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SUMMARY OF ACTIVITIES
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1. OIL SEARCH

Seismic Party No. 1 - Northern Queensland

Flinders River Seismic Survey

Seismic Party No. 1 was engaged on an investigation of the Flinders Regional Gravity Low in Northern Queensland, to ascertain if the generally low gravity values indicate the existence of a Palaeozoic basin beneath the Artesian Basin sediments of this area.

The survey commenced on 9th May 1966 with Reflection Traverse A, surveyed north from near Rowen Lynn No. 2 Bore, 18 miles south-east of Richmond, Queensland. The traverse was surveyed continuously from Rowen Lynn Bore to Richmond and then north-east along the Richmond - Coalbrook road, a total distance of about 43 miles. The continuous profiling method of reflection shooting was employed, using 1800 ft. split spreads. Shot patterns usually consisting of 5 holes drilled to depths of from 75 to 125 feet were used initially with 16 geophones per trace in line at intervals of 10 feet along the traverse. (See plate

A strong reflection recorded at the southern end of Traverse A at about 0.65 second persisted to the north along most of Traverse A. It indicated a gentle dip to the south along Traverse A. It occurred at about 0.55 second along the Richmond - Hughenden road and at 0.50 second or less where it was recognisable near the northern end of the traverse. The quality of this reflection deteriorated markedly from south to north. Some shallower reflections of poorer quality were recorded on the southern half of the traverse. Correlation of the seismic results with Rowen Lynn No. 2 Bore indicated that the main reflection was associated with an horizon near the base of the Mesozoic. Where the main reflection was very strong a simple multiple was often recorded at about twice its reflection time.

Noise tests and tests of various shot and geophone arrangements were carried out near the beginning of the survey, but as reflection results deteriorated northwards on Traverse A and as no definite indications of sediments below the Mesozoic sequence were obtained a programme of intensive experimentation was carried out just east of Richmond in an attempt to improve record quality, particularly at pre-Mesozoic levels. Some reduction of noise was obtained by doubling the number of shot-holes and geophones and also by increasing the spacing between them. Two miles of Traverse A along the main road east of Richmond were re-shot using the heavier technique. The results obtained were a little better than those obtained originally, particularly on the early parts of the records, but no definite evidence was obtained of the existence of pre-Mesozoic sediments. The main reflection recorded still deteriorated badly in quality towards the northern end of Traverse A.

A refraction probe was carried out over a nine mile section of Traverse A about 15 miles north of Richmond. A refractor with a velocity of 18,300 ft/s was recorded at a depth of about 2600 feet. A short refraction probe was also done near Stawellton to the north-east, not far from metamorphic basement outcrops. Here a refractor with a velocity of 17,500 ft/s was recorded from a shallower depth.

Traverse D was surveyed eastwards from a point about 6 miles east of Julia Creek, to cross the St. Elmo Structure and the Nonda Gravity Depression which forms the north western part of the Flinders Regional Gravity Low. Initially 5 miles of reflection profiling was carried out, but results were poor. Some shallower events at about 0.2 second were probably associated with granite basement, which was expected at a depth of about 1000 feet. Continuous refraction profiling was then done over the next 10 miles, mapping a refractor with velocity ranging from 16,500 ft/s to 18,500 ft/s at a depth of about 1000 feet. This refractor indicated gentle dip to the east except on the last mile where steeper east dip was indicated. Beginning about 17 miles east of Julia Creek a further 23 miles of continuous reflection profiling was surveyed eastwards. Reflection quality was poor to fair. Gentle east dips were usually recorded, except near the eastern end of the refraction traverse,

where steeper east dips were recorded as on the refraction profile. The recorded time of the deepest correlateable reflection increased from about 0.3 second at the western end of this segment of traverse to about 0.6 second at a point 23 miles further east. Some conformable, shallower reflections were also recorded. After a gap of about 9 miles, Traverse D was again continued to the east with reflection profiling for another 9 miles over which similar results were obtained. Little or no dip was indicated. Although a number of deep events were recorded on Traverse D, none of these is regarded as a genuine reflection which might indicate the presence of Pre-Mesozoic sediments.

Shallow refraction profiles were shot near Nonda, Nelia and Maxwellton Bores to measure the refraction velocity of the Toolebuc Member of the Wilgunya Formation. Velocities of the order of 10,000 ft/s were recorded.

The main conclusion from this work in the Flinders Regional Gravity Low is that no trough of Palaeozoic sediments exists beneath Mesozoic sediments, at least in the western part of the low.

Seismic Party No. 2

Experimental Seismic Survey for Comparison with the Vibroseis Survey, Otway Basin, Victoria and S.A., 1966.

The 1965 programme in the Otway Basin was not completed because of the wet conditions on traverses V2 and V3. Additional recording on these traverses was required to confirm the provisional conclusions of the 1965 survey and therefore Seismic Party No. 2 returned to the area in 1966 to complete the work.

Some of the final records on traverse GL2 were spoilt by instrument cross-feed after 2 seconds. Opportunity was taken while the party was in the area to reshoot these records to make them suitable for publication.

Apart from participation in BUMP and CRUMP the party was stood down for the remainder of the year because of lack of professional staff.

Seismic Playback Centre

Seismic data from current and 1961-65 Bureau surveys and from a subsidised seismic survey have been processed during 1966. Processing priority has been given to current work for which cross-sections are required for perusal in the field and for progress report enclosures. From January until June 1966, with 2 operators in the playback centre, an average of 25 cross-sections per month have been produced mainly for use in records and reports. Since July, with 3 operators, an average of 52 cross-sections have been produced per month.

The centre has averaged 151 equipment production hours per month compared with a possible maximum 214 hours for a normal 22 working day month. Down time has included normal maintenance repairs, and integration of ancillary equipment. The DS7 magnetic recorder was integrated with the playback centre equipment mainly to enable magnetic tapes, recorded at different speeds to that of the playback centre equipment, to be processed. The Rola single channel tape recorder, which had been used for recording data on the Joseph Bonaparte Gulf marine sparkarray survey, was integrated with the playback centre equipment to enable a test section to be transcribed to normal 24 channel magnetic tapes for further processing. The T.I. 8000 Explorer and VT.6 oscillograph camera were set up in the centre for a short time mainly to provide a means of simultaneous monitoring of 24 trace seismic records. Currently the Electro-Tech ER66 oscillograph camera is set up in the centre. A duo-decatrack system has replaced the decatrack system, and a muting device for blanking out high amplitude first break energy, has been added to improve stacking of common depth point recordings.

Cross-sections and/or test playback of magnetic tapes have been produced mainly with variable area/wiggle trace presentation for the following surveys :

Flinders River 1966. Preliminary sections have been produced for field use and progress report enclosures.

Traverse A (Richmond) Reflection, Velcoity Profile, Noise Tests and Comparison Records.
Traverse D (Julia Creek) Reflection.

S. Georgina Basin 1965. Cross-sections were produced for record purposes.

Traverses A, B, C, D, E Reflection and Noise Tests.
Traverse A Comparison Records, Velocity Profile, Offset Reflection
Traverse D Comparison Records.

J. Bonaparte Gulf Marine Sparkarray Survey 1965.

Line P6. Cross sections were produced for study of the effects of various types of mixing on a typical sparkarray section.

