetic profiles to be assembled in a suitable form for interpreting.

A number of computer programmes were written to enable suitable plots, etc., to be prepared for the interpretation of the data.

All the geological, gravity, seismic, and magnetic data have been co-ordinated into a single Record (in preparation).

Interpretation, New Britain/New Ireland 1969 Crustal Survey

Interpretation of the New Britain/New Ireland survey seismic refraction data was started as soon as data handling techniques had been perfected as mentioned above. Two officers have been working on the detailed interpretation from March onwards.

The shots and recording stations on the survey were distributed over a large area which includes a variety of structures. For interpretation purposes it was necessary to select a number of profiles to which standard reciprocal seismic refraction interpretation methods could be used.

Because of the multiplicity of possible profiles and the necessity of correlating data at profile intersections, etc., the interpretation is not expected to be finished until 1971. Depths and velocities of the various refractors were obtained during the latter part of the year and are being tied in with gravity and geological information.

Hawaii Institute of Geophysics Marine Survey

The Hawaii Institute of Geophysics conducted a marine geophysics programme in the seas around New Ireland during August and September. Because of BMR's interest in the area, it was agreed that various BMR officers should participate in the survey. One officer from Regional Structural Surveys took part in the survey. The geophysics programme, which consisted mainly of two-ship seismic refraction shooting, was completed in 6 weeks.

An operational report of the survey has been completed by the party leader from Seismic and Marine Section.

Overseas Visit, J.B. Connelly - Hawaii Institute of Geophysics

Because of BMR's involvement in the 1970 Hawaii Institute of Geophysics marine programme it was agreed that J.B. Connelly should spend two months in Hawaii helping in the interpretation of the survey results, and in the process acquire interpretation techniques in which the Institute specializes.

Connelly left for Hawaii at the end of September and the study and interpretation programme is going well.

Crustal Studies Review

BMR has been engaged now for a number of years in studies of the gross structure of the earth's crust and upper mantle. It was decided that it would be useful exercise to review the various projects of such a nature in the Australian region with the idea of forward planning for future surveys. In many of these projects such planning must be done years ahead because of the complex logistic, equipment, and co-ordination problems involved. This review was started in the latter part of the year and is expected to be finished early in 1971.

Instrumentation

The Systems Development Group has been developing tape recording equipment for use at unattended sites in seismic refraction experiments and surface wave projects. Many of the component units are available commercially, and the first delivery of equipment should take place early in 1971.

Development tests have also been carried out on long-period seismometers to make them suitable for recording over a larger range in temperature than was previously possible.

Palaeomagnetic Group

Rocks of the Bowen Basin and Gosses Bluff were processed. A new spinner magnetometer arrived but the calibration has not yet been completed. The electronic equipment needs checking.

Publications

Records issued during 1970:

Barlow, B.C. - National report on gravity in Australia, July 1965-June 1970. Bur. Miner. Resour. Aust. Rec. 1970/62

Cooke, R.J.S. - Reconnaissance gravity observations near Amery Ice Shelf, Antarctica, summer 1968/69. Bur. Miner. Resour. Aust. Rec. 1970/31

Van der Linden, J. 1970/56 Third order regional magnetic survey, Queensland 1967. Bur. Miner. Resour. Aust. Rec. 1970/56

Addresses to scientific bodies

International symposium on recent crustal movements and associated seismicity, Wellington, 10-18 February

"Seismicity of New Guinea and the Solomon Islands region, and the new global tectonics" (D. Denham)

"Tectonics of the New Guinea-Solomon Islands region" (I.D. Ripper)

ANZAAS Congress, Port Moresby, 17-21 August

"The seismicity of the New Guinea-Solomon Islands region" (D. Denham and I.B. Everingham; delivered by Everingham).

"Global tectonics and the New-Guinea-Solomon Islands region" (I.D. Ripper)

GEOPHYSICAL SERVICES SECTION

The section comprises three major Subsections, Electronics, Mechanical, and Services, and the activities of the Section are reported under these headings. The Electronics and Mechanical Subsections are concerned primarily with equipment development, construction, and maintenance, and the Services Subsection covers procurement, rock measurements, engineering geophysics, and geophysical drafting.

ELECTRONIC SUBSECTION

The Subsection is divided into three groups, Instrument Development, Systems Development, and Electronic Maintenance.

Instrument Development Group

Staff resignations and a number of urgent unscheduled projects interfered with the completion of major projects during the year. Though this was disappointing, a considerable amount was accomplished in 1970.

This year more extensive use of printed circuits largely eliminated the hand wiring of circuit boards, with resultant gains in construction time and reliability. However these gains were largely offset by extra drafting time required (up to 4 times as long). Additional sub-professional help in both drafting and on the bench will be required if the group is to cope with a continuing work load such as experienced in 1970.

The instrument laboratory became fully functional under a STO1. A detailed equipment history was organized and progressive calibration of all instruments commenced. In addition calibration of field equipment such as magnetometers, crystal clocks, and similar equipment was carried out.

Reports on the various projects are listed below.

MNS2 Proton Magnetometers. Development of the second prototype progressed to the point where $\pm$ 1 gamma count scatter can be achieved in all applications other than airborne, when a rapid cycling rate is necessary in the presence of considerable noise from the installation. Under these conditions a 4 gamma envelope is obtained for 1 second cycling. Sources of aircraft noise are still being investigated, as is the use of a toroidal detector and a separate airborne tuning unit. Experiments were carried out in which some signal enhancement was obtained by synchronous polarization and a literature review of techniques of dynamic nuclear polarization was commenced with a view towards more rapid reading rates. A computer programme was written and used to optimize the design of the pre-amplifier input stage.

The construction of three production models was commenced, the first of these will now be completed early in 1971.

MFS7 Airborne Fluxgate Magnetometer. This project consists of modifying an AN-ASQ10A submarine detector for use as a geophysical instrument and differs in concept from the previous AN-ASQ8 modification by using total feedback, thus eliminating the need for a stable backing-off field. This approach requires a compromise between gain and

filtering efficiency, and as a result of a detailed stability analysis several different filters were designed and have still to be evaluated. Test results on the prototype indicate a basic noise level below one gamma and flight tests in the Twin Otter are scheduled before the end of the year. However, it has been found that small variations in the drive signal amplitude are a source of drift, and further work is required to eliminate this. The final chassis should be completed by April 1971.

MFR2 Three-Component Fluxgate Magnetometer. Apart from some drafting and the construction of the detector elements no work was done on this project. Four detector elements were also made for the Institute of Antarctic Research.

General Purpose Feedback Amplifiers. In addition to the DC amplifier (TAM1) and filter (TAF1) designed last year, a low frequency AC amplifier (TAM2) and a geophone pre-amplifier were designed. Fifteen of the latter were built for the New Guinea airborne seismic survey. The main application of the TAM2 will be in regional seismic equipment.

Twenty-five TAM1 amplifiers and fifteen TAF1 filters were built under contract and integrated into the marine seismic system. A mains-operated regulated power supply was designed and constructed to power a bin containing these units.

Marine Seismic Clock. An additional digital clock was designed, constructed, and installed during the survey working-up period.

Marine Sparker Recorder and Control Units. Three Esterline Angus potentiometric recorders were provided with control electronics, and modified for use as seismic stratification profiler recorders, for the 1970 marine contract survey, and a similar unit was built for the Queensland coastal erosion survey. Their performance was far from ideal, particularly on fast sweeps, but they met an immediate need and are being further improved.

Twin Otter Installation. The designs for a timing control, doppler display unit, and sundry power and control units have been commenced. Aircraft installation has also started.

Miscellaneous Airborne Projects. A remote control unit for the 70 mm camera was designed and used by National Mapping.

Sources of drift in the MFS6 magnetometer were investigated but not fully eliminated.

Pre-amplifiers and associated power supplies were designed for three-channel Speedomax recorders.

Data Acquisition for Grain Size Analyser. A punched tape acquisition system was designed and constructed for use with a particle size analyser for the Geological Branch. Some modifications to the analyser itself were also necessary. This equipment is in use and working satisfactorily.

Temperature Measurement by Thermistors. A measurement circuit was designed and a computer programme written to optimize circuit parameters for linear temperature measurement over any specified range for any thermistor. The results are still awaiting evaluation, but a linearity of better than 1% is certain. Possible applications for this include oceanographic and well-logging probes.

Oscillator for Low Power Clocks. The design of low power digital clocks for regional seismic surveys is scheduled on the 1971 programme. Investigations into a suitable crystal oscillator circuit were commenced and a circuit is being evaluated for reliability and stability.

100W. Sine Wave Inverter. A 100 W. 50 Hz unit was designed and constructed for use in Antarctic seismic surveys.

Observatory Power Supplies. Three 6 volt 300 watt regulated supplies were designed and constructed for Antarctic magnetic observatories.

Transformer and Power Supply Design. Because of the large number of special power supplies required for various projects during the year, the design of such supplies was investigated in general terms and a number of useful graphs and equations compiled for future use.

Systems Development Group

Tidal Gravity. Work on the tidal gravity measurement project continued but with reduced priority. The new solid state amplifier and oscillator were constructed and tested as individual units. Measurements are being taken to obtain a reliable estimate of the drift rate of the North American Gravity Meter and how this varies with the time interval between unclamping the meter and taking the measurement.

Pendulum Gravity Apparatus. The solid state circuitry for the pendulum gravity measurement equipment was constructed and the individual units tested. The commercial items needed have been obtained, and system tests will start when the pendulums and swinging chamber are returned from CSIRO Sydney.

Automatic Digital Magnetic Observatory. The automatic digital acquisition system for magnetic observatories should be tested as a complete system early in 1971. This programme was first delayed by stability problems in the servo system for the magnetic variometers and then by shortage of suitable personnel caused by resignation.

Sonobuoy System for 'Airborne' Seismic Survey. The use of sonobuoys for seismic refraction work in swamp land using marsh geophones was tested successfully during the first six months of the year, with Lake George as the ground test site and the DC3 aircraft as the airborne test vehicle. When the survey was started in New Guinea in September a major difficulty was inadequate signal from the geophones. Preamplifiers were designed and built to try to overcome this problem as a priority task.

Drift Stabilized Long Period Seismometer. Experiments to stabilize a Press-Ewing long period seismometer against temperature drift were carried out from April to July; a working system has been assembled and is now being tested. The detailed design, mechanical and electronic, should be finalized by the end of 1970 and three seismometers modified early in 1971.

Remote Sensing Investigation. The investigation of remote sensing techniques was continued throughout 1970. A geologist (W.J. Perry) and a geophysicist (P.J. Hillman) visited the National Aeronautics and Space Administration, as part of a four man team from the Department of National Development, to obtain information on the Post Apollo Programme and in particular on the two Earth Resources Technology Satellites due to be launched in 1971 and 1972. Messrs Perry and Hillman also visited several other centres where research is being done on the application of remote sensing systems to geology and mineral exploration and additionally a few firms who produce or use remote sensors. A Departmental Report has been written on the NASA visit and a BMR record will be written on the remainder of the tour.

Electronic Maintenance Group

Throughout the year this group has assisted various field parties in the assembly and testing of their survey equipment. Assistance has been given in particular to the marine seismic contract survey party, the well-logging parties, and the airborne seismic survey party.

Acceptance tests have been carried out on a large range of new and repaired equipment. Special mention should be made here of the testing of marine equipment as this entails the chartering of a suitable vessel for the sea trials. During this year sea trials have been carried out of marine seismic streamers and sonar doppler equipment.

New salinity measuring equipment required for the Queensland Coastal Erosion survey was also built by this group after unsuccessful attempts to modify existing equipment. A number of new items of equipment were built for the observatory group, including power supplies, control panels, and time marking equipment.

The flow of repairs of items of equipment from both within and without the branch continued unabated.

MECHANICAL SUBSECTION

The Mechanical Subsection comprises three groups, Mechanical Design, Mechanical Instrument Construction, and Mechanical Maintenance and Testing. Their functions are to design and build mechanical instruments and equipment which are required for BMR work but are not available commercially, and to overhaul and maintain existing instruments and equipment.

The position of Mechanical Engineer Class 2 in charge of Mechanical Design has remained vacant throughout 1970, and there seems little prospect of filling this position in the near future. Otherwise the Subsection has been reasonably well staffed.

The normal programme of maintenance and repair of instruments and equipment accounted for most time in the Subsection during the year. Typical items were chart recorders, portable well loggers, microbarometers, aircraft survey cameras, magnetometers, and gravity meters in the Mechanical Maintenance and Testing Group, and items such as motor generators and fitting out of survey vehicles in the heavy workshop. Much repair work was let to contract.

Some of the bigger tasks completed in the Mechanical Instrument Construction Group were a tape head stepper for the MS-42 seismic central playback office for use with DS-7 magnetic tapes, several accessories for the Laser-Scan equipment, and many jobs necessary for the preparation of the deep-well-logging truck for the 'difficult' bore-logging programme. Three portable marine instrument cabins were fitted out for survey work and a series of experimental radar reflector marker buoys were built for marine survey work and tested off Montague Island. Many jobs such as instrument panels, racks, special fittings, and mechanical devices were completed in support of projects under development or construction in the Electronic Subsection.

A number of fairly large jobs in addition to many small jobs were completed for other branches. A Hassler cell for whole core measurement of permeabilities of rock cores was built for Mineral Resources Branch. A rapid sediment analyser tube, an A frame and coring platform for estuarine investigations, and a 70 mm film stereo viewer were constructed for Geological Branch and a Proline auger drill was rebuilt to fit a Landrover.

SERVICES SUBSECTION

The Services Subsection comprises four groups: Procurement, Rock Measurements, Engineering Geophysics, and Drafting.

Procurement Group. The work involved in investigating equipment requirements, equipment available, and specifying equipment for tenders has been exceptionally heavy. In addition to heavy 'normal' programmes in 69/70 and 70/71 financial years ($363,600 and $438,400 respectively) an additional $300,000 worth of equipment has to be procured for the current contract marine survey work. Help from other groups has been essential.

Rock Measurement Group. The position of Geophysicist Class 2 in charge of this group remained unfilled throughout 1970. Nevertheless a considerable number of routine measurements on rock specimens have been made by a Technical Assistant throughout the year. These include magnetic susceptibility and remanent magnetism, density, and ultrasonic and electrodynamic measurements on rock cores to determine their elastic properties for engineering and other purposes.

Engineering Geophysics Group

At the beginning of the year five out of seven positions in the Engineering Geophysics Group were filled. During the year one position of Geophysicist Class 1 (B. Dolan) and one of T/A Class 2 (M. Dickson) were filled, bringing the Group to full strength.

During the year several geophysical surveys were done for Federal and State Authorities. Locations of these surveys are shown on Plate E1.

Jervis Bay Foundation Investigation. Following the evaluation of the 1969 investigation (Taylor, B.M.R. Record 1969/146) the AAEC decided on the Murray Beach site as the location of the atomic power station. At their request a detailed seismic refraction survey was undertaken. The purpose of the survey was to determine the foundation conditions of the site including the cooling water discharging tunnels and channels.

35000 ft of seismic refraction traverses were shot with a geophone spacing of 10 ft. This close spacing was required because the material to be excavated consists of several layers characterized by different seismic velocities with beds of lower velocity sandwiched between the beds of higher velocity (see Plate E2). The data were evaluated and the report issued (Polak & Hill, B.M.R. Record 1970/32).

The excavations which were commenced on the site indicate that the rocks there are very resistant to the bulldozer blade - much more than on other locations for the same seismic velocities. Some measurements on cores from the Jervis Bay bores are being made at the BMR rock-testing laboratory.