Line P10. Several test sections were produced for study of the seismic noise on the section.

Experimental Survey for comparison with the "Vibroseis" survey 1965. Cross sections were prodiced for preliminary and final record enclosures.

Traverses V2, V3, GL2, HS1, HS2, HS3, HS4 Reflection
Traverses V2, SD2, HS1 Comparison Records
Traverse GL2 Velocity Profile, Transverse Noise Test
Traverse HS3 Reflection (A.D.G. magnetic tapes)

S. Carnarvon Basin 1964. Common depth point stacking was made for cross sections for report enclosures.

Traverse C (Gascoyne Junction) 3 and 6 fold C.D.P. coverage - Reflection
Traverse D (Pelican Hill) 3 fold C.D.P. over nearest 6 Traces to shot point.
Traverse D (Pelican Hill) 6 fold C.D.P. over nearest 12 Traces to shot point.
Traverse D (Pelican Hill) 3 traces for cross correlation purposes.

S.E. Georgina Basin 1964. Cross sections for report enclosures.

Traverses B, S, V, A Reflection nearest 12 traces to shot point
Traverses R, N, V, A Noise Tests

S.E. Georgina Basin 1963. Cross-sections for report enclosures.

Traverses F, M, G, L, E, Q Reflection (1800' spreads)
Traverses A, B, C, D, Refraction
Traverses E, H Velocity Profile
Traverses A, D, F Reflection (600' spreads) F. Reflection - collinear offsets.
Traverses A, F Noise Tests.

Thargomindah - Noccundra 1962-1963. Repeat, with revised corrections, of sections previously made in variable density presentation.

Traverse L, N, O, P, Q, R, S. Reflection

Giles - Carnegie 1961-1962. Cross sections produced for record use

Traverses N, M, F19 & Mr. Everard. Comparison Records

Trinidad Subsidised Seismic Survey 1964. Cross sections were produced to enable the Subsidy Group to study the results in section form.

Lines 1, 3 - Reflection (varying spread lengths).

90 Mile Beach Marine Seismic Survey. Several records were played back for examination prior to designing a time-domain filter to use for processing the section.

Line A SP114-122 Reflection

During the remainder of the year processing of data will be carried out for the following surveys :

Flinders River 1966 - preliminary cross-sections during the course of the survey and final cross-sections after revision of corrections.

S.E. Georgina Basin 1963-1964, Giles Carnegie 1961-1962 - few remaining sections required for report enclosures.

90 Mile Beach Marine Seismic Survey - time domain filtered cross-sections.

Experimental "Vibroseis" Survey, Otway and Sydney Basins 1964 - final cross-sections will be processed for inclusion in a report.

Comparison of experimental "Vibroseis" and shot-hole seismic surveys in the Otway and Sydney Basins 1964-1965 - final cross-sections will be processed for inclusion in a report comparing the Vibroseis and shot-hole methods.

Airborne Magnetic Survey, Tasmania - Crustal Investigation (VH-MIN)

During February and March, 1966, an airborne magnetic survey was flown over Tasmania and adjoining areas of ocean to the west and east which extended 100 miles offshore.

The main purposes of the survey were to determine the use of high level surveying and assist geological mapping in terms of resolving major geological structures. All aeromagnetic traverses were designed to sample two land-sea contacts and known major geological structures. By recording the magnetic data at an altitude of 10,000 feet above sea level the magnetic effect of surface or near surface sources was greatly reduced. This permitted the magnetic expression of deeper crustal sources to be resolved more easily.

The land mass of Tasmania was zoned on the basis of the character of the magnetic profiles and these zones show good correlation with known geology. Ultrabasic bodies which extend for approximately 50 miles are inferred to account for large anomalies detected in zone F (Plate 2). No large magnetic anomalies were found underlying the extensive dolerite sheets in the east and south-east except at Port Cygnet where a possible dolerite feeder of great depth extent was detected.

The western off-shore area is, in general, magnetically flat and magnetic basement is close to the sea-floor over most of the area, although several small troughs were delineated. In the north-west the basement is very shallow and possibly reflects Cambrian sedimentation similar to that east of the Precambrian block in north-west Tasmania.

The eastern off-shore area has greater magnetic relief. A very pronounced anomaly extends 80 miles north-south at approximately 60 miles from the coast. The magnetic basement is generally close to the sea-floor although deep troughs which descend to over 15,000 feet below the sea floor were detected in several places.

Magnetic anomalies with wavelengths greater than 20 miles indicative of deep crustal structures, were not apparent on the profiles. These are probably obscured by large amplitude, small wavelength anomalies which to some extent have been reduced by surveying at high level. One method of resolving the long wavelength anomalies is to represent the magnetic data as a Fourier expansion and effectively smooth the data by extracting the higher frequency terms and reconstructing a residual contour map. To take full advantage of this technique, it is recommended that the magnetic field be sampled in greater detail with better positional control.

Airborne Magnetic Survey, Sydney Basin, N.S.W. (VH-MIN)

This survey, which consisted of a series of East West Traverses flown across the western part of the SYDNEY 1:250,000 area, was completed during September, 1966. The survey was designed to complete the aeromagnetic coverage of the SYDNEY area, about the western boundary of the Sydney Basin. Interpretation of the magnetic and radiometric data is in progress and the record is expected to be completed by the end of December 1966.

Contract Aeromagnetic Survey, Northern Great Artesian Basin, Queensland

The contract aeromagnetic survey of JULIA CREEK, RICHMOND, HUGHENDEN, McKINLAY, MANUKA (part), TANGORIN (part), BOULIA, MACKUNDA, MUTTABURRA (part) and SPRINGVALE 1:250,000 areas was continued by AMEG Pty. Ltd.

Survey operations were completed in August. Compilation of the magnetic data is in progress, and as yet no magnetic contours have been received.

Gravity Surveys (Sedimentary Basins)

Southern N.S.W. and the A.C.T.

A helicopter gravity training survey was carried out in Southern N.S.W. and the A.C.T. (see Plate 3, area A). Approximately 20,000 square miles were covered at an average station density of 1 per 50 square miles. Five B.M.R. officers received advanced training on gravity field procedures and in particular on the techniques of helicopter gravity work. In addition 14 people were attached to the party for periods ranging from 3 to 14 days. There were 27 short term trainees (2 days or less) and visitors. Five students were also attached to the party for periods ranging from 7 to 14 days.

As well as carrying out training and obtaining gravity coverage, three investigations into survey techniques were carried out. They were:

1. Station photography

   In association with the Division of National Mapping, several methods for more accurately determining gravity station positions were investigated, and a suitable technique was evolved. A method involving the photography of station positions, marked on the ground by paper strips, from a height of 500' with a 35mm camera proved to be the most satisfactory technique, and is now being used on all Bureau helicopter gravity surveys.

2. Control stations using elevation meters

   Elevations were determined in the northern part of the survey area by the Division of National Mapping's Johnson Elevation meter. The object of this survey was to provide extra elevation control for the helicopter survey in areas where spirit levelled bench marks were not in existence.

3. Barometric levelling

   The theory that barometric levels obtained by using a single base diurnal can be improved by using a 3 base diurnal technique was tested. The 3 bases were sited at the apices of equilateral triangles enclosing the areas of operation. It was shown that the general level of accuracy would be improved and the occasional large elevation errors could be eliminated. This work was carried out in association with Mr. J. Allman of the University of New South Wales.