Moura Coalfield Survey. The purpose of the survey was to find what use could be made of geophysics to investigate the structure of the coalfield and in particular to locate faults which can greatly influence the economics of mining in the area. One square mile of the Moura Coalfield was chosen. In this area the depth to the workable coal seams varies between 0 and 1500 ft. Several geophysical methods were used, but only three methods were used extensively.

The seismic reflection work provided good results for coal seams deeper than 300 ft. The offset shooting pattern was used; with a geophone spread of 550 ft (24 channel) the shots were placed 300 ft at right angles from the centre of the spread. Magnetic recording was used throughout the survey.

A sample profile obtained along one of the traverses is shown on Plate E3. The strong reflector which is closely associated with the coal horizon can be clearly followed up dip towards the outcrop. The locations of two faults and a third suspected fault are shown.

Seismic refraction was used to provide information on the depth of weathering for correction of reflection results. In the area of shallow coal seams near outcrop, where reflection work did not prove conclusive, an attempt was made to use refraction to follow beds associated with the coal seams. However, the resultant time-distance curves are very irregular and cannot be confidently interpreted.

Gravity measurements were made with stations on a 200 ft by 100 ft grid. The Bouguer anomaly contours were plotted, but further interpretation of the data is required to evaluate the extent to which gravity may help in outlining structure.

Magnetic measurements were taken over the same location on which gravity was done. The magnetic contour map shows several well defined features, but as in the case of gravity, further interpretation is necessary to evaluate the usefulness of the method.

Resistivity depth probing, induced polarization, and electromagnetic methods were each tried for a couple of days. Not enough was done to reach a definite conclusion, but initial results were not encouraging.

One borehole drilled by the Department of Mines has been logged; gamma, resistivity, spontaneous potential, differential temperature, and caliper logs were obtained.

Coastal Erosion Survey. The purpose of this survey was to collect data on the near-shore regions of the sea coast between Brisbane and Noosa Heads. The data are required by the Queensland Government to assist in the construction of a scale model of the coast. Of principal interest was bottom topography, sub-bottom features including location and quantity of unconsolidated sediments, and sea current information. The ship with min, navigation system, surveyors, and echo sounder were provided by the Queensland Government.

Boomer and sparker energy sources were used to obtain bottom and sub-bottom information and depths to bedrock, but in general results were poor. It was found that a great deal of experimentation was necessary tc obtain detailed high resolution data in the shallow waters traversed. However, in the last week of survey a system giving excellent high resolution data was devised. A section of high resolution sparker record obtained in the Brisbane River in the last few days of survey is shown in Plate E4.

Salinity and temperature variations of the near-surface water were also recorded, using specially designed equipment. Several interesting regions were encountered in Moreton Bay.

Most of the work planned could not be completed as a result of continuous installation or instrumental difficulties experienced from the outset, mostly with the seismic profiling equipment. These were so serious that the party could not be confident of maintaining an efficient operational system, and in view of this the survey was terminated earlier than originally proposed.

Musa Gorge Dam Site, Papua. A reconnaissance survey was carried out to assist in the selection of one of five possible damsites for a large (500 ft high) earth dam. The five sites are located in a deep gorge with very steep sides up to 1200 ft high.

Seismic refraction techniques were used to determine the depth of weathering, seismic velocities in the bedrock, and information on the elastic properties of the rocks. The weathering is very deep, up to 120 ft. The bedrock consists of rock with velocities up to 15500 ft/sec, and modulus of elasticity of 6×10^6 lb/sq. in. It is characterized by high velocity anisotropy indicating that jointing is pronounced and the joints, parallel to the sides of the gorge, are open.

Tennent Dam Site, A.C.T. A seismic refraction survey was carried out on the site of a proposed dam on the Gudgenby River, A.C.T. 10,000 ft of seismic traverses were shot at a geophone spacing of 10 ft. The results were evaluated and at the request of the Commonwealth Department of Works an additional 2,000 ft of traverses were shot to obtain further information on shear zones, weathering on the proposed spillway, and the quantity of construction material available.

Orroral Valley Seismic Survey. The seismic refraction method was used to investigate a section of a valley in granite. It is a part of an Australia-wide survey to collect data on typical valleys in different types of strata to be used in the water balance computations.

Weston Creek Effluent Lagoon. A seismic refraction survey on the site of the proposed sewerage lagoon provided information on rippability of overburden to assist in planning the excavation.

Tuggeranong Sewer Scheme. The Commonwealth Department of Works is preparing plans for a tunnel proposed to take sewerage from Tuggeranong to Weston Creek. A magnetic traverse 15,000 ft long with 50 ft interval between stations was done along the line. Some magnetic anomalies located are related to excavations, water pipes, and other human activities, but others indicate faults, geological boundaries, and changes in thickness of alluvium. Selected locations were further investigated with seismic refraction work.

Belconnen Building Site, A.C.T. Seismic refraction work was done on the proposed office building complex site to determine the foundation conditions. 10 ft geophone spacing was used. Seismic velocities in overburden are 5000 ft/sec. Underneath jointed bedrock has velocity of 8000 ft/sec. overlying fresh bedrock of velocity 12500 to 15000 ft/sec.

Barton Building Site, A.C.T. Seismic refraction work was done to determine foundation conditions for a large office building on a site on Kings Avenue (the location of the old Central Library).

Geophysical Private Contract Checking. Three engineering geophysical contract projects in A.C.T. were checked, for Department of Works and NCDC.

Christmas Island Groundwater. The use of magnetic and resistivity surveys to assist in the search for water continued in 1970 as in previous years. The field data are being collected by the staff of the British Phosphate Commissioners, and interpreted by the Engineering Geophysics Group.

Borehole Logging

Contract Logging. The usual technical supervision of $100,000 contract logging was carried out throughout the year.

Difficult bore logging. The bores included in this survey were those which contractors refused to log for various technical reasons. Of 30 bores visited or attempted 20 were logged to a cumulative total depth of 53147 ft, using gamma, temperature, differential temperature, flowmeter, caliper, and collar locator methods.

Other bore logging. Two bores were logged in the Sydney Basin in co-operation with the N.S.W. Department of Mines. One bore was logged near Esk for Mines Department, Queensland. Shallow coal bores were logged at Pascoe River, York Peninsula, and two deep water bores at Weipa.

Geophysical Drafting Group

The activities of the Subsection are summarized under its four major groups, ground, airborne, gravity, and cartography.

Ground Surveys Drafting Group

The monthly production averages for the seismic, metalliferous, engineering, crustal studies, and observatory groups were:

Plates: 64
Amendments: 13 drawings
Records bound: 82
Record covers printed: 567

In addition an average of 11,590 dyelines per month were produced in the printing subgroup. These include plates for Records and dyelines produced for a wide range of uses in BMR.

Airborne Surveys Drafting Group

Work consists of pre-survey compilation of certain areas, plotting, drawing preliminary contours, and preparation of plates. The following survey areas were covered during the year.

Goulburn N.S.W. 1965	Regional	Surveys
Canberra A.C.T./N.S.W. 1967-69	"	"
Southern Cape York, Qld., 1969	"	"
Bonney Well, N.T., 1970 (Tennant Creek)	"	"
Eucla Basin, S.A. 1970	"	"
N.E. Victoria, 1971	"	"
Shoalhaven River, N.S.W. 1970	"	"
Western Australia, 1969	"	"
Sir Samuel-Duketon, W.A. 1967	"	"
Cootamundra-Wagga, N.S.W. 1970	"	"
South Australia, 1970	"	"
Mann-Woodroffe, S.A. 1969 (Petermann Ranges)	"	"

Cloncurry, Qld., 1970	Detailed Surveys
Tennant Creek, N.T. 1970	" "
Burke River, Qld., 1969	" "
Thorntonia, Qld., 1969	" "
Shoalhaven River, N.S.W. 1970	" "
Rum Jungle, N.T. 1969	" "
Leonora-Laverton, W.A. 1970	" "
Victoria, 1970	" "

Gravity Surveys Drafting Group

Work consists of preparation of aerial photography, pre-survey compilation, fair drawings, and miscellaneous plates and amendments.

The following survey areas were covered during the year.

1969 Pacific Gravity Calibration Line Survey
1968 Helicopter gravity survey, W.A.
1969 Helicopter gravity survey, W.A.
1970 Helicopter gravity survey, S.A. (Flinders Range Area)
1968 Helicopter Gravity survey, N.S.W./Qld.
1970 Helicopter gravity survey, T.P.N.G.
1970 Helicopter gravity survey, S.A. (Western area)
Gravity map of Australia (40 miles to 1 inch multi-coloured litho-edition)
Isogal station location sketches
41 areas at 1:500,000 scale Bouguer anomalies maps of Cape York area were published.

Cartographic Drafting Group

Maps were printed of the following areas during 1970.

Magnetic 1:126,720 (2 m to 1") Victoria River Survey 1966, N.T. - 16 map areas
Magnetic and radiometric, 1:126,720 (2 m to 1") 1964 and 1966 W.A. - 16 map areas
Magnetic, 1:250,000, Great Artesian Basin 1966 - 10 map areas
Magnetic, 1:250,000, Papuan Gulf Basin basic belt, 1966 - 11 map areas
Magnetic and radiometric, Amadeus Basin, 1965 - 9 map areas
Magnetic, Georgina Basin, 1964 - 1 map area

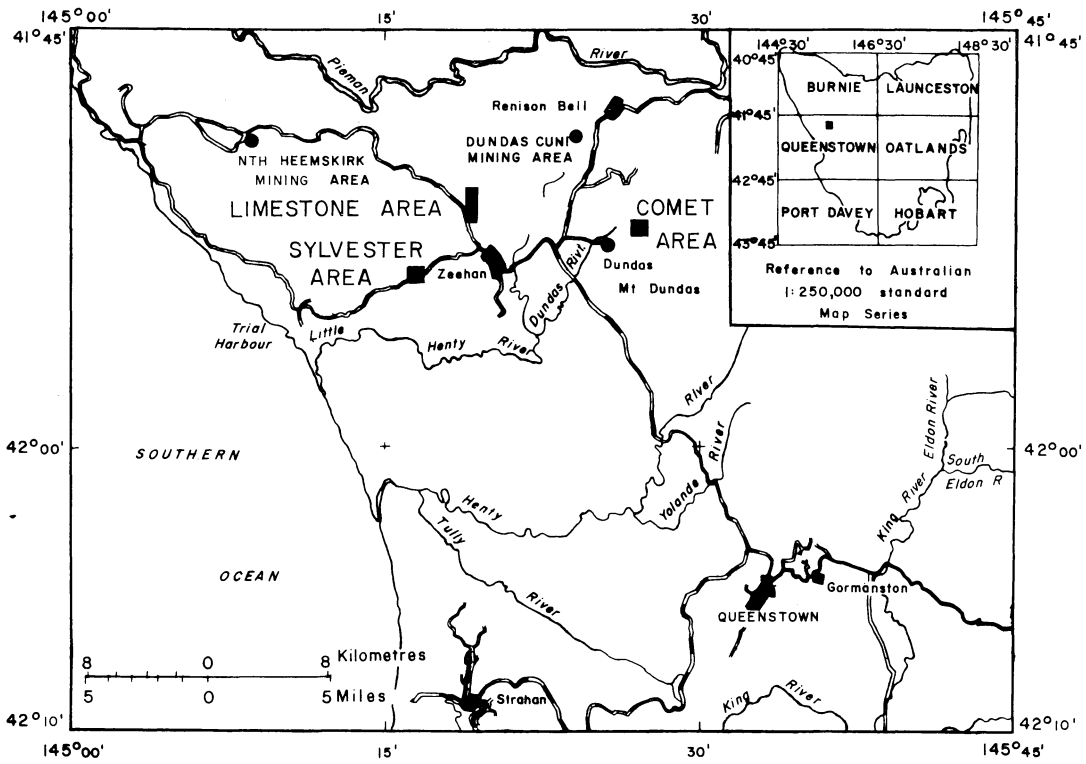
The following areas are proposed for printing by December 31st, 1970.

Magnetic 1:50,000 Astrolabe T.P.N.G. 1966 - 10 map areas
Magnetic and radiometric 1:126,720 (4 m to 1") Sir Samuel-Duketon, 1967 - 8 map areas
Magnetic 1:126,720 (4 m to 1") Victoria River N.T. 1966 - 4 map areas
Magnetic and radiometric 1:250,000 Amadeus Basin N.T. 1965 - 2 map areas

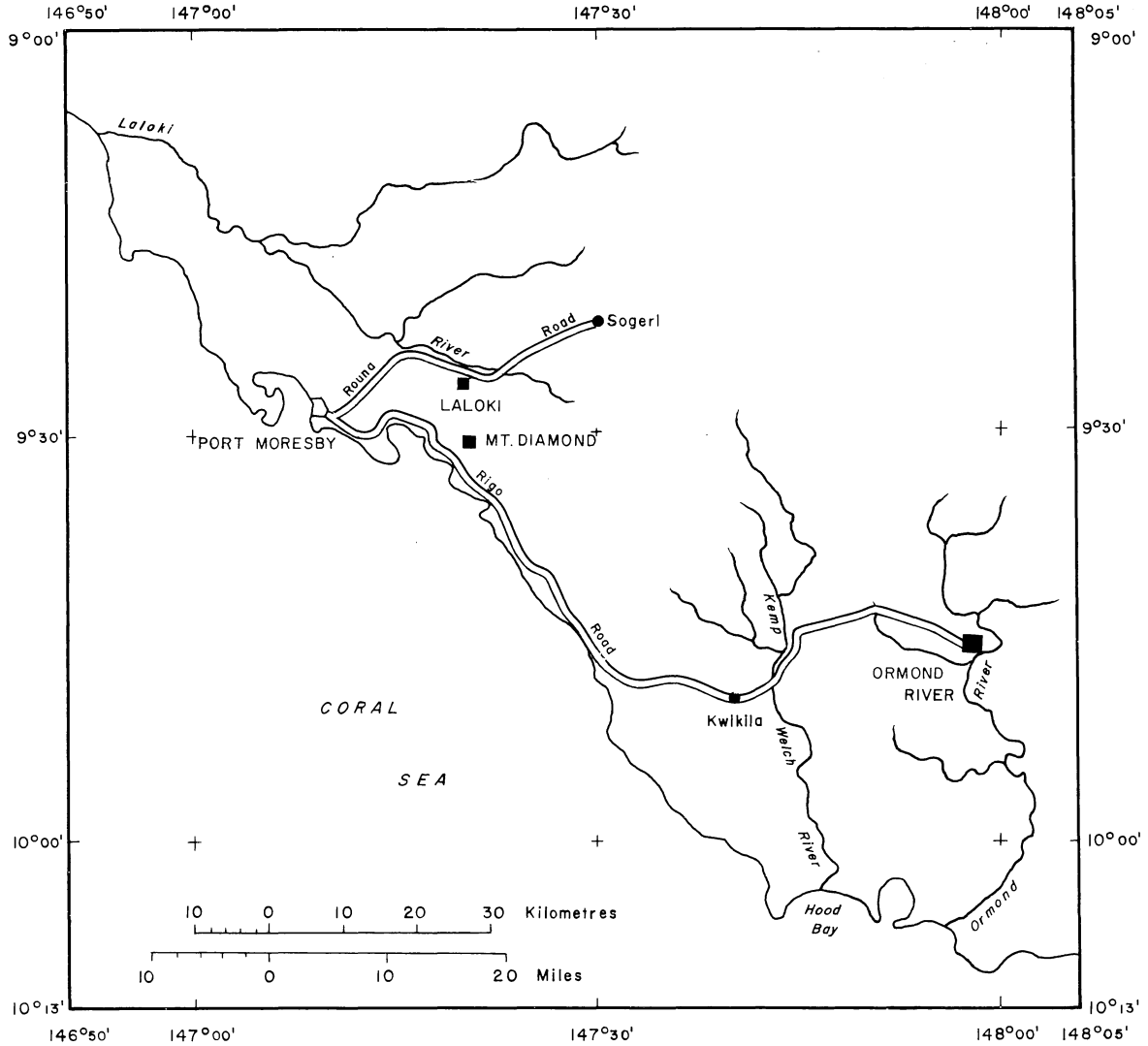
Reprints will be made of the following maps out of print.