The bouguer anomaly results (Plate 4) indicate a region of fairly uniform bouguer anomalies. The bouguer anomaly pattern can be divided into two broad areas or provinces.

An area (area 1, Plate 4) which extends up to 50 miles inland is characterized by south-south-west trending contours. This trend is probably caused by crustal thickness variations, as the edge of the continental shelf is not more than 40 miles off-shore. The bouguer anomaly values range from +50 mgals in the coast to -20 mgals on central CANBERRA.

Inland from the coastal zone (area 1 Plate 4) the trend of the contours is south to south-east (see area 2, Plate 4). This trend is probably a reflection of the deep structure of the Tasman Geosyncline. The gravity-geology correlation is good with acid igneous rocks being delineated by relative low bouguer anomaly features and basic igneous rocks giving rise to relative positive anomalies.

An intense relative high on south-east COOTAMUNDRA was detected. As follow-up on this gravity feature could not be done before the end of the survey it is proposed to carry out this work early in 1967. It is believed that the relative high is caused by basic igneous material, associated with a zone of mineralization. Occurences of cobalt, nickel and asbestos are known in the area.

Contract Helicopter Gravity Survey, Northern Queensland and Arnhem Land, N.T.

A contract survey covering all of Queensland north of the 20° parallel and the eastern part of Arnhem Land is at present in progress (14.10.66, see Plate 3). No results of the survey are yet to hand.

It is expected that the survey will provide information on the following:

1. The structure of the eastern margin of the Carpentaria Basin and its relation to the Tasman Geosyncline.

2. The development of sediments in the Northern part of the Great Barrier Reef.

3. The structural relation between Australia and New Guinea.

As at the 14.10.66 the contractor has covered some 150,000 square miles and read about 3,500 grid stations.

Bouguer Anomaly Map of Australia

Following on from the publication of the first edition of the Bouguer Anomaly Map of Australia, additional data are being incorporated onto the map. The second edition of the map should be completed early in 1967.

2. METALS

Ground Investigation for lead-zinc, McArthur River, N.T.

Between the 14th and the 27th of September, 1966, an I.P. test survey was conducted in the McArthur River area, N.T., about 380 miles NNW of Mount Isa. The area is held under a prospecting authority by Carpentaria Exploration Company Ltd. which has been conducting systematic I.P. surveys over it using ASARCO Equipment since 1961. Several lead-zinc occurrences are known in the area, the most important of these being the H.Y.C. deposit situated immediately north of McArthur River Station. Technical problems relating to ore treatment preclude the successful exploitation of this deposit for the present.

E.M. surveys in the McArthur River area were conducted by the Bureau in 1959 and by A.B.E.M. under contract to the Bureau in 1963.

The object of the test was to compare I.P. measurements obtained with the Bureau's McPhar equipment operating in the "frequency" domain with those of Carpentaria Explorations equipment operating in the "time" domain.

Six I.P. spreads were surveyed with the McPhar equipment and the results were compared with those previously obtained by Carpentaria Exploration. The electrode arrangement used by the Bureau's party was dipole dipole while the company used a pole dipole array.

Three spreads over the H.Y.C. orebody gave very similar results to those obtained by Carpentaria Exploration. Two spreads at right angle to each other in the Wicken's Hill area showed strikingly similar features to those obtained by Carpentaria Exploration. The Bureau's equipment worked well in the third area over the Emu Fault where the ASARCO results were very much affected by varying self-potential field and by telluric noise.

I.P. depth probing and I.P. bore hole logging techniques were demonstrated to the party by Carpentaria Exploration.

Ground investigation for copper, Mount Lyell, Tasmania

Cape Horn area. A geophysical survey was conducted in the Cape Horn area, three miles north west of Queenstown, in early 1966. (See Plate 5). The Mount Lyell Company requested the survey to aid their investigations of the occurrence of sulphide minerals along the schist-conglomerate contact in this area. The methods used were electromagnetic (Turam), self-potential and induced polarization.

All traverses were surveyed by the Turam method. The interesting features outlined by the Truam method were then investigated with the I.P. and S-P methods. Geophysical anomalies were recorded with all methods, and the S-P and Turam anomalies coincide while the I.P. anomalies are slightly offset.

The main Turam anomaly extends through the area and is in the schist, and approximately 200 feet away from the schist-conglomerate contact. Another anomaly near the Corridor area meets the main Turam anomaly near 1600 S. Although the I.P. anomalies are slightly offset they appear to be due to the same sources as both types of anomaly are strongest on the same traverses.

The results suggest that finely disseminated sulphide is present in the schists throughout the area. In places this disseminated mineralization reaches appreciable concentrations (possibly where I.P. and Turam anomalies coincide). These zones of concentrated mineralization are probably in the form of en echelon lenses.

This interpretation is in accordance with the known geology. Pyrite is evident in many outcrops, and early mining records reveal the presence of small bornite and chalcopyrite lenses. The early geophysical work of the Mount Lyell Company also confirms this.

Drill holes were recommended to test the main geophysical results.

Diamond drilling, Dobbyn, Queensland

Resistance and self potential logs were made of drill holes Dobbyn No. 2, 3, 4, 5, 6, 11 and Kamileroi No. 1; radiometric logs were made of Dobbyn No. 6 and Kamileroi No. 1.

Results of logging in the Dobbyn area revealed conductors which can be interpreted as sources of geophysical anomalies detected during the 1963-64 survey.

Gould Area, Rum Jungle, N.T.

From the results of the 1965 Gould Area survey, an area was selected for a detailed geophysical and geochemical survey in 1966. The areas of the 1965 and 1966 geophysical surveys are shown on Plate 6. Slingram was done on all traverses. The results (Plate 7) showed anomalies north of the anomalies found in the Mt. Minza part of the Gould Area in 1965 and also showed anomalies in the Waterhouse area. These Waterhouse area anomalies were known to exist from E.M. work done in 1957. Turam work was done on the anomalies north of the 1965 Mt. Minza area to obtain further information on the conductors. Magnetic work was done in the 1966 Gould area and this work has been extended into the 1965 Mt. Minza area. Magnetic results to date reflect the geological environment. Surface radiometric readings were made in the survey area. A few weak anomalies, mainly associated with laterite, were found.

Test I.P. work was done on two traverses in the Waterhouse area, on two traverses in the area north of the 1965 Mt. Minza area, and on one traverse in the Mt. Minza area. All the results are similar and showed marked resistivity anomalies with fairly high frequency effect background, but no well-defined frequency effect anomalies over E.M. conductors. Electrode grounding conditions were poor and no great depth penetration was achieved.

Survey results are in an early stage of reduction and no detailed interpretation has yet been attempted.

Woodcutters Area, Rum Jungle, N.T.

Test geophysical work was done in 1966 in the Woodcutters area, Rum Jungle East, over two areas of geochemical anomalies (L3 and L5, Plate 6).

In the L3 area, Turam was done on a local grid and anomalies possibly associated with the Coomalie Dolomite - Golden Dyke Formation were found. An I.P. traverse across the Turam anomalies showed a resistivity pattern typical of a contact. The frequency effect background was fairly high with no well-defined anomaly. A second I.P. traverse north of the Turam anomalies showed a vague, weak frequency effect anomaly and a resistivity anomaly.