Chillagoe-Einasleigh-Gilberton 1957 with photo surround. Radiometric - 2 sheet areas
Pilbara 1956 - 2 sheet areas
Wyndham-Halls Creek 1955 - 2 sheet areas
Kalgoorlie 1957 - 1:126,720 (4 m to 1") magnetic and radiometric - 4 map areas

BMR Record 70/107 PLATE 1



VLF-EM TEST SURVEYS TASMANIA 1970



ASTROLABE & ORMOND RIVER SURVEYS T.P.N.G. 1970

LOCALITY PLANS

K55/B7-236A

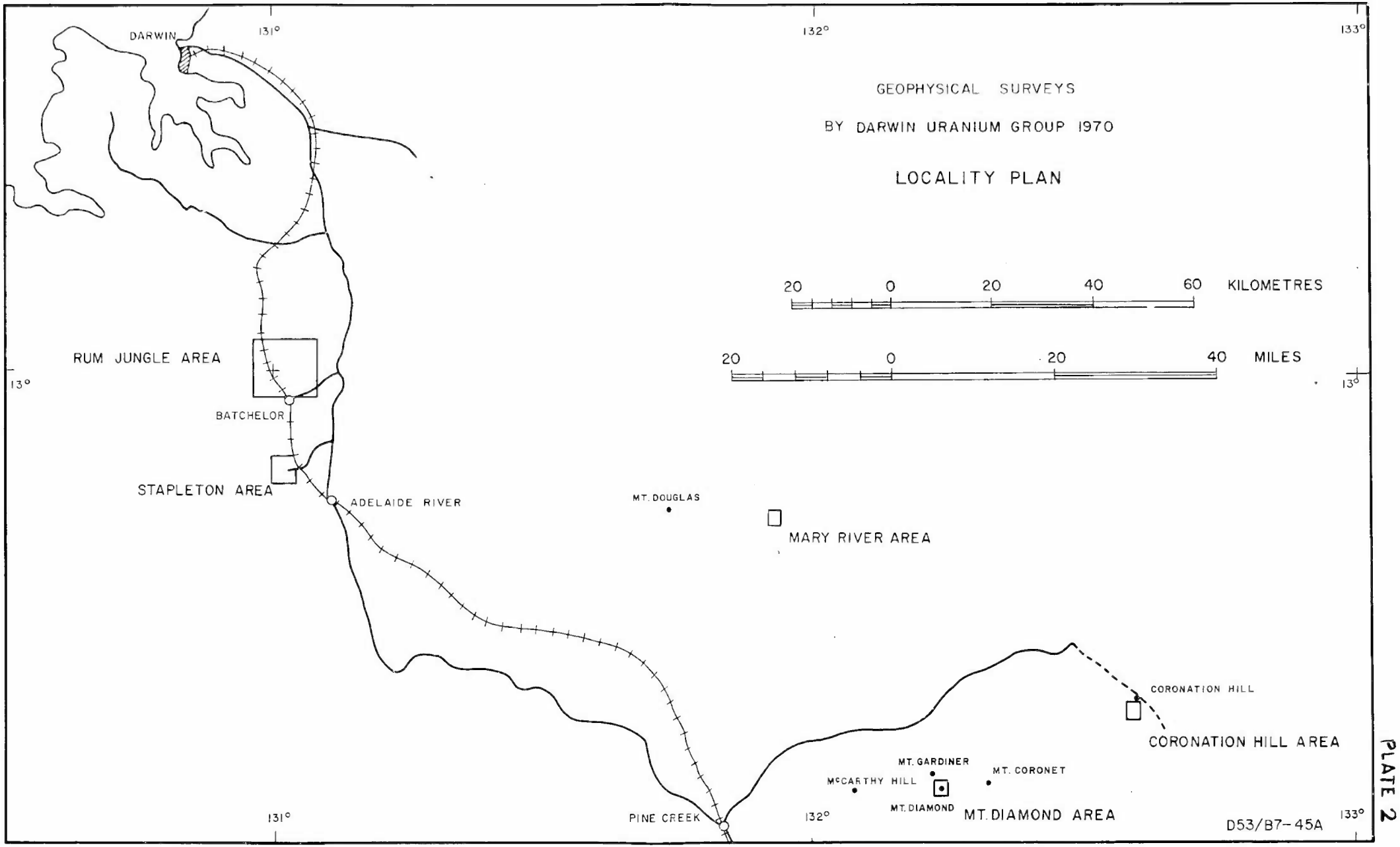
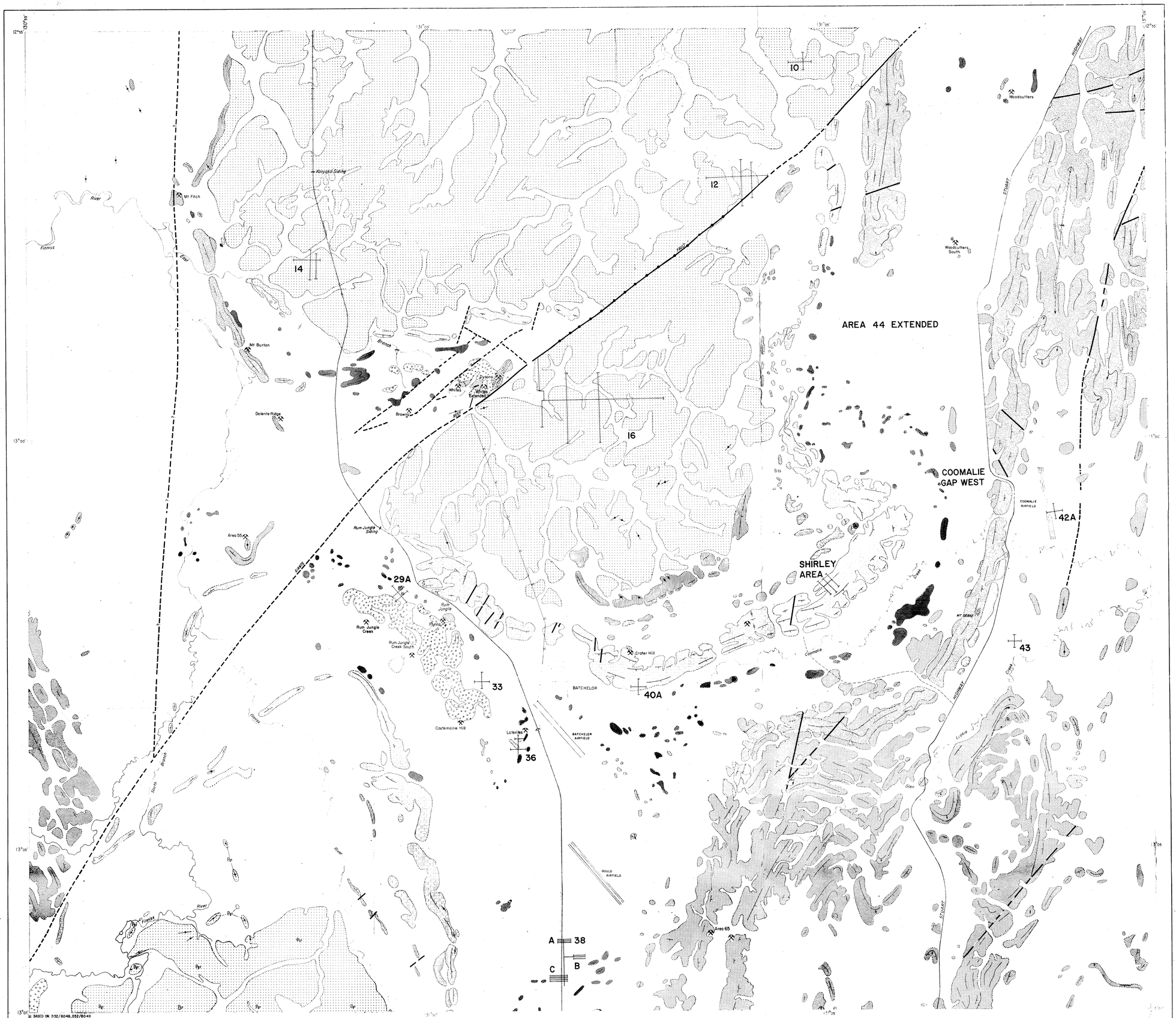

GEOPHYSICAL SURVEYS
BY DARWIN URANIUM GROUP 1970
LOCALITY PLAN
20 0 20 40 60 KILOMETRES
20 0 20 40 MILES
DARWIN
131°
132°
133°
13°
RUM JUNGLE AREA
BATCHELOR
STAPLETON AREA
ADELAIDE RIVER
MT. DOUGLAS
MARY RIVER AREA
CORONATION HILL
CORONATION HILL AREA
MT. GARDINER
McCARTHY HILL
MT. CORONET
MT. DIAMOND
MT. DIAMOND AREA
PINE CREEK
D53/B7-45A

PLATE 2

PLATE 3



BASED ON D52/8048, 052/8049

GEOLOGICAL LEGEND

QUATERNARY

Alluvium

UPPER PROTEROZOIC

TOLMER GROUP
BULDIVA SANDSTONE
DEPOT CREEK SANDSTONE MEMBER
Quartz sandstone, with lenses of haematite-rich breccia and lenses of quartz pebble conglomerate

LOWER PROTEROZOIC

AGICONDIAN SYSTEM

RUM JUNGLE GRANITE
Biotite granite

WATERHOUSE GRANITE
Porphyritic granite, and adamellite

Basic intrusives

FINNISS RIVER GROUP
BURRELL CREEK FORMATION
Siltstone, greywacke siltstone, greywacke, quartz greywacke

GOODPARLA GROUP
GOLDEN DYKE FORMATION
Quartz siltstone and carbonaceous siltstone, in places pyritic

MASSON FORMATION
ACACIA GAP TONGUE
Quartz greywacke, quartz sandstone, pyritic and silicified in places; pyritic, carbonaceous siltstone, siltstone

BATCHELOR GROUP
COOMALIE DOLOMITE
Silicified and metamorphosed dolomite

CRATER FORMATION
Quartz greywacke, greywacke, arkose, fine and pebble conglomerate, siltstone

CELIA DOLOMITE
Algal dolomite, in places silicified and metamorphosed, silicified dolomitic breccia, tremolite schist

BEESTONS FORMATION
Arkose, greywacke, siltstone, conglomerate, arkosic conglomerate, white friable quartz sandstone

- Geological boundary
- Dip and strike of strata
- Trend lines
- Established synclinal trough – position accurate
- Established synclinal trough – concealed; position approximate
- Plunge of syncline
- Plunge of anticline
- Established fault – position accurate
- Established fault – position approximate
- Established fault – concealed
- Probable fault
- Quartz vein
- Quartz-tourmaline vein
- Fossil locality

GEOLOGY AFTER RUM JUNGLE DISTRICT
SPECIAL SHEET, 1:63,360, 1960 EDITION

TOPOGRAPHICAL LEGEND

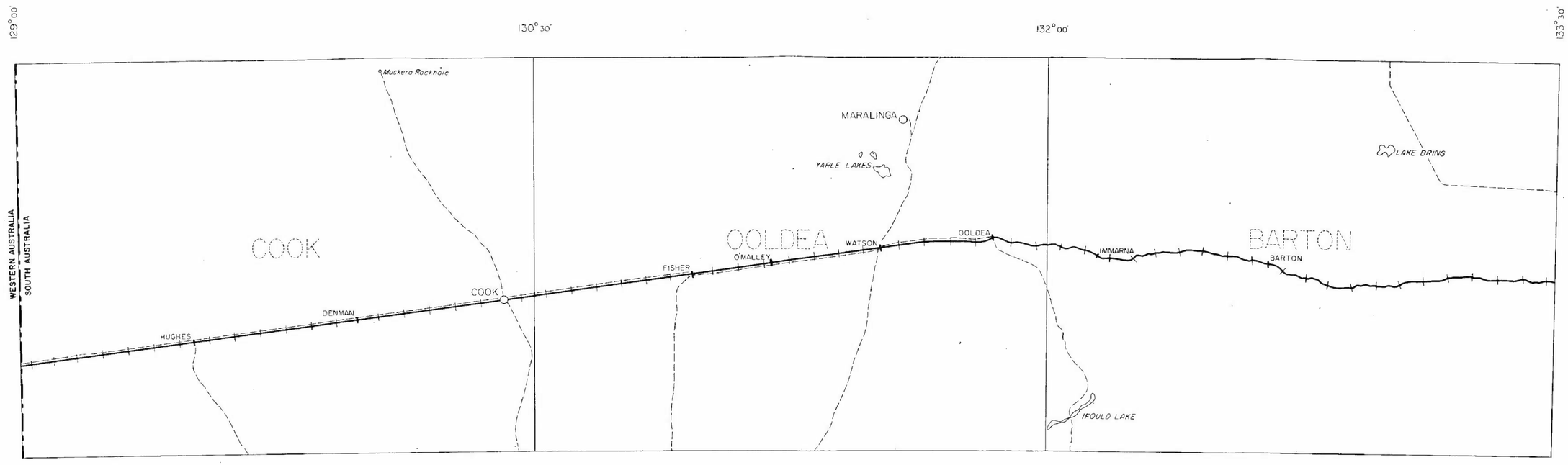
- Highway
- Road or track
- River or creek
- Railway with station and siding
- Mine or prospect
- Open cut
- Dump
- Transmission line
- Dam
- Grid surveyed by TVS (Portable Gamma Ray Spectrometer), 1970

36

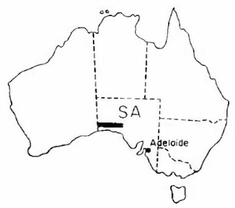
LOCALITY
AND
GEOLOGY

3 MILES
4 KILOMETRES

D52/87-558



LOCATION DIAGRAM



AIRBORNE SURVEY, EUCLA BASIN, SOUTH AUSTRALIA, 1970

LOCALITY MAP

MILES 10 0 10 20 30 40 50 60 70 80 MILES

KILOMETRES 10 0 10 20 30 40 50 60 70 80 90 100 KILOMETRES

REFERENCE TO 1 : 250,000 MAP SERIES

MASON	WYOLA	MAURICE	TALLARINGA	COOBER PEDY
FORREST	COOK	OOLDEA	BARTON	TARCOOLA
EUCLA	COOMPANA	NULLARBOR	FOWLER	CHILDARA

TO ACCOMPANY RECORD NO.