In the L5 area, I.P. was done on traverses 204S, 208S and 220S; i.e. over the targets of DD 66/2, 66/1 and 66/3. The results again showed fairly high background frequency effects, possibly due to carbonaceous slates, with no well-defined frequency effect anomalies. Electrode grounding conditions were poor and no great depth penetration was achieved.

Truam was done over the L5 area but the results were inconclusive. The results were influenced by conducting slates.

A test gravity survey was started in September and is expected to be completed late in October. Insufficient results are available at present for interpretation purposes, but it appears that there are numerous sources of gravity anomalies in the area that could mask the small anomalies to be expected from ore-bodies. L5 is the geochemical anomaly where most of the gravity work is being done, but other geochemical anomalies in the Woodcutters will be covered and some long test traverses will be read.

Six self-potential traverses were done in the L5 area. These all produced negative centres at points which possibly can be correlated with geochemical results. Electrode grounding conditions were poor and it is intended to do a test S-P survey later in the year after conditions have improved.

Huandot North and Coomalie Gap West, Rum Jungle, N.T.

A small amount of test I.P. work was done over electro-magnetic conductors in the Huandot North and Coomalie Gap West areas of the 1964 geophysical survey. Some strong frequency effect anomalies were obtained over some of the conductors. Results are being studied with a view to recommending drilling targets.

Radiometric Laboratory, Darwin, N.T.

A continuous programme of maintenance and repairs was carried out on the Darwin Uranium Group's geophysical prospecting equipment, auger-hole radiometric probing units, bore-hole logging units and the Darwin Seismic Observatory equipment.

Radiometric assays were made of 23 samples for a private company and of ten samples for B.M.R. purposes.

A programme of electro-magnetic (Slingram) model experiments was carried out. Thin models of various conductivities, at varying depths and dips were used. The experimental results will be used in interpreting field results.

Compilation of geophysical data in the Rum Jungle area was started. Information is being forwarded from Darwin to Head Office where it is being put on standard 400 ft to the inch sheets by the Drawing Office. Sheets E93 and E83 are completed and Sheets E72 and E82 well advanced.

Final reports on the 1965 geophysical surveys were completed and forwarded to Head Office.

Borehole Logging, N.T.

Resistance and self-potential logs were made of drill holes B.M.R. 65/2, 66/1, 66/2 and 66/3 in the Rum Jungle Area; radiometric logs were made of drill holes B.M.R. 66/1, 66/2 and 66/3. Radiometric logs were also made of three holes in the Darwin area for the Resident Geological Section, N.T.A., and of three T.E.P. drill holes on behalf of T.E.P.

In the Rum Jungle area, logging of holes 66/1, 66/2, and 66/3 showed that in the Woodcutters area, the conductivities of sulphides encountered is not appreciably different from enclosing carbonaceous slates, thus making the interpretation of geophysical electric survey results rather complex.

It is expected that holes 66/4, 66/5, 66/6, 66/7 and 66/8 in the Rum Jungle area will be completed and logged before the end of 1966, and that six holes in the Amadeus Basin will be logged in November.

Airborne Magnetic and Radiometric Survey, Goulburn, N.S.W. (VH-MIN)

An airborne magnetic and radiometric survey of the GOULBURN 1:250,000 area, requested by the N.S.W. Department of Mines, was flown during the period 26th November, 1965 to 28th January, 1966. The aim of the survey was to assist geological mapping and delineate areas for detailed prospecting for metalliferous deposits.

Plate 8 shows the area subdivided into zones based on magnetic character, the different magnetic characters being ascribed to different rock types. The NNW trending magnetic anomalies reflect the structural trends of the Tasman Geosyncline in which the GOULBURN area lies. Several fold axes are delineated.

Intense anomalies of the order of 300 gammas occur near the margins of granite bodies and suggest the presence of mineralization along the granite/sediments contacts. Strong negative anomalies over areas mapped as Tertiary basalt indicate that some of these basalt flow remnants are reversely polarized.

The radiometric data shows a correlation between radioactive "highs" and regions of granite and porphyry outcrop. The survey revealed 28 radiometric anomalies of restricted source, of which 17 are recommended for ground investigation.

Airborne Magnetic and Radiometric Survey, Central South Australia (VH-MIN)

An airborne magnetic and radiometric survey was flown in the COPLEY, CURDIMURKA, and parts of the LAKE EYRE, COOBER PEDY, BILLA KALINA, TARCOOLA and KINGOONYA 1:250,000 map areas of central South Australia during the period April to June 1966. This work was requested by the Department of Mines South Australia in 1965 and completed the aeromagnetic coverage of the eastern part of the State.

Three distinct geological provinces are contained within the area surveyed. COPLEY and south east CURDIMURKA map areas form the north-west outcrop of late Precambrian and Cambrian sediments of the Adelaide Geosyncline. LAKE EYRE, CURDIMURKA, BILLA KALINA and COOBER PEDY map areas approximate the southern margin of the Great Artesian Basin. TARCOOLA and KINGOONYA map areas, whilst in places have thin veneers of Mesozoic sediments, form the eastern boundary of the Precambrian Shield. The main purposes of the survey was to assist geological mapping, to detect structures associated with mineralization, and to determine the regional sub-surface structure where possible.

The interpretation of the magnetic data is shown in Plates 9 to 12, the more important results of which are summarized below.

Three magnetic trends dominate the survey area. These are oriented NW, NNW, and N.

In the COPLEY map area the magnetic anomalies which trend N are due to vertically inclined thin sheet type sources located at depths between 18,000 and 20,000 feet. These structures are restricted to the southern half of the area near the western and eastern boundaries. Susceptibilities up to 3.5×10^{-2} c.g.s. have been determined for the magnetic sources, indicative of their basic composition.

Both systematic and ~~ramdon~~ random distributions of minor magnetic anomalies are also apparent in the COPLEY area. These anomalies are related to faults, diapiric structures and iron-rich sediments located at shallow depths.

The north west Fault lineament is seen to extend from the COPLEY map area diagonally across the CURDIMURKA map area. This strucutre divides CURDIMURKA into a region of shallow magnetic basement in the east, where magnetic trends are oriented NW, and deep magnetic basement in the west with magnetic trends oriented NNW.

Intense magnetic anomalies were recorded in the BILLA KALINA map area which are related to jaspilites.

Moderate amplitude anomalies with NW trends recorded in an area of crystalline basement rock outcrop in south east COOBER PEDY and south west BILLA KALINA map areas form a belt which extends through KINGOONYA into the TORRENS map area. These anomalies have a form throughout indicative of shallow sources. The south west boundary of the belt delineates the Gairdner (aeromagnetic) lineament.

A minor trough which contains approximately 2000 feet of sediments is seen to extend into the survey area in COOBER PEDY map area from the Lake Phillipson bore.

Some magnetic anomalies trend NE in COOBER PEDY and west BILLA KALINA map areas, parallelling the neighbouring Pidinga Lineament.

Intense radiometric anomalies were recorded in the Mount Painter district of the COPLEY map area. These anomalies are related to known uranium mineralization.

Airborne Magnetic and Radiometric Survey, Laverton-Edjudina, W.A. (VH-MIN)

This survey of the LAVERTON and EDJUDINA 1:250,000 areas, requested by the Western Australian Department of Mines, was flown during the period mid-June to mid-August, 1966. The 12,600 square mile area, situated within the eastern goldfields region, forms part of the Archaean Yilgarn Block, a subdivision of the Western Australian Shield. The objectives of the survey were to aid the systematic regional mapping of the shield, and to assist in the search for nickel deposits which could be associated with ultrabasic intrusions.

Virtually the entire magnetic pattern is due to differing magnetic properties of rocks at or near the surface. In order to assist in the mapping of surface rocks, magnetic trends have been delineated and the area has been divided into a series of zones defined by the dominant anomaly-amplitude range and by the degree of anomaly continuity between flight lines (Plates 13 and 14).

Tabulated below are the zone-types and their magnetic character.

Zone Type	Anomaly Range	Magnetic Linearity
1	less than 50 gammas	poor
2	50 to 100 gammas	poor
3	100 to 200 gammas	poor
4	greater than 200 gammas	poor
5	less than 100 gammas	good
6	100 to 250 gammas	good
7	250 to 500 gammas	good
8	greater than 500 gammas	good

The zones and more particularly the trends, show good agreement with mapped geology. Beyond the slight trend-line flexures due to the positional inaccuracy of the data in its preliminary form, the magnetic trends faithfully follow the folding of the lava/sediments sequence. A summarized interpretation of the zones' geological significance is given below.

Type 1 zones - Non-ferromagnetic sedimentary sequences, and homogeneous acidic igneous masses.

Type 2 zones - Mainly normal granite.

Type 3 zones - Granodiorite, syenite and other more basic varieties of the granite, and gneiss.

Type 4 zones - Irregular masses of basic and ultrabasic intrusives.

Type 5 zones - Intermediate and basic lava flows interjacent with metamorphosed and unmetamorphosed sediments. Also injection gneisses, dykes and basic pergmatites.

Type 6 zones - Similar to zone type 5, but with slightly increased basicity and/or wider rock bands.

Type 7 zones - Mainly basic lavas with minor sediments with the probable addition of minor basic and ultrabasic intrusives.

Type 8 zones - Mainly banded iron formations and ultrabasic intrusives.

Based on the above conclusions the survey area is seen to consist of vast heterogeneous granitic masses enclosing elongated outcrops of interbedded lavas and sediments (greenstones). The granitic areas show ill-defined regions of generally increased basicity. The greenstone belts appear to contain a considerable proportion of non-magnetic sediments, the lavas being of relatively minor importance. Banded iron formations, although of variable magnetite content and of variable width, produce the highest amplitude anomalies and they can be traced magnetically for considerable distances.

Although the economically important ultrabasic intrusives do not produce a uniquely distinguishable anomaly pattern, eleven areas have been suggested as being more likely to contain these rocks.

From the curvature of magnetic trends and zones sixteen fold axes have been delineated within the greenstone belts. The regional pitch of many of these folds appears to be directed southerly. From the co-linear termination of magnetic trends and zones fourteen possible and probable faults have been interpreted. The central known fault in the EDJUDINA area is interpreted to head north-easterly.

Twelve near-east-west dykes of considerable length have been recognized by their distinctive magnetic properties. One of these dykes has a strong remanent magnetization vector which masks the effect of induced magnetization.

The general level of radioactivity is 25 to 75 counts per second (c.p.s.). Values below 25 c.p.s. are often associated with water-filled salt lakes. Almost all high radiometric anomalies (some being over 300 c.p.s.) are correlated with either dry salt pans or granitic outcrops protruding through alluvial cover. The eastern granite in the EDJUDINA area appears to be less radioactive than the western granite.

Eighty seven radiometric anomalies satisfying the point-source criteria were detected. Nine of these have amplitudes exceeding ten times the standard deviation of the associated noise envelope.

Considerable success appears to have been achieved in satisfying the objectives of the survey. The magnetic data in particular can be used to trace the boundaries of major rock units and to delineate many aspects of regional structure. Also, subsequent ground investigations in the search for nickel may be focussed on areas where there is a much greater likelihood of finding ultrabasic intrusives. The good agreement

between the interpreted geology and the detailed geological mapping available in this area indicates that the airborne method should continue to be extensively used in the goldfields region of Western Australia.

Detailed Aeromagnetic Survey, Western Victoria (VH-GEO)

At the request of the Geological Survey of Victoria, a survey was carried out to test the usefulness of the aeromagnetic method in detecting the thickness and state of decomposition of Tertiary basalt lava flows in Western Victoria. These flows overlie a sedimentary sequence that could contain brown coal deposits. The deposits may be of commercial value if the overlying basalt is sufficiently thin or sufficiently decomposed.

Fifty-six square miles of surveying was carried out north and north-west of Creswick and 10 square miles north of Hamilton. A further 70 square miles were surveyed at Hamilton during October. At Creswick, the basalts from a number of now extinct volcanoes in and around the survey area have filled an old valley system cut into Ordovician slates and sandstones. At Hamilton, the basalt overlies a thin Tertiary sequence in most of the survey area and is in contact with rhyolite in the west of the area.

The basalt sequence consists of a number of flows varying from dense hard rock to light vesicular lava interspersed with layers of clay, sand and gravel. The flows can be expected to vary in the strength of their remanent magnetization as well as their induced magnetization, and palaeomagnetic measurements have shown that the remanent magnetization may be either normal or reversed in direction. Due to this complexity, the total magnetic field contour maps resulting from the survey showed a very disturbed field over the areas of basalt. The intensity of the field appears to vary randomly from point to point so that it is unlikely that any method could be devised for determining the thickness or the state of decomposition of the basalt. The results from the Creswick Area (Plate 15) show a gradual change from disturbed to relatively undisturbed field over the boundary between the basalt and the Ordovician slates and sandstones. It should be possible to estimate the position of such a boundary to within $\frac{1}{2}$ mile, from the results of similar aeromagnetic surveys.

Detailed Aeromagnetic Survey, Tennant Creek, N.T. (VH-GEO)

A detailed aeromagnetic survey of seven areas in the Tennant Creek mineral field was flown by the B.M.R. during the period early July to mid September 1966 (Plate 16). The region surveyed, totalling 122 square miles, consists of three areas close to the Tennant Creek township and two areas approximately 30 miles north of the town. The areas were chosen by the Bureau's Geological Branch in collaboration with the Northern Territory Administration and were of particular interest because of their location in favourable geological environment and/or interesting magnetic features detected in previous regional aeromagnetic surveys flown by the Bureau's DC-3 aircraft in 1956 and 1960.

The purpose of the survey was to resolve complex anomalies detected in the earlier surveys and to assist in the overall geological interpretation of the areas. An attempt was made to estimate the position and type of source rock causing the anomalies and to localise areas of prime importance to be followed up by ground magnetics with a view to establishing drilling targets.

The magnetic contour pattern in areas 1, 2, and 7 closely resembles that detected by the DC-3, the predominate trends being east-west or slightly north of west. Magnetic anomalies are often superimposed on magnetic ridges. The sources of the anomalies are probably relatively small quartz magnetite bodies of large susceptibilities whereas the magnetic ridges and anomalies with large areal extent are probably due to

dispersed disseminated magnetite in Warramunga sediments. In area 7, a large amplitude anomaly north-east of The Plum Mine, two smaller ones near The Plum and New Hope Mines and one 2½ miles west of New Hope Mine are recommended for further investigation. An anomaly 1 mile east of Arcadia appears to be the only promising feature in area 1. The largest anomalies in area 2 were detected at the intersection of a magnetic lineament and shear zone. Although a favourable location for mineralization, previous drilling in this area intersected lamprophyre intrusions which are probably the sources of the anomalies.