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

H52/BI-2

PLATE 5

BAUM | BIARU | BOWUTU MTNS | MAGERI POINT

WAU | SALAMAUA

BULLDOG | ONO RIVER | GARAINA | WARIA RIVER | HERCULES BAY

MONCKTON RIVER | MT YULE | MT NELSON | GIUMU RIVER | GIRA RIVER | DOUGLAS HARBOUR

AKAIFU RIVER | TULLY PEAKS | MT CHAMPION | MT ALBERT EDWARD | IOMA | OPI

YULE | BUNA

MAIVA | KUBUNA | ONONGE | MENGA | MT PARKES | DANAWATU | BUNA

HALL SOUND | DIULU | MT CAMERON | MT VICTORIA | KOKODA | POPONDETTA

ORO BAY

GALLEY REACH | VANAPA | NOMA | MYOLA | KOMBARI

PONGANI

MUSA RIVER | CAPE NELSON

MONI

DOVE | WANIGELA

RIVER

TUFI

AROA | PORT MORESBY

PORT MORESBY | BASILISK | GAILE | DEMORI | ORMOND | NAMO | UBO

KWAGIRA RIVER

MOI BIRI BAY | POSA POSA HARBOUR

CORAL | KAPA KAPA | KEMP WELCH RIVER | OVEAU | MT CLARENCE | KEVERI | MT ORIAN | GWOINA RANGE

GOODENOUGH BAY

HOOD BAY | MARSHALL LAGOON | DURAMA | ABAU | BAILEBO | URAMA

MT THOMPSON | CAPE FRERE | AWAIAMA BAY | SEWA BAY

TABLE BAY | MILLPORT HARBOUR

MULLINS HARBOUR | SAGARI RIVER | MILNE BAY | EAST CAPE

KALO | ABAU | SAMARAI

ARGYLE | BAXTER HARBOUR | GUAUGURINA BAY | SIDEIA ISLAND | ENGINEER GROUP

SABLE

CAPE NELSON

TROBRIAND ISLANDS

KIRIWINA ISLANDS

1

2

GOODENOUGH ISLAND

CAPE VOGEL

FERGUSSON ISLAND

FERGUSSON ISLAND

WEST | EAST

DAWSON STRAIT

NORMANBY ISLAND EAST

DEBOYNE

CALVADOS

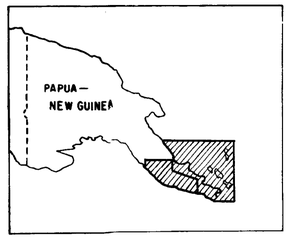
147° | 148° | 149° | 150° | 151°

8° | 9° | 10° | 11°

147°05'8" | 148°30' | 8°53'30" | 9°20' | 9°30' | 9°55' | 149°42'30" | 10°43' | 150°15' | 151°30'

Based on PNG/80-17

LOCATION DIAGRAM



AEROMAGNETIC SURVEY

EASTERN PAPUA

FLIGHT-LINE PATTERN FOR PANEL AT 8,000 FT. A.S.L.

SCALE

MILES 10 0 10 20 30 40 50 60 70 80 90 MILES

KILOMETRES 10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

LEGEND

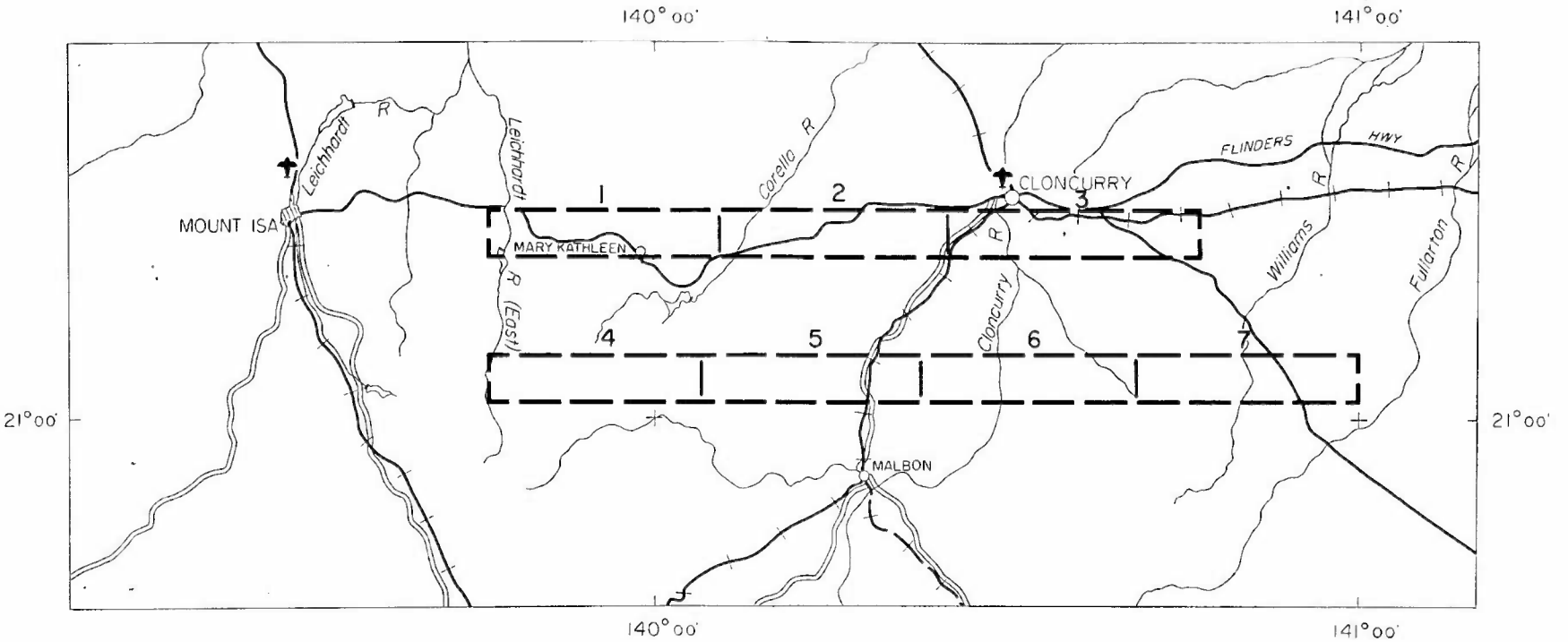
Survey boundary

Flight lines

TUFI — 1:250,000 Topographic Series

UBO — 1:63,360 Topographic Series

PNG/81-4-1



DETAILED AIRBORNE SURVEY, CLONCURRY, QLD 1970

LOCALITY MAP

MILES 10 0 10 20 30 40 50 MILES

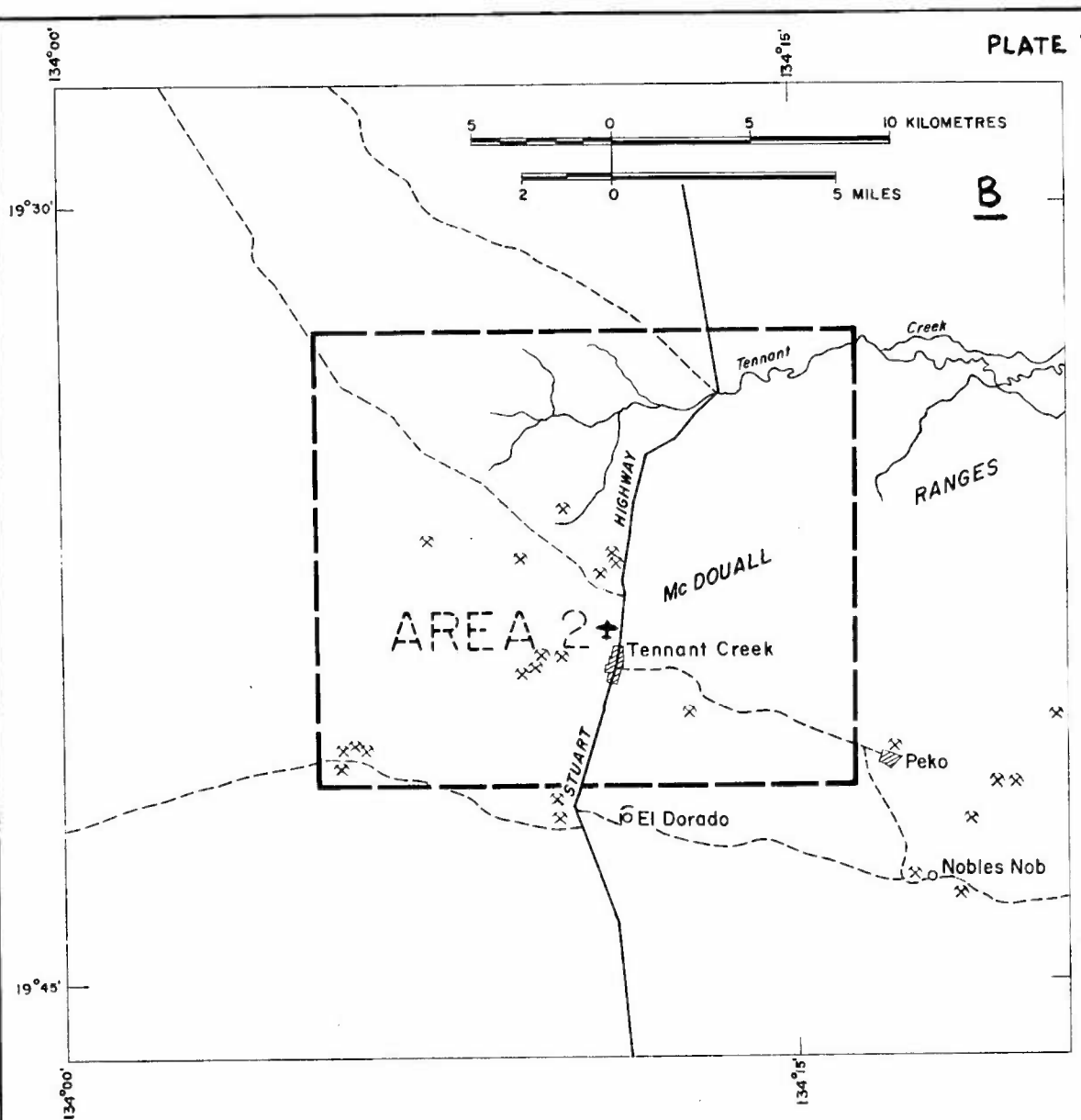
KILOMETRES 10 0 10 20 30 40 50 60 70 KILOMETRES

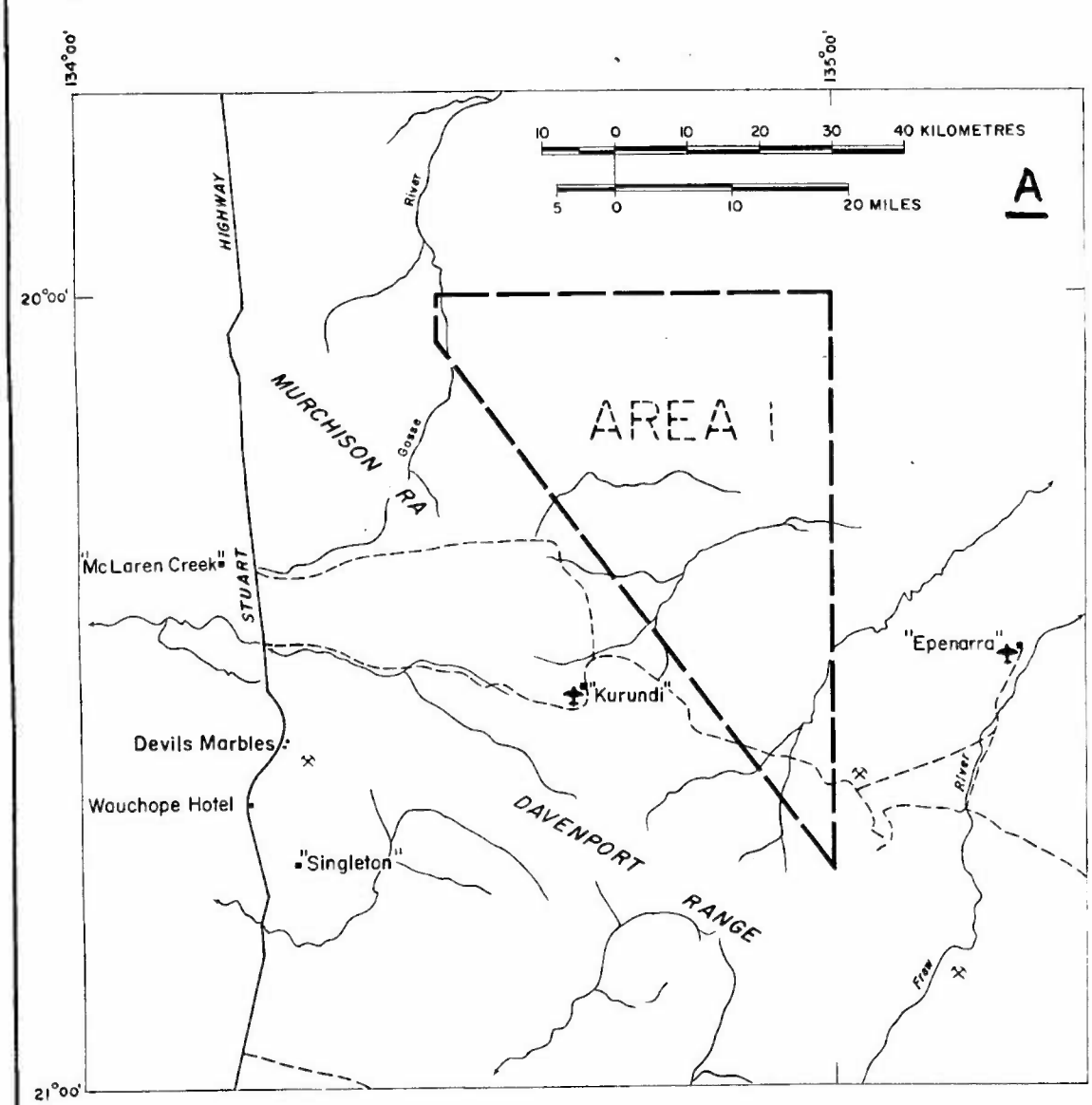
Boundary of survey area

PLATE 6

F54/BI-49A

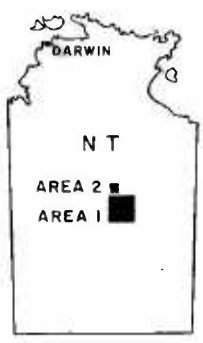
PLATE 7





AIRBORNE SURVEYS, TENNANT CREEK, NT 1970

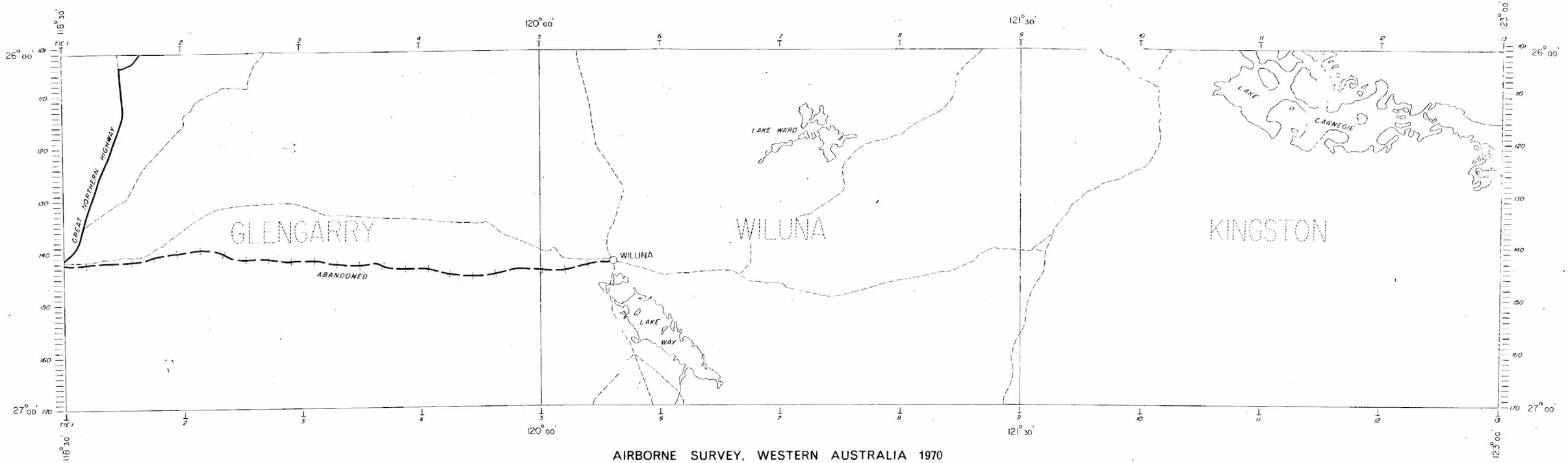
LOCALITY MAP



Survey boundary

E53/81-57

PLATE 8



AIRBORNE SURVEY, WESTERN AUSTRALIA 1970

(CONTRACT)