In area 3, a north-west trending anomaly on the flank of a broad magnetic gradient increasing to the west, was detected. The source of this anomaly is shallow and appears to be a steeply dipping basic intrusive body.

Areas 4, 5 and 6 are magnetically flat with the exeption of the south-west part of 4. The disturbed magnetic pattern in this region is possibly due to a flat lying basic body with variable magnetic susceptibility. It is terminated to the east by a very pronounced lineament trending north-north-east, which possibly reflects a fault with a downthrow to the east. The entire region is covered by recent alluvium and a series of hammer or auger drill holes to bedrock is recommended to test this lineament. The remainder of areas 4, 5 and 6 show very little magnetic relief and no evidence of the North Star shear zone was found in the contour pattern.

Detailed Aeromagnetic Survey, Daly River, N.T. (VH-GEO)

Between mid-September and mid-October, the Cessna aircraft made a detailed survey of 55 square miles of the Daly River Mineral Field. The area is located just north of the Daly River about 90 miles south-west of Darwin.

The aim of the survey was to delineate the contacts between the sedimentary units and the dolerites and granite, with a view to determining the structure influencing copper mineralization.

The preliminary contour map shows NNE trending anomalies of amplitudes up to 150 gammas through the centre of the area with magnetically flat zones to the east and west and intense isolated anomalies along the eastern edge of the area. The NNE trends reflect the geological structure and probably represent dolerite sills within the Lower Proterozoic sedimentary sequence (see Plate 17). As there is no apparent edge effect between the granite and the sediments, it is not possible to delineate the boundary between them. A number of strong magnetic gradients within the area have been interpreted as due to faults trending between east and north-east.

Warr's Mine in the north of the area has a circular anomaly of 100 gammas associated with it, indicating a source about 300 yards in diameter. The other mining localities do not have any significant anomalies associated with them. A preliminary assessment of the results suggests that the source of the mineralization is related to the dolerites and not to the granite 30 miles south of the area, as previously thought.

Because of the presence of intense magnetic anomalies in the southern part of the area and the apparent continuity of the magnetic trends to the south-west, further detailed aeromagnetic work is recommended for the areas to the south and south-west of the present survey area.

Victoria River Basin Contract Aeromagnetic Survey, N.T.

A contract for an aeromagnetic survey of four 1:250,000 areas (Auvergne, Waterloo, Limbunya and Birrindudu) totalling 28,500 flight line miles, was let to Adastra-Hunting Geophysics Pty. Ltd. in May, 1966.

The survey operations commenced in October and approximately 2000 line miles had been flown by mid-October.

Contract Aeromagnetic Survey, T.P.N.G.

Papuan Basic Belt, Astrolabe Area and Papuan Basin

Tender specifications were drafted for a contract aeromagnetic survey of the Papuan Basin - Papuan Basic Belt and Astrolabe Area, T.P.N.G. This tender is expected to be issued in November, 1966, and the contract survey should commence during the early months of 1967.

The survey involves approximately 22,000 flight line miles and covers the onshore and offshore parts of the Papuan Basin, the northern section of the Papuan Basic Belt, and detailed survey of the Astrolabe mineral field.

Aeromagnetic Maps of Australia

Two Australia-wide maps are being produced, one showing contours of total magnetic intensity, and the other showing contours of magnetic basement topography as interpreted primarily from aeromagnetic data. The sacle and geographic projection used for both maps are identical with those of the Tectonic Map of Australia. All available data, whether collected by the Bureau of Mineral Resources or by private companies, are being used.

Where different surveys join or overlap, there is generally a slight discrepancy in interpretation at their common boundaries. Similarly, magnetic intensity contours are not always continuous across these boundaries, due to differences in datum levels and contour intervals. To date, no attempt has been made in either map to rationalize the data to produce contour continuity.

Plate 18 illustrates diagrammatically the present progress.

Summaries of many of the private company reports have been written as a preliminary stage to the evaluation of the final maps and the subsequent writing of Explanatory Notes.

This work is proposed as a continuing project for 1967 during which time both maps and an accompanying text should be published.

Palaeomagnetism

Rock samples for palaeomagnetic measurement were collected from the Bowen Basin in June-July, 1966.

Work was continued on the construction of the B.M.R. astatic magnetometer in the Black Mountain magnetic laboratory.

Palaeomagnetic measurements were continued on the rock samples collected from New Guinea in the previous year.

Power Spectral Analysis of Aeromagnetic Anomalies

The digitized data of a 340 miles long east-west aeromagnetic traverse across Tasmania have been modified to remove errors and an eight-hole digital tape has been made. A power spectral analysis programme is in FORTRAN language has been written for the CDC 3600 computer at C.S.I.R.O. and this is in processs of being tested.

Computer Programme for Airborne Reductions

Owing to a staff shortage brought about by the resignation of two senior officers in the Airborne Section, the writing of this programme has been let under contract to Control Data Aust. Pty. Ltd., Canberra. Programme writing will commence in October 1966 and should be completed early in 1967.

Magnetic Compensation of Aircraft VH-MIN

A collection of compensation data of past VH-MIN surveys has been made. Preliminary reading of available literature on the subject has also been made.

Magnetic Model Studies by Digital Computer

No progress has been made on this project up to October. Work is expected to recommence in November and it is proposed that project be extended into the first half of 1967.

Magnetic Anomalies due to Cylindrical Bodies

A preliminary investigation of some of the relevant literature has so far been carried out on this project. A complete analysis of the subject will probably require computation of standard curves in a digital computer. It will be useful to consider this project in conjunction with the more encompassing project "Magnetic Model Studies by a Digital Computer".

3. ENGINEERING AND HYDROLOGY

Logging Great Artesian Basin, Queensland

The gamma ray logging programme for waterbores, started in 1960, was continued by a contractor (Schlumberger) and the Bureau's own logging party. The Bureau logged 32 bores, and it is expected that the contractor will log about 100 bores for a total contract price of $100.000.00. Where possible, electric logs were taken as well. At the request of the Irrigation and Water Supply Commission of Queensland some flow meter and caliper logs were also taken to disclose casing leaks and water losses.

Warangoi Damsite, New Britain, T.P.N.G.

It is desired to build a dam across the Warangoi River with the idea to build a hydroelectric power station. With a seismic refraction survey the thickness of the river gravel layer was determined as 160 feet. The abutments consist of very permeable rock of 4,600 ft/sec seismic velocity. Bedrock velocities range between 7,500 and 11,000 ft/sec, indicating weak to moderately strong rock.

River Express Way, Brisbane

A seismic refraction survey was made along the left bank of the Brisbane River, from Grey Street Bridge to Technical College, then across the old local wharf along the centre line of the proposed Express Way. Depth to good foundation rock varied between 20 and 100 feet.

Buffalo River Damsite, Victoria

It is planned to build a dam about 12 miles upstream from Myrtleford, Victoria. The water is to be used for irrigation. 40,000 feet of seismic and 5000 feet of resistivity traverse were completed.

At the eastern side of the river the bedrock is at great depth, with layers of gravel of 120 feet thick.

River and Port Investigations, Launceston and Devonport, Tasmania

In Launceston the re-investigation of a new bridge site with sonar boomer equipment near or inside the gorge was not successful because of reflections against the walls. In Devonport a survey on the site of a new bridge across the Mersey delineated a deep channel filled with softer sediments. The traverse in the proposed harbour area indicated compacted sediments or bedrock at shallow depths beneath layers of soft, silty sediments.

Aspen Island, Canberra

In connection with the building of a carrilon, the depth of compact rock (bedrock) was seismically determined at 40 to 60 feet.

Groundwater Resistivity Investigation, Kooweerup, Victoria

The survey disclosed an old sub-surface sandbar near the coast at about 50 feet. From the intertidal coastal area further inland the water quality improves steadily. No evidence of salt water intrusions was found. The survey was also used to make a comparison between various resistivity meters.

Secretariat Building, Canberra

At this site, cavities in the partly decomposed limestone form a serious problem. It was attempted to disclose these cavities by using sonar boomer seismic equipment. The energy source consisted of an electric spark in a drum with water placed on wet ground. Reflections were recorded with a geophone. The resolution of the seismic events was not sufficient to solve the complicated geological structure. Further research in this system is needed.

Seismic Telemeter Stations, Rabaul Observatory, T.P.N.G.

To make the telemeter stations work the seismic velocities in the earth crust have to be measured, and it is desired to obtain data on the earth crust structure in the area. A standard S.I.E. seismic refraction seismograph was used in conjunction with the observatory. 47 charges from 10 to 300 lbs were exploded. Refraction and reflection events were recorded. This was a preliminary survey to determine the limiting conditions of the equipment. Further work is needed.

Vibration Tests, Footscray Ammunition Factory, Victoria

Vibrations were measured on a specially constructed pillar in the Standards Laboratory, and on a jigboring machine. Major vibrations showed amplitudes up to 0.8 micron with frequencies from 20 to 250 cps. Vibrations originate mainly from personnel movements and machinery. Some 1000 cps frequency noise was recorded.

Vibration Test at Lake Bellfield Damsite, Victoria

The tests were carried out to determine the maximum permissable explosive charge to be used to excavate a spillway without damaging the concrete lining of the diversion tunnel. An empirical relation between distance, charge and acceleration (used as a measure for possible damage) was established.

Waterflow through Porous Media, A.A.E.C., Lucas Heights, N.S.W.

The first of a series of flow experiments with iodine 131 as a tracer was carried out. The idea is to improve Darcy's law for various types of media, and to measure the dispersion in flow. Tests will be continued in November, 1966, and in 1967.

Wivenhoe and Middle Creek Damsite, Usk, Queensland

The dams are planned to provide a supplementary water supply for Brisbane. Field work will be completed in November, 1966.

4. REGIONAL SURVEYS

REGIONAL GRAVITY

Regional gravity field work during 1966 is shown on Plate 19.

Pendulum Gravity Measurements

No field work was done during the year.

The Bureau's G.S.I. pendulum apparatus was returned to the manufacturer for re-working of the knife edges of the pendulums and the agate plates of the swinging chamber. The apparatus is due back in Australia at about the end of the year.

The W.P.C.L. (Western Pacific Calibration Line) pendulum survey using the Cambridge pendulum apparatus was postponed because Cambridge University was unable to carry out its commitments to make measurements on the northern portion of the Line. Australia's commitment to make measurements from Tokyo - Manila - Darwin - Brisbane - Melbourne and return will be put on the regional programme for 1967.

Isogal Regional Gravity Survey

Isogal gravity base stations were established at Thursday Island (Horn Island) in Queensland and at Daru in the Territory of Papua and New Guinea in May, 1966, in order to provide control for part of a B.M.R. helicopter gravity survey and to extend the coverage of the Australian National Gravity Network.

Follow-up work on established Isogal stations continued throughout the year in eastern Australia. The station sites were marked with brass discs and in some cases by concrete blocks and brass discs. Local gravity and elevation ties were completed and the stations were pin-pricked on aerial photos where available. Station descriptive data including sketches, photographs and plotting on D.C.A. aerodrome plans were checked and supplemented where necessary.

Preparation of final station descriptive drawings proceeded throughout the year.

Gravity Meter Measurements by Overseas Visitors

Further international gravity ties to Australia and observations within Australia were made by overseas organizations co-operating with the I.U.G.G. in the establishment of the W.P.C.L. and F.O.W.G.N. (First Order World Gravity Network).

Observations by the United States Air Force using 4 internationally calibrated La Coste meters were made from Johannesburg (South Africa) - Perth - Melbourne - Canberra - Sydney - Nadi (Fiji) and return as part of a programme of international east-west ties between calibration lines.

Observations by the Dominion Observatory of Canada using 2 internationally calibrated La Coste meters were made along the W.P.C.L. which includes the Australian east coast calibration chain. Observations were also made from Melbourne - Adelaide - Alice Springs - Darwin and return.

Papuan Ultramafic Belt Gravity Survey

266 new gravity stations were established in the area of the Papuan ultramafic belt in co-operation with a geological field party. Elevations were measured by microbarometer with frequent ties to sea level and gravity observations were made with a low drift rate, geodetic La Coste meter. The locations of the gravity stations are shown in Plate 20.

Using jet boats gravity readings were taken along all rivers from the Mambare to Salamaua to the limit of navigability. A helicopter was used to establish stations between the Owen Stanley Ranges and the sea from Salamaua to Warigela. In many areas, notably in the Boweetu mountains, access was impossible by either boat or helicopter because of dense vegetation and very steep slopes. Readings were taken at approximately 1/3-mile intervals along a foot traverse starting on ultramafic rocks at the top of the Otavia Range and crossing gabbroic intrusive rocks and basic volcanics between there and Ioma.

Very large gravity anomalies are associated with the ultramafic rocks and very steep gravity gradients with the Owen Stanley Fault Zone.

Regional Gravity Traverses, Southern N.S.W.

Gravity traverses were run along roads in southern N.S.W. to provide control for the 1966 helicopter gravity training survey. Two gravity meters were read side-by-side during most of the survey in order to provide meter performance data.

Gravity values are based on Isogal stations in the areas and adjusted for loop closure. Accurate elevations for most of these stations are available. Elevations for the remainder will be obtained during follow-up work on the helicopter survey.

The traverses and loop closures are shown in Plate 21.

Regional Gravity Connections, S.W. Queensland

Gravity observations were made at benchmarks along National Mapping contract3rd order level traverses in south-west Queensland. The positions of these benchmarks were identified on air photos. Gravity and elevation ties were made to stations of the 1962 experimental helicopter heighting and gravity survey to provide control for the final computation of the results of that survey. Ties were also made to other surveys in the areas in order that these can be re-computed to recent datum values.

Automatic Computing Procedures

A programme system GRAVHTS has been developed and is now operational on the C.S.I.R.O. CDC 3600 computer. A complete suite of programmes is now available to replace all manual computations of Bouguer anomalies from raw field data. Observed gravities and elevations are

calculated and adjusted by the method of least squares. Final values are stored on magnetic tape which can be further updated by a peripheral programme. Another programme will accept input at stages other than the raw field data (in this way existing hand-computed results can be taped). Free air and Bouguer anomalies are computed from the magnetic tape.