LOCALITY MAP

LOCATION DIAGRAM

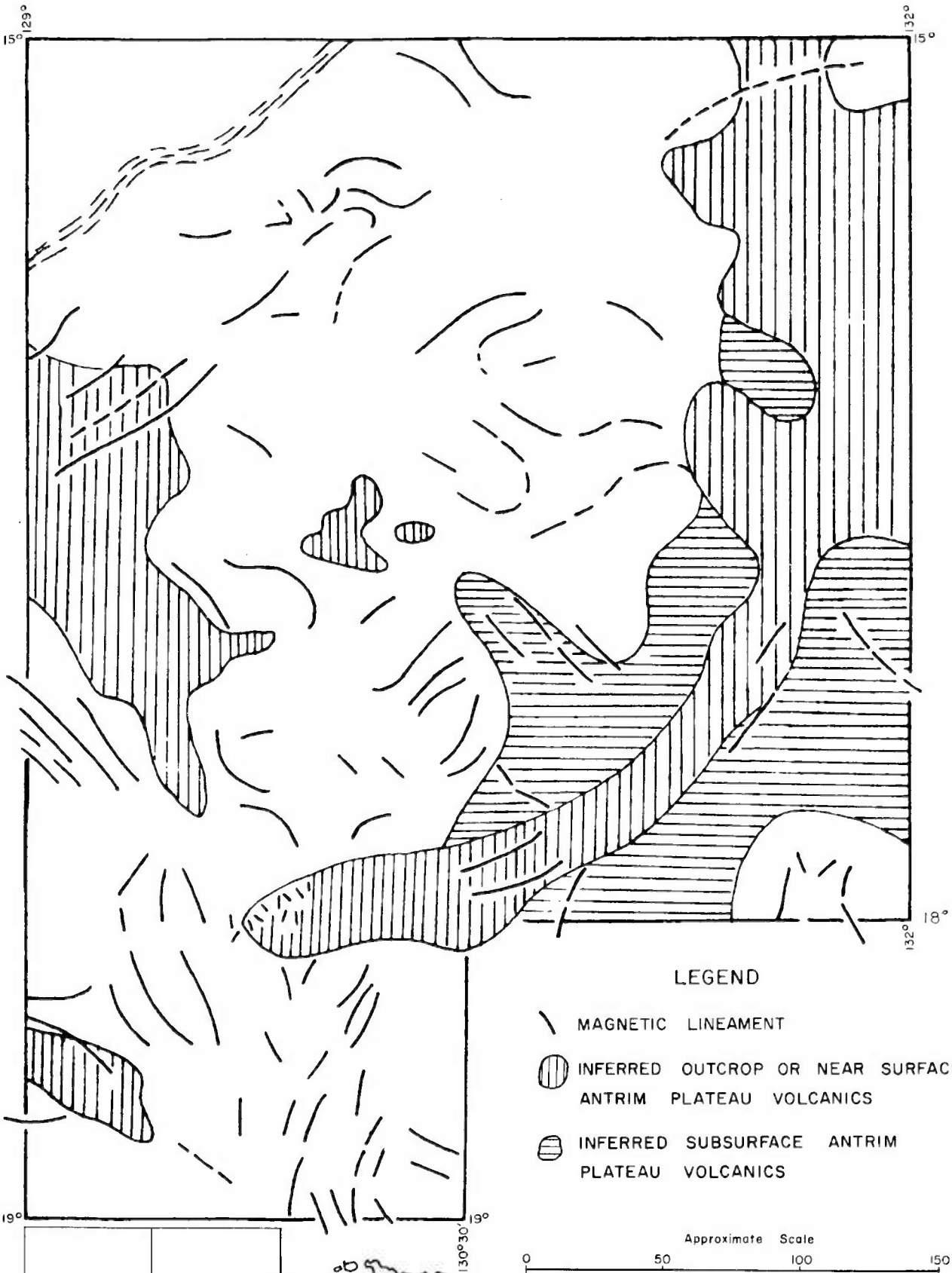
ROBINSON RANGE	PEAK HILL	NABBERU	STANLEY	HERBERT
BELELE	GLENGARRY	WILUNA	KINGSTON	ROBERT
CUE	SANDSTONE	SIR SAMUEL	DUKETON	THROSSELL

MILES 10 0 10 20 30 40 50 60 70 80 MILES

KILOMETRES 10 0 10 20 30 40 50 60 70 80 90 100 KILOMETRES

G 51 / B1 - 21

PLATE 9



LEGEND

MAGNETIC LINEAMENT

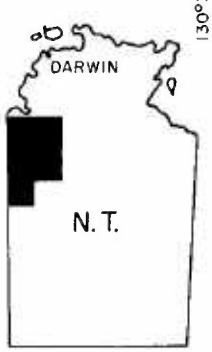
INFERRED OUTCROP OR NEAR SURFACE ANTRIM PLATEAU VOLCANICS

INFERRED SUBSURFACE ANTRIM PLATEAU VOLCANICS

Approximate Scale

0 50 100 150 KILOMETRES

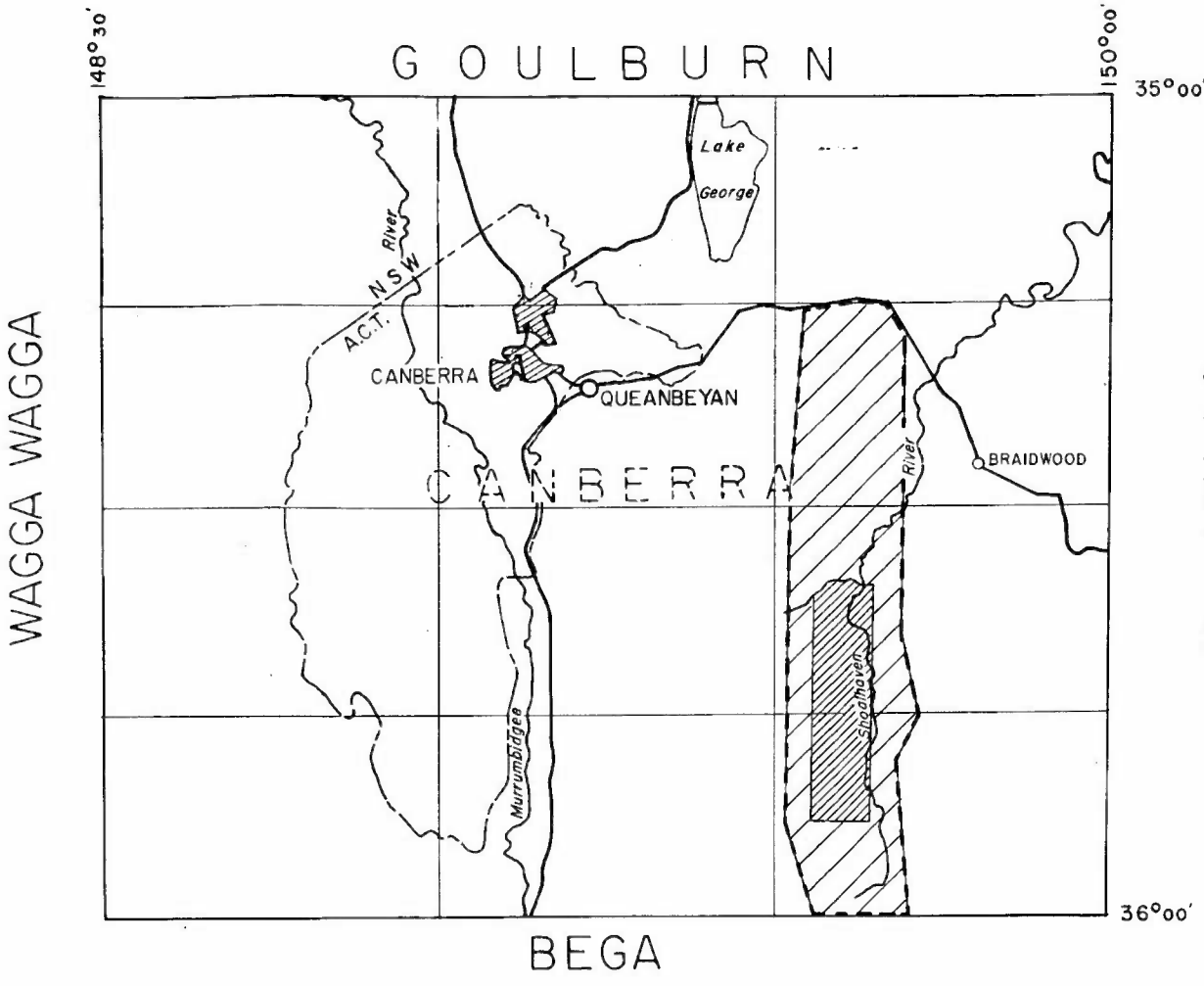
AUVERGNE	DELAMERE
WATERLOO	VICTORIA RIVER DOWNS
LIMBUNYA	WAVE HILL
BIRRINDUDU	



VICTORIA RIVER BASIN

MAGNETIC INTERPRETATION (PRELIMINARY)

PLATE 10



AIRBORNE SURVEY SHOALHAVEN RIVER NSW 1970

LOCALITY MAP

10 0 10 20 30 40 MILES

10 0 10 20 30 40 50 60 KILOMETRES

LOCATION DIAGRAM

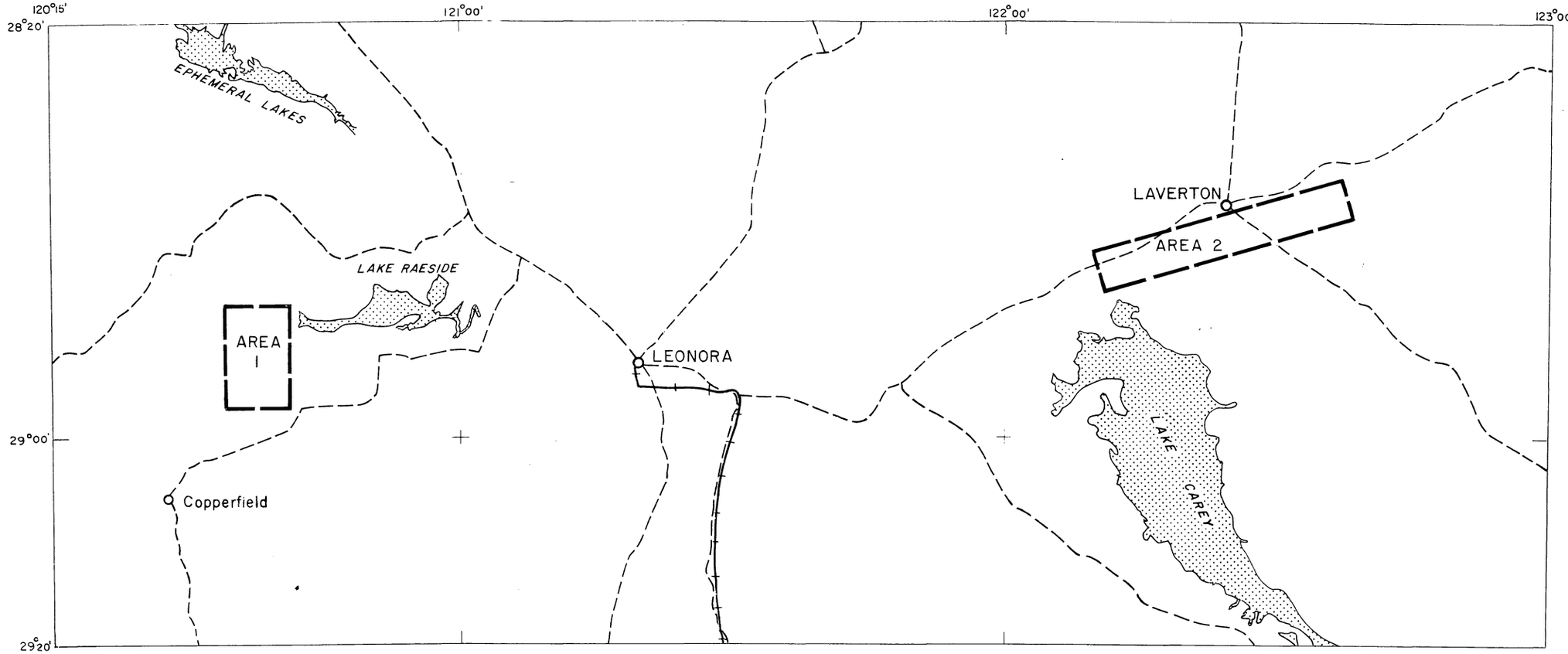
LEGEND

State boundary

Survey boundary – 1/2 mile spacing

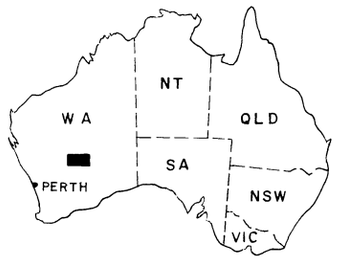
" " 1/5 " "

I 55/BI-60A



DETAILED AIRBORNE SURVEY, WESTERN AUSTRALIA 1970

LOCALITY MAP



Survey boundary

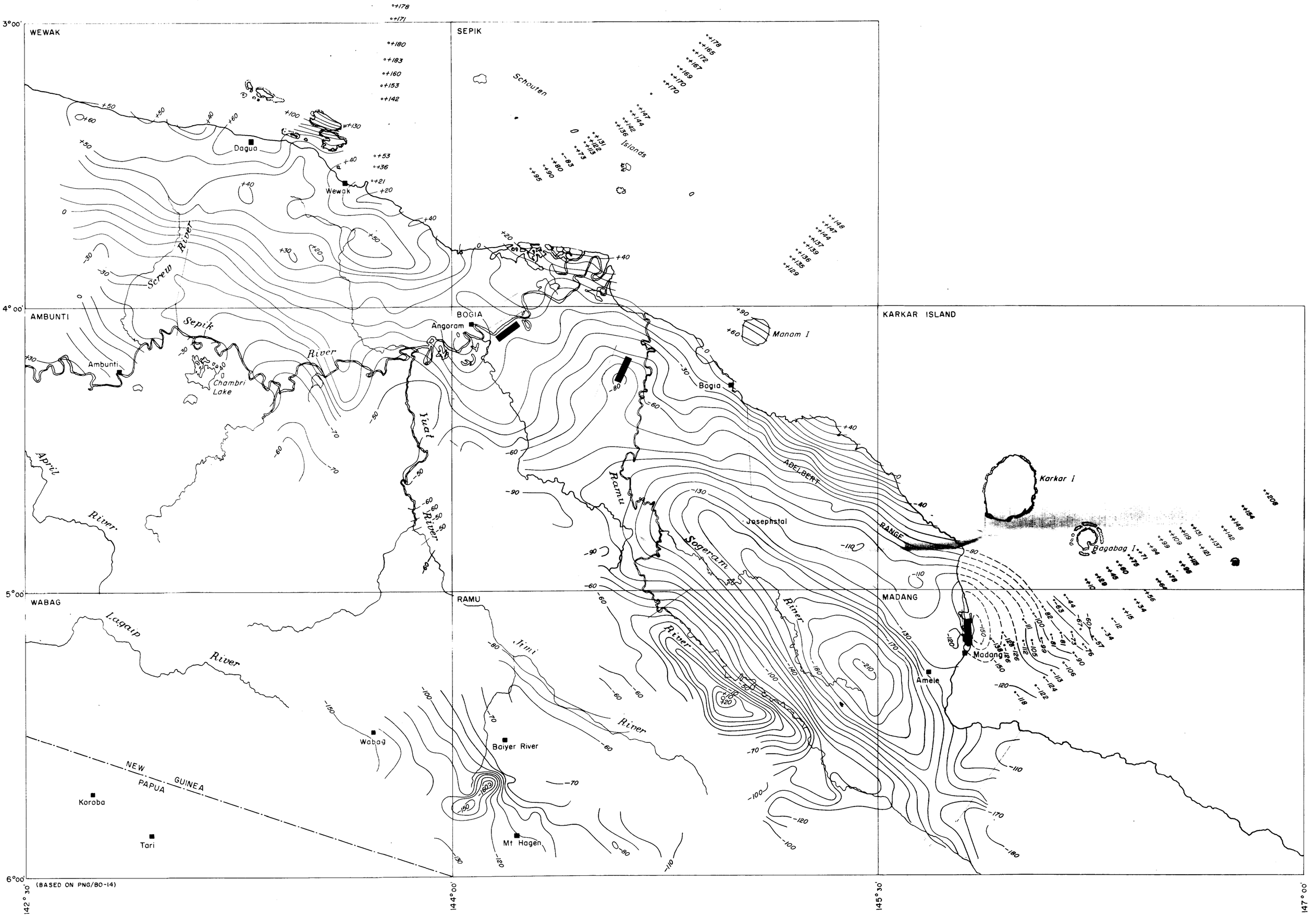
10 0 10 20 30 40 50 60 70 80 KILOMETRES

5 0 10 20 30 40 MILES

H51/BI-96 A

PLATE 11

Record 70/107



BMR Seismic Traverses

Preliminary Bouguer Anomalies Sepik-Ramu area computed using a rock density of 2·67 g/cm³. Marine data from U.S.S. Shoup, 1963-1964, reduced to Bouguer anomalies using bathymetry from Krause (1965)

Projection : Lambert conformal conic

LOCALITY PLAN

NEW GUINEA BASIN AIRBORNE SEISMIC SURVEY 1970

SCALE

10 0 10 20 30 40 50 MILES

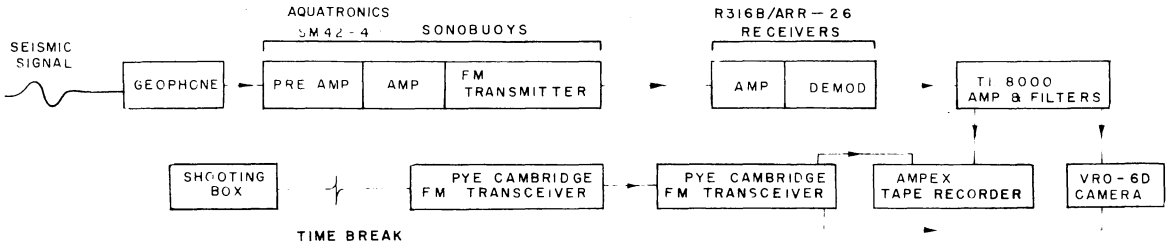
10 0 20 40 60 80 KILOMETRES

Contour interval 10 milligals

PNG/B2-26-3

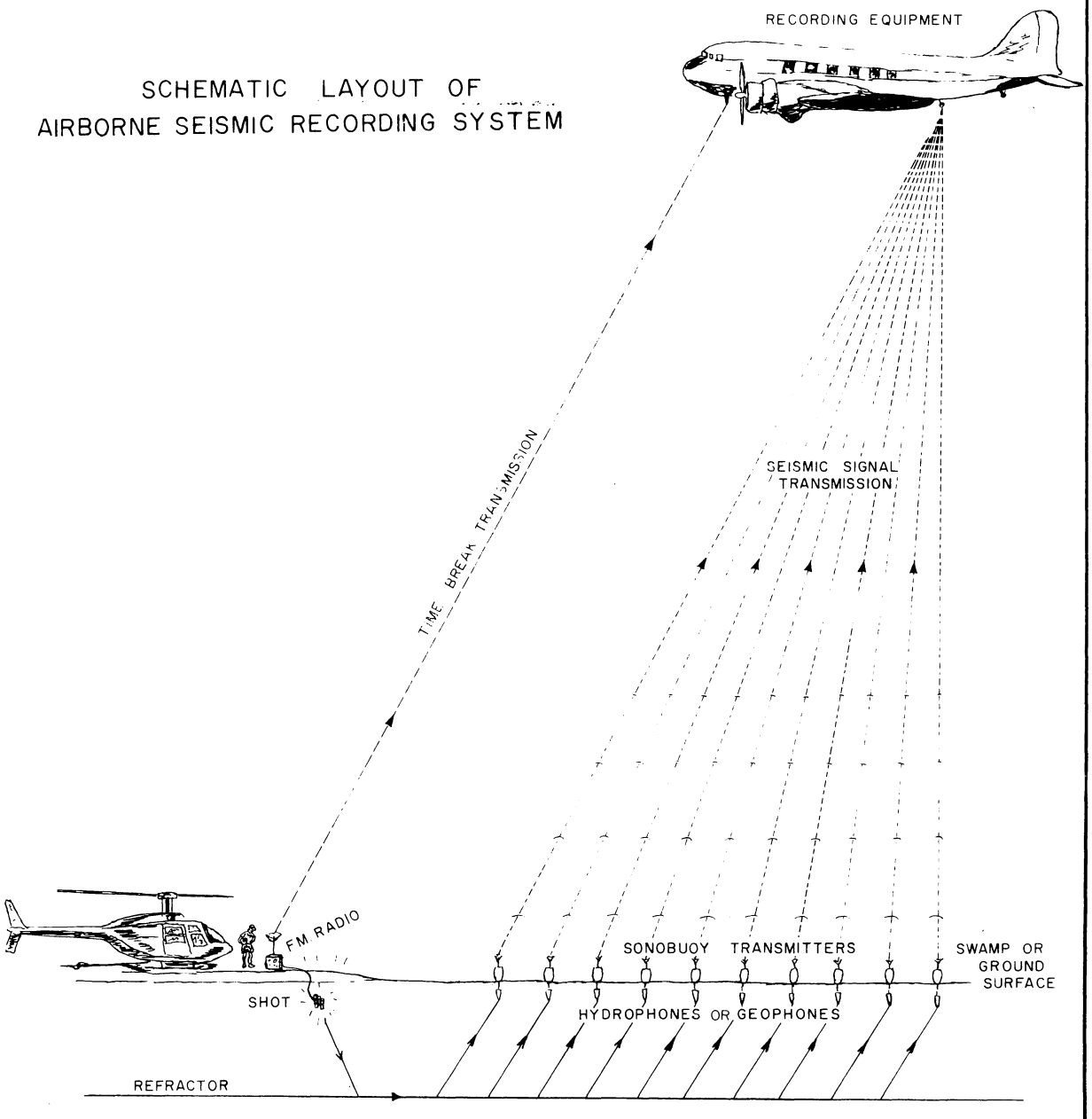
Record 70/107

PLATE 52



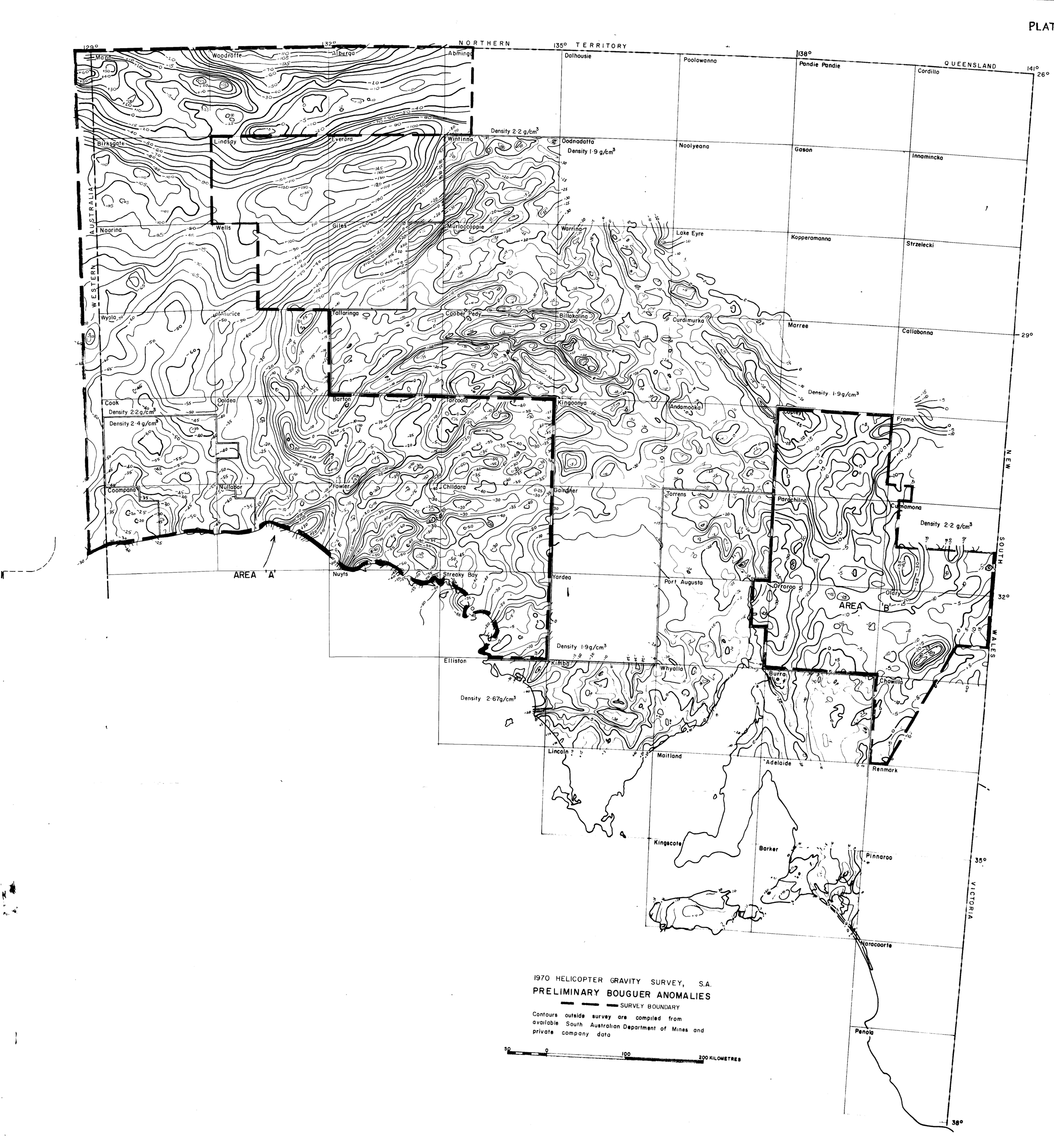
BLOCK DIAGRAM OF RECORDING SYSTEM

SCHEMATIC LAYOUT OF AIRBORNE SEISMIC RECORDING SYSTEM



G85/3-132-2A

PLATE G1



1970 HELICOPTER GRAVITY SURVEY, S.A.

PRELIMINARY BOUGUER ANOMALIES

SURVEY BOUNDARY

Contours outside survey are compiled from available South Australian Department of Mines and private company data

50 0 100 200 KILOMETRES

PLATE G2

114°00' 115°00' 117°00' 118°00' 120°00' 121° 30' 123°00' 124° 30'

30°00' 32°00' 34°00' 36°00'

Hill River Moora Bencubbin Jackson Kalgoorlie Kurnalpie Cundeelee

Perth Kellerberrin Southern Cross Boorabbin Widgemooltha Zanthus

Pinjarra Corrigin Hyden Lake Johnston Norseman Balladonia

Busselton Collie Dumbleyung Newdegate Ravensthorpe Esperance Malcolm

Augusta Pemberton Mount Barker Bremer Bay Mondrain Island Cape Arid

Irwin Inlet Albany

1 2 2A 3 4 5 8 8A 9 10 11 12 13 14 14 15 17 18

NOTE: The information contained in this map has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources.
It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

LEGEND

18 No. of gravity traverse.

-40 -30 Bouguer Anomaly in milligals. Contours from 1969 Reconnaissance Helicopter Gravity Survey.

KALGOORLIE DETAILED GRAVITY SURVEY, 1970
TRAVERSE LOCATIONS

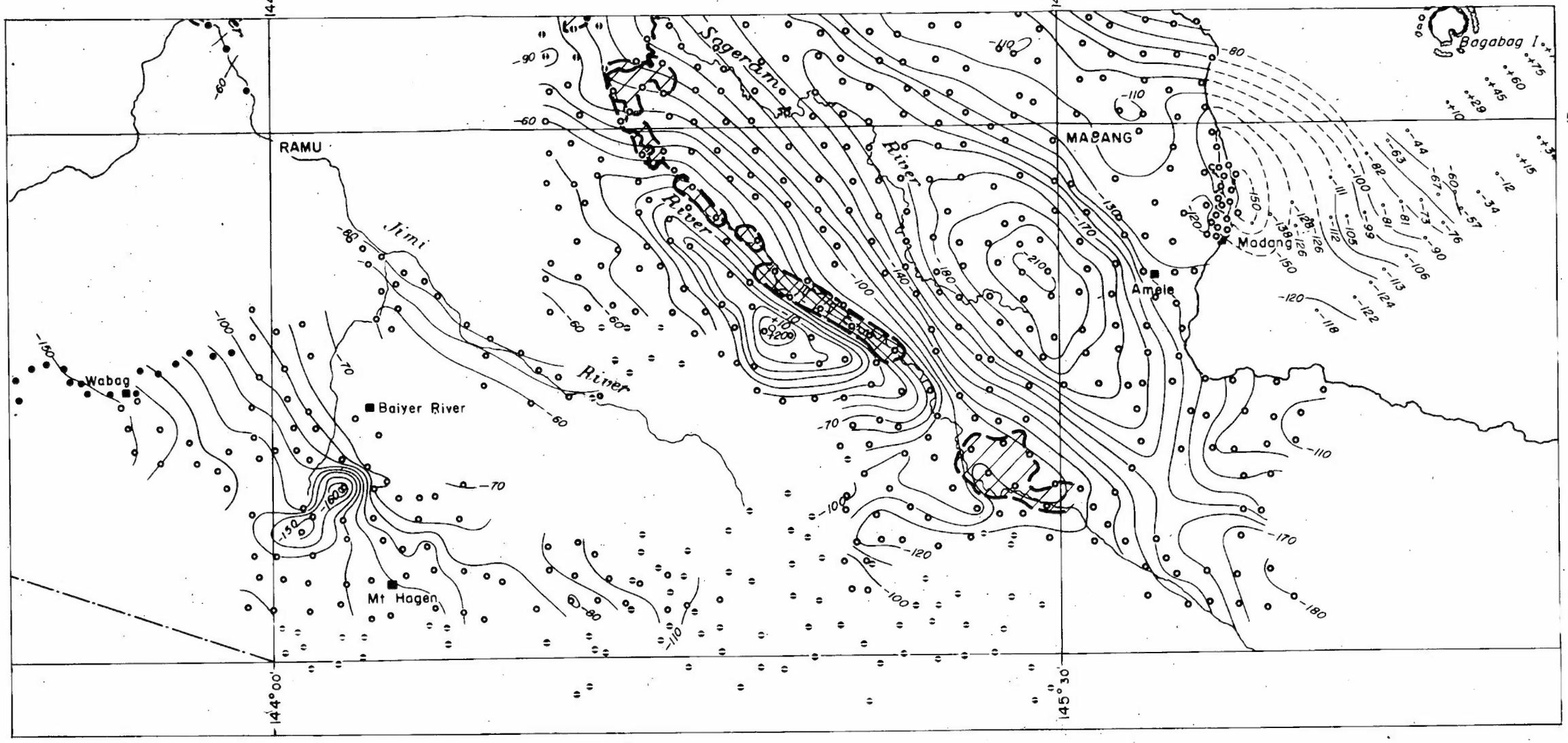
SCALES

50 0 100 200 KILOMETRES

40 0 40 80 120 MILES

WA/B2-25-2

PLATE G3



LEGEND

- Helicopter gravity station, 1970
- Helicopter gravity station
- Road or river gravity station } 1968
- Hoversite gravity station
- Isogal
- Swamp

Preliminary Bouguer Anomalies Sepik-Ramu area computed using a rock density of 2·67 g/cm³. Marine data from U.S.S. Shoup, 1963-1964, reduced to Bouguer anomalies using bathymetry from Krause (1965)

Projection : Lambert conformal conic

1970 NEW GUINEA HELICOPTER GRAVITY SURVEY

STATION LOCATIONS

SCALES

10 0 10 20 30 40 50 60 70 80 KILOMETRES

10 0 10 20 30 40 50 MILES

Contour interval 10 milligals

PNG/B2-35-1

PLATE G4

AUSTRALIA
GRAVITY SURVEYS
AS AT 1-11-70

- One station per 50 sq. miles or better
- One station per 50-100 sq. miles
- One station per 100-200 sq. miles
- Surveys in progress and proposed

Reconnaissance

Regional

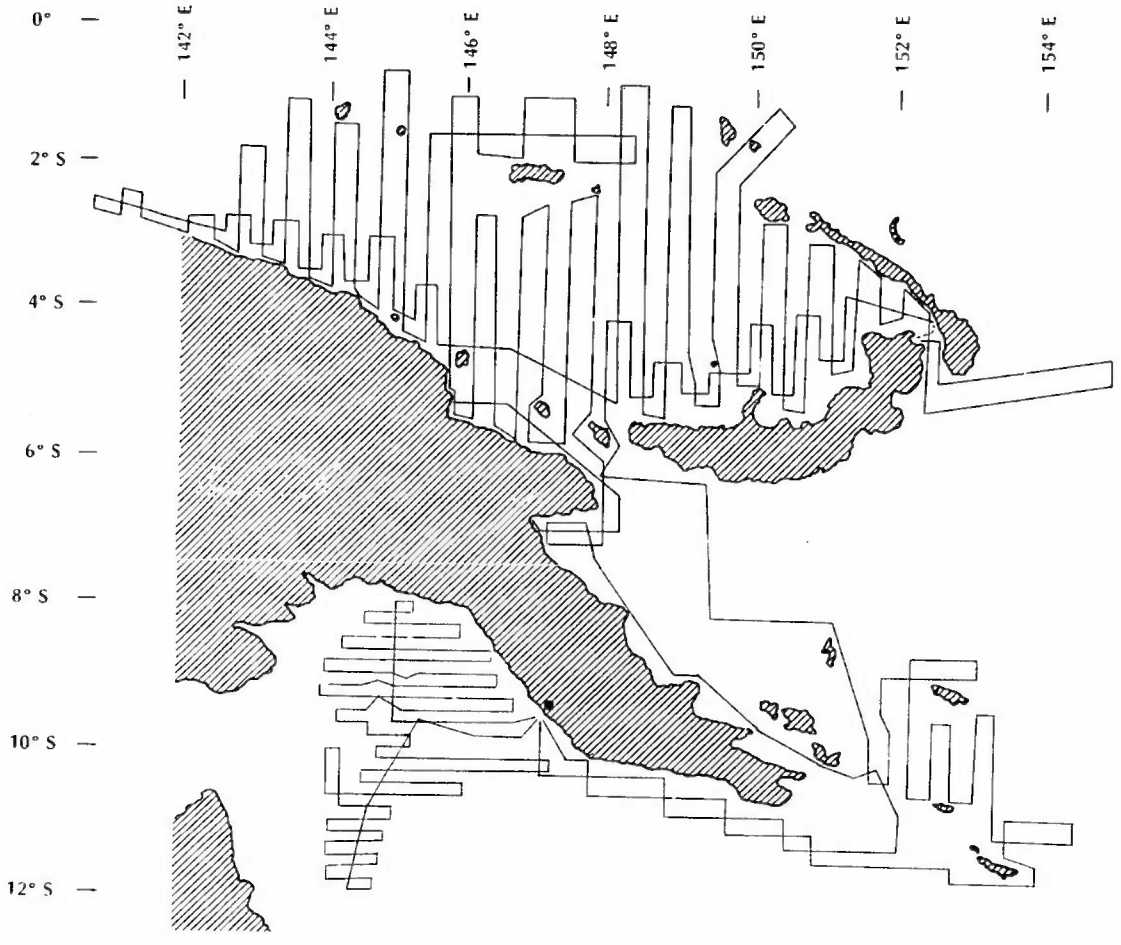
Note: Station density estimated on basis – 1 station per 5 miles along traverses or at intersection of traverses whichever is the greater

BOIGU C54-11 DARU C54-12

(BASED ON A/BO-14)

A/B2-33

PLATE M1



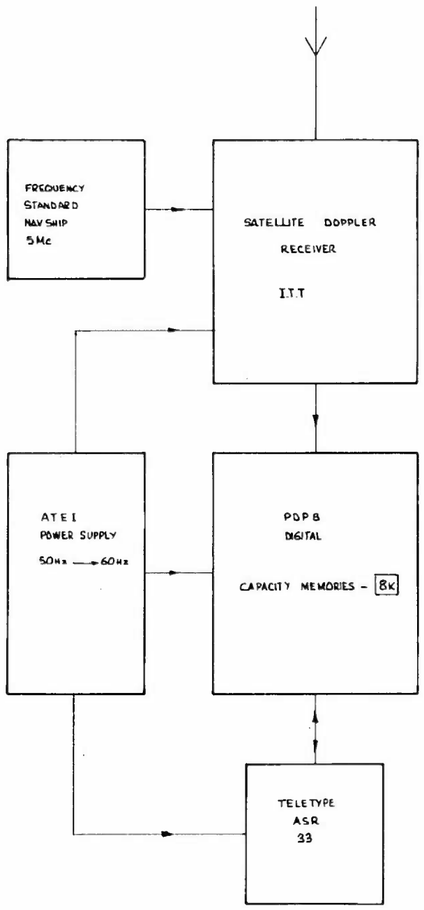
MARINE GEOPHYSICAL SURVEY OF THE GULF OF PAPUA & THE BISMARCK SEA, 1970

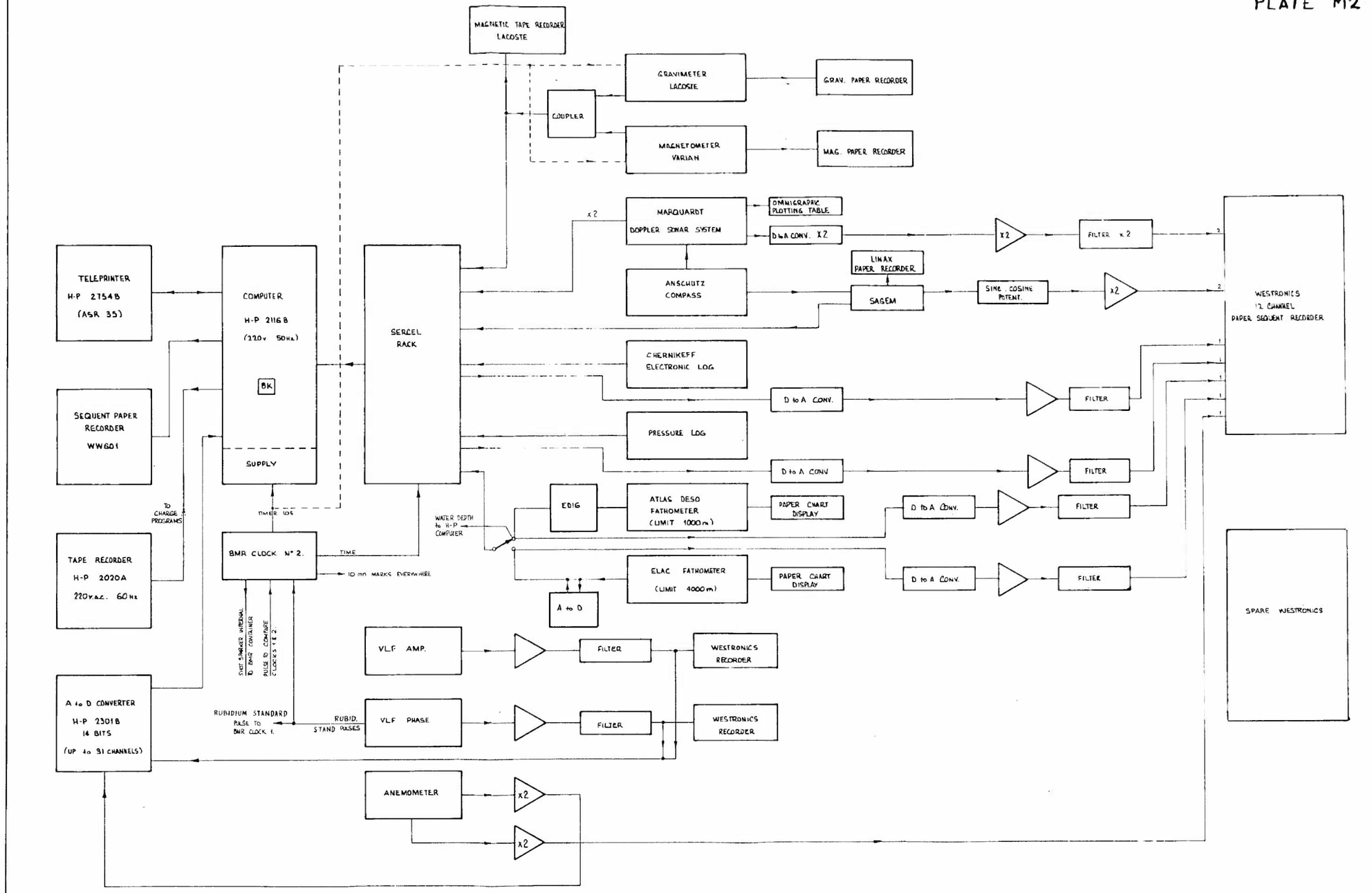
TRAVERSE PLAN

PNG/B8-24A

PLATE M2

SATELLITE DOPPLER POSITIONING SYSTEM





BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

DATA ACQUISITION SYSTEM
1970 MARINE SURVEY

G 449 - 46

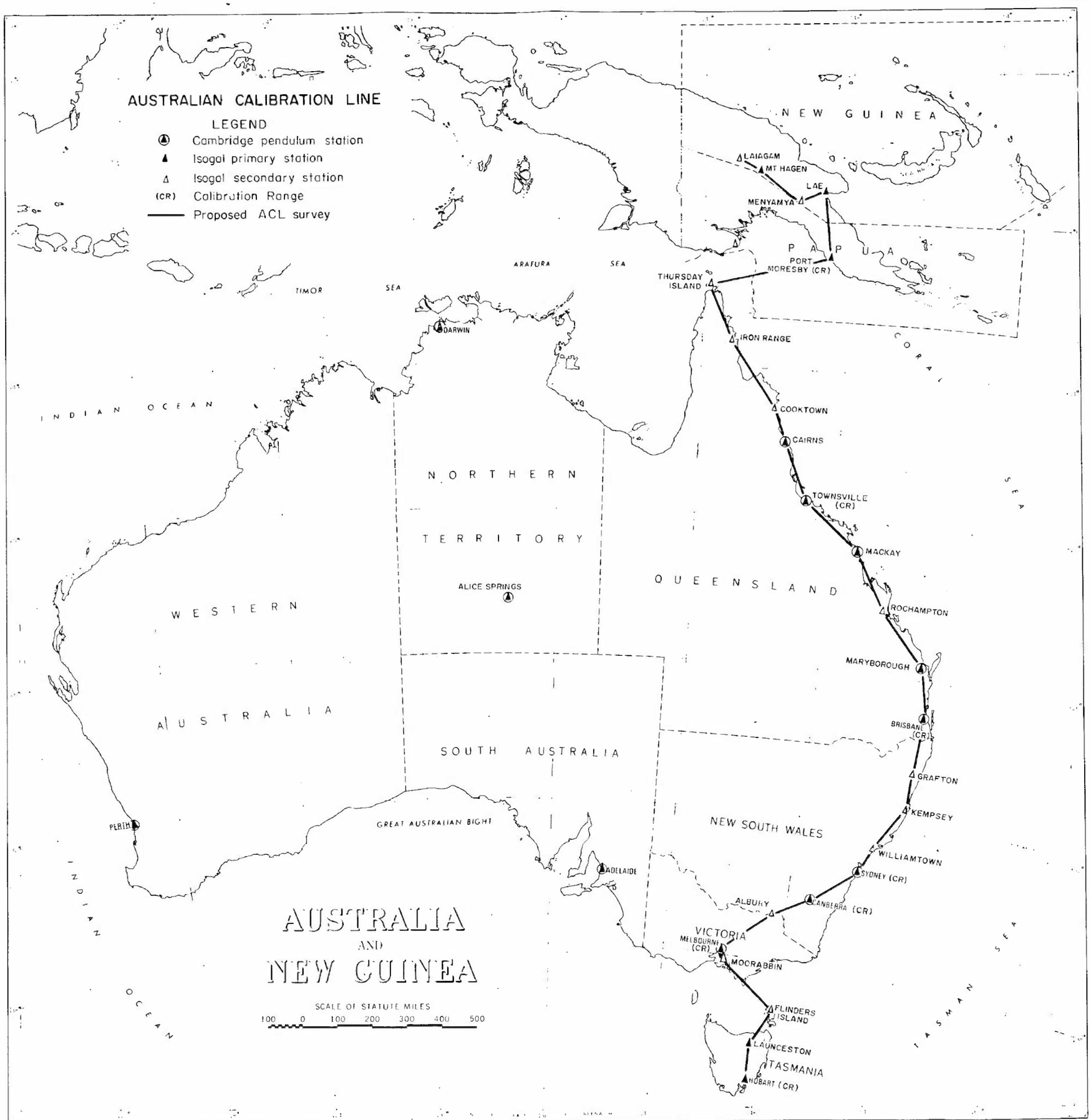

AUSTRALIAN CALIBRATION LINE
LEGEND
Cambridge pendulum station
Isogal primary station
Isogal secondary station
(CR) Calibration Range
Proposed ACL survey
NEW GUINEA
LAIAGAM
MT HAGEN
LAE
MENYAMYA
PAPUA
PORT MORESBY (CR)
ARAFURA SEA
TIMOR SEA
THURSDAY ISLAND
DARWIN
IRON RANGE
COOKTOWN
CAIRNS
TOWNSVILLE (CR)
MACKAY
ROCKHAMPTON
MARYBOROUGH
BRISBANE (CR)
GRAFTON
KEMPSEY
WILLIAMTOWN
SYDNEY (CR)
CANBERRA (CR)
ALBURY
VICTORIA
MELBOURNE (CR)
MOORABBIN
FLINDERS ISLAND
LAUNCESTON
TASMANIA
HOBART (CR)
INDIAN OCEAN
NORTHERN TERRITORY
ALICE SPRINGS
WESTERN AUSTRALIA
QUEENSLAND
SOUTH AUSTRALIA
NEW SOUTH WALES
GREAT AUSTRALIAN BIGHT
PERTH
ADELAIDE
CORAL SEA
TASMAN SEA
AUSTRALIA AND NEW GUINEA
SCALE OF STATUTE MILES
100 0 100 200 300 400 500

PLATE E1

AUSTRALIA AND THE TERRITORY OF PAPUA & NEW GUINEA

Lambert Conformal Conic Projection Standard Parallels 10°S and 30°S

Scale of Miles Scale of Kilometres

This map is based on the Geological Map of the World, Australia & Oceania

INDONESIA

IRIAN

WEST

PAPUA NEW GUINEA

ARAFURA SEA

TIMOR SEA

INDONESIA

INDIAN OCEAN

CHRISTMAS ISLAND

BORE LOGGED

BORE LOGGED

MUSA DAM SITE

CORAL SEA

SOLOMON SEA

GULF OF CARPENTARIA

NORTHERN TERRITORY

QUEENSLAND

DIFFICULT BORE LOGGING

MOURA COALFIELD SURVEY

ESK BORE LOGGED

COASTAL EROSION SURVEY

CONTRACT LOGGING

WESTERN AUSTRALIA

SOUTH AUSTRALIA

NEW SOUTH WALES

BORE LOGGING

JERVIS BAY FOUNDATION

A.C.T SURVEYS

A.C.T

VICTORIA

TASMANIA

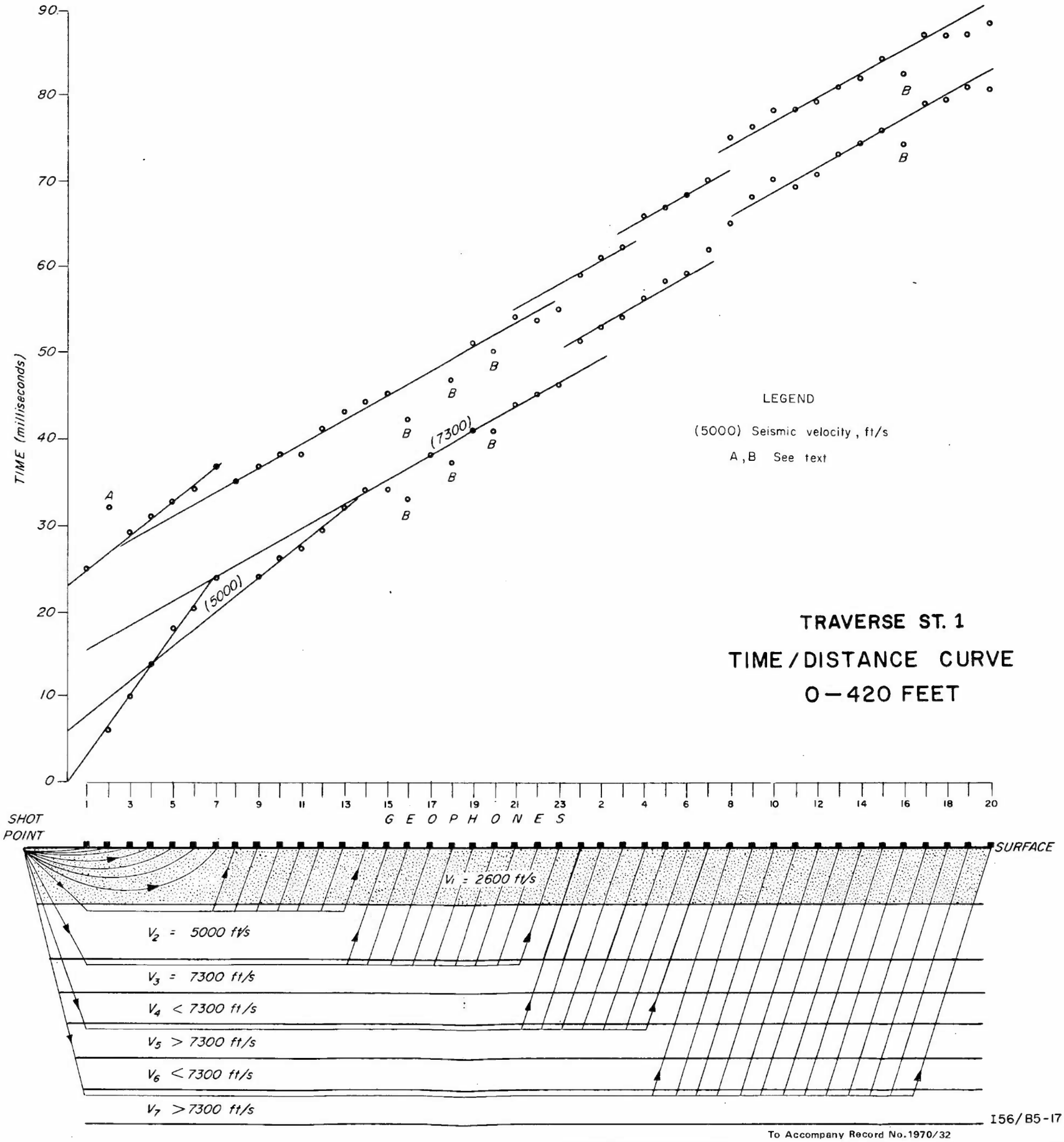
GREAT AUSTRALIAN BIGHT

INDIAN OCEAN

TASMAN SEA

(Based on A/BO-29-1)

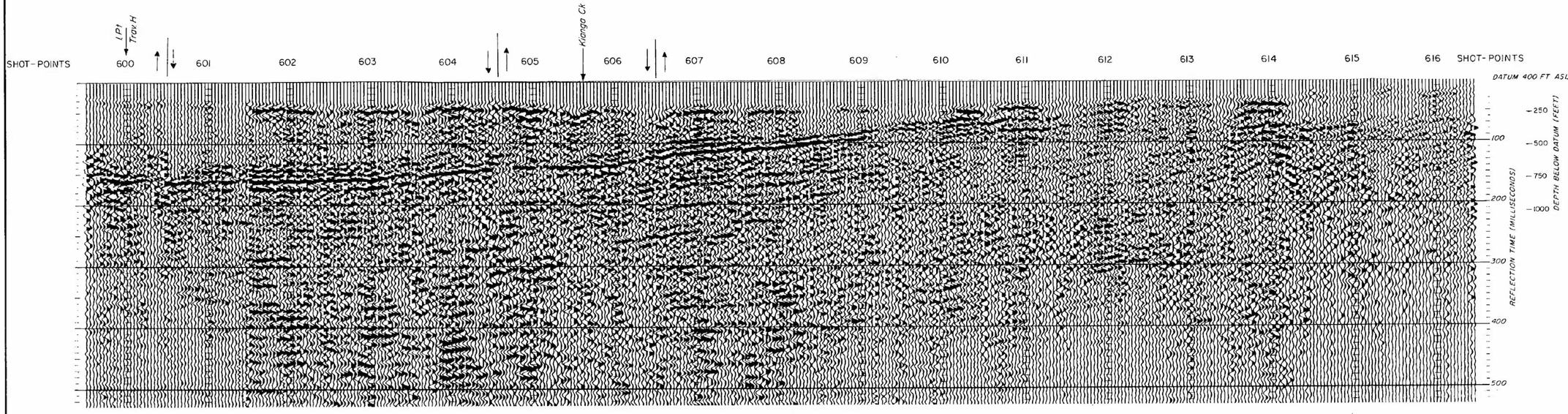
PLATE E2

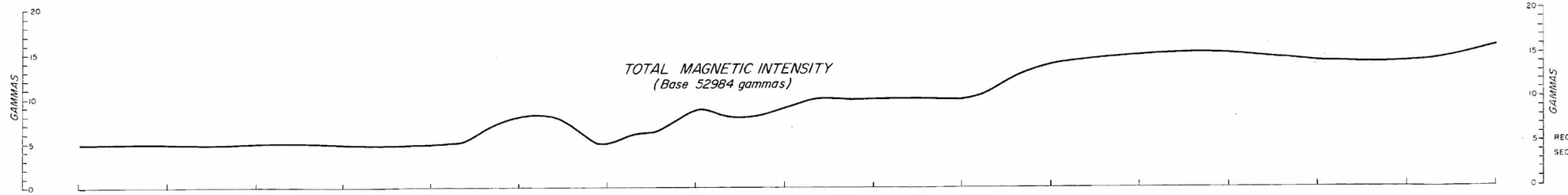


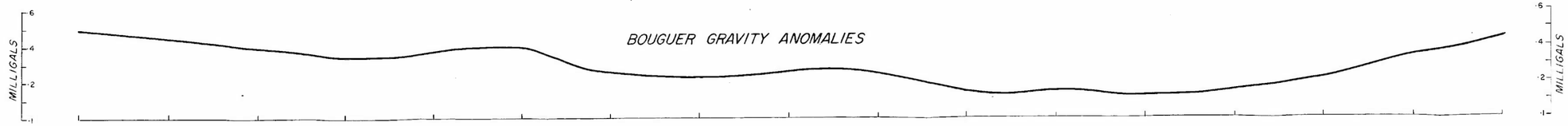
I56/B5-17

To Accompany Record No. 1970/32

PLATE E3







RECORDING INFORMATION

Magnetic Recorder	:	PMR – 20
Amplifiers	:	PT – 700
Prefilters	:	——
Filters	:	L65 – Out
AGC	:	Medium
Gain Initial	:	–80
Final		–20
Geophones	:	HSJ – 14 Hz
Geophone Station Interval	:	25 ft
Geophone Pattern	:	8 per trace, 3 ft apart in line perpendicular to traverse
Shot-hole Pattern	:	1 hole
Offset	:	300 ft south
Depth	:	60 to 90 ft
Charge	:	1/4 lb to 2 1/2 lb

PLAYBACK INFORMATION

Filters	:	L65 – KK 75
AGC	:	Off
Gain Initial	:	–30
Final	:	–20
Trip Delay	:	1 sec
Compositing	:	Nil

VELOCITY INFORMATION

Velocity log of stratigraphic hole NS-70

HORIZONTAL SCALE

100 0 100 200 400 FEET

100 0 100 METRES

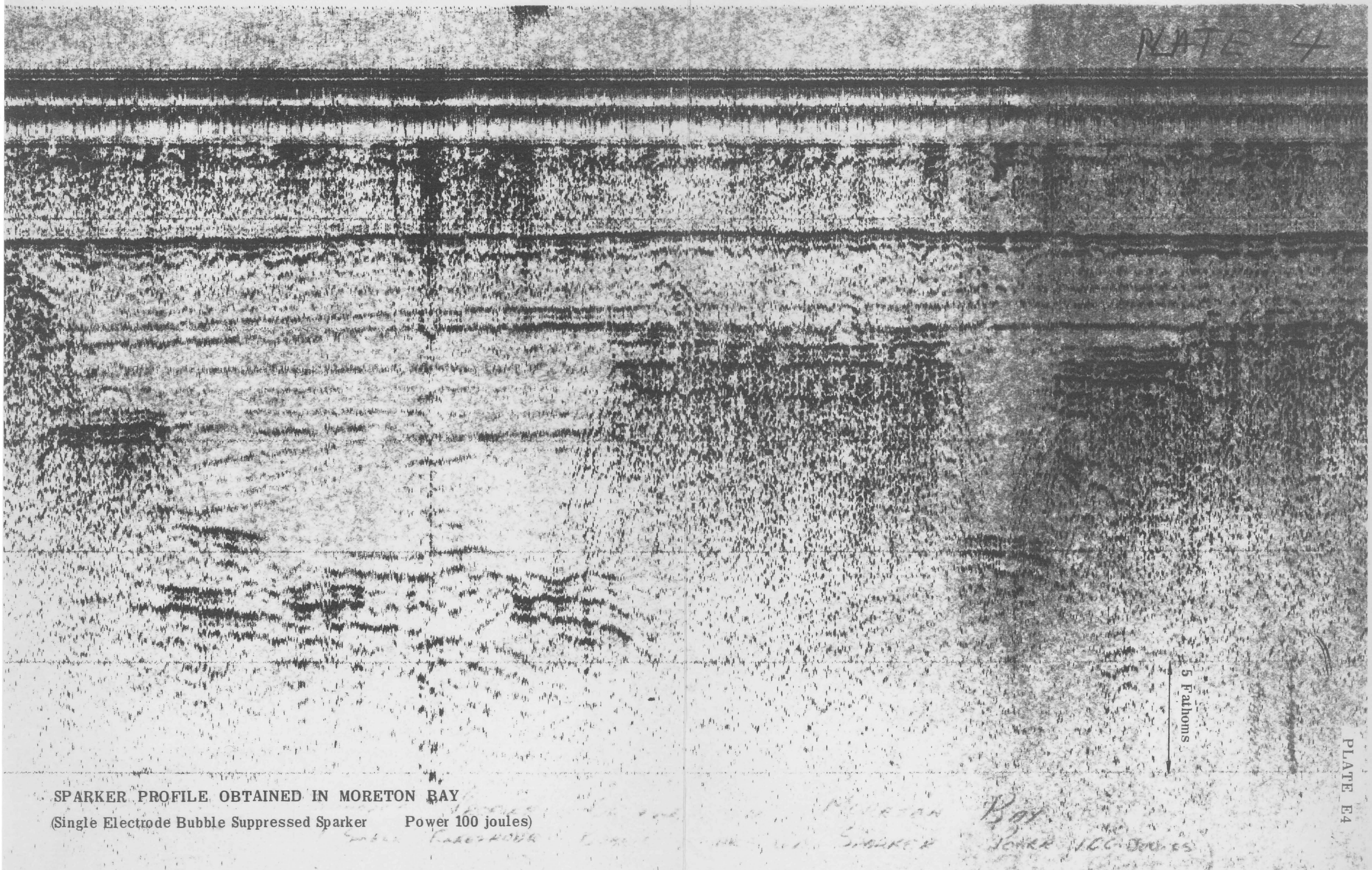
RECORDED BY : BMR Engineering

SECTION BY : BMR Playback Centre SIE MS 42

MOURA COALFIELD, QLD 1970

TRAVERSE G

G56/B5–81



SPARKER PROFILE OBTAINED IN MORETON BAY

(Single Electrode Bubble Suppressed Sparker Power 100 joules)