An interpretative programme has been developed to calculate residual anomalies.

The 1966 helicopter gravity training survey was the first gravity survey to be completely reduced using automatic computing data processing. Final computation of the 1962 helicopter gravity survey has been carried out. Processing of the 1960 and 1961 surveys is proceeding.

Gravity Meter Performance Tests

Some additional gravity meter performance data was acquired during the year during various field surveys. Completion of laboratory tests is programmed for the period December, 1966 - February, 1967.

Tests directed at operating La Coste G104 at a temperature lower than that recommended were carried out. Some modifications were made to this meter, which has been purchased by the Antarctic Division for glaciological work.

Earth-Tide Recording

Because of a shortage of staff none of this work was carried out during the year.

Gravity Map of Australia

Production of free air and Bouguer anomaly maps of Australia incorporating all available gravity data computed to compatible datum values (May, 1965 Isogal values) has commenced. The project will take several years to complete and will use data obtained by A.D.P.

REGIONAL MAGNETIC SURVEYS

Isogonic maps of Antarctica were completed and issued as a Record.

A portable fluxgate variograph was completed and tested. It proved to be very temperature sensitive and will require some modification.

Two compass swinging sites at Sydney Airport were surveyed for QANTAS.

A re-occupation survey of 35 first order sites was commenced in September.

A start was made on investigating the induction problem of the oceans by numerical methods.

Palaeomagnetic Group

Some rock samples from New Guinea were measured, but showed great scatter in directions before washing. The group was transferred to the Airborne Section in March, 1966.

Upper Mantle Project - Aeromagnetic

At the conclusion of the Laverton - Edjudina airborne survey in Western Australia in August, 1966, the VH-MIN survey party flew a series of parallel aeromagnetic traverses, one mile apart, from the Swan River on the outskirts of Perth to 11 miles east of Merredin (Plate 22). This work was requested by the Director of the Western Australian Geological Survey as a contribution to an Upper Mantle Project sponsored by the Australian National University and others. This project is to investigate in detail a zone 10 miles wide along a line from Perth through Kalgoorlie to Balladonia, over the oldest portion of the West Australian Precambrian Shield. Investigations will include a 'geotraverse' of the zone and various geophysical, geochemical and geological investigations, including drilling to a probable maximum depth of 1000 feet.

The object of the airborne traverses was to complete the aeromagnetic coverage of the western leg of the zone, and eight traverses were flown at 500 feet above ground level to conform with previous surveying. In addition to the magnetometer, two scintillometers were operated along these traverses. Two of the traverses were reflown at a barometric altitude of 8500 feet above sea-level in order to investigate deeper geological phenomena by decreasing the masking magnetic effect of detailed surface irregularities.

Reduction of data and interpretation of these magnetic traverses will commence in December, 1966.

5. OBSERVATORIES

Headquarters (Canberra)

Scaling and preparation of geomagnetic results from all observatories continued. The scaling machine was out of service until the end of June. During that time a 4096-bit coding disc was installed to replace the 1024-bit disc previously used. Since the end of June scaling has proceeded at the rate of about 1 observatory year per month.

Members of the Observatory Groups took part in the field parties for Projects BUMP and CRUMP, seismic experiments in Bass Strait and off the coast of Queensland respectively.

The analysis of geomagnetic diurnal variation for the I.G.Y. continued.

The investigation of T-phases recorded at Macquarie Island was completed and the results submitted for publication.

Mundaring Observatory

Recording with World Standard and Benioff seismometers continued at Mundaring. The Willmore seismometer continued in operation at Kalgoorlie.

Recording with the Lacour magnetograph continued at Gnangara. It was standardized weekly. A loop inductometer at Mundaring was operated on Regular World Days.

Swarms of small tremors at Arthur River and at Talbot Bridge were investigated.

Signals from explosions (of the order of 300 lbs.) detonated by WAPET and in the construction of a harbour at Kwinana were recorded at several field locations to improve the knowledge of crustal structure of Western Australia.

Recording with the Cossor ionosonde continued.

Port Moresby Observatory

Recording with the World Standard, and other, seismographs was continued.

The programme of surface wave phase velocity determination was continued. The recorder at Popondetta was transferred to Kerema and another recorder installed at Daru, making a four element network consisting of Port Moresby, Tapini, Kerema and Daru.

A wide band seismometer was installed by the Department of Terrestrial Magnetism in July. This is part of a programme to investigate the distortion of shear waves in the upper mantle by comparison of SKP signals from South American earthquakes as recorded in South America and in New Guinea.

Recording with normal and rapid-run Lacour magnetographs continued. They were standardized weekly. A proton magnetometer was adopted as the primary standard of magnetic intensity.

Recording with the I.P.S. ionosonde continued.

Melbourne Observatory Group

The recording programme in seismology and geomagnetism continued at Toolangi, Macquarie Island, Mawson and Wilkes using the instruments listed below:

Toolangi:	Benioff short-period seismometers Columbia long-period seismometers Lacour magnetograph
Macquarie Island:	Benioff vertical seismometer Lacour normal-run magnetograph Lacour rapid-run magnetograph
Mawson:	Benioff short-period vertical seismograph Benioff medium-period horizontal seismographs Lacour normal magnetograph Lacour low sensitivity magnetograph Selzer bar-fluxmeter
Wilkes:	Grenet short-period vertical seismograph Columbia long-period seismometers Ruska normal magnetograph Ruska rapid-run magnetograph

Magnetographs were standardized at least once a week.

Signals from a vertical seismometer at Melbourne Observatory were recorded by a helicopter in the Melbourne office to give immediate information about earthquakes.

Darwin Seismic Observatory

A three component short-period Willmore seismometer is normally in operation in Darwin. However, the N-S component was on loan to Head Office for use in operation BUMP for three months (February to April) and has been on loan again since 23rd August for use in operation CRUMP. The V component has been on loan to Mundaring Geophysical Observatory since 9th May.

Provisional bulletins were issued regularly, usually twice a week. ISRC data were sent to Head Office for card punching and forwarding to Edinburgh.

6. LABORATORIES

Design and Development Group

The year's work was hindered by the move from Melbourne and by staff shortage.

Some months were spent on improving the design and reliability of the airborne proton magnetometer and associated equipment in VH-GEO.

A three component fluxgate magnetometer for regional magnetic surveys was completed and is fully operative. A temperature effect in one component is still under investigation. The handbook for this instrument was completed.

A single component fluxgate magnetometer was modified and installed for the Ionospheric Prediction Service in Sydney. A handbook was also completed for this instrument.

A fluxgate magnetometer calibrating unit was designed and constructed.

Development was completed of a system to synchronize the marine seismic spark array recorder with an external timing source. System design was commenced for application of spark array equipment to common depth point methods.

The group was involved in design, installation and operation of timing equipment for Projects BUMP and CRUMP.

A new rate meter for the Widco 500 ft logger was designed.

Work continued on the design of a digital magnetic observatory system.

A proposed magnetic and general purpose test site in the Kowen Forest was investigated and found to be satisfactory.

Design of a new digital recording system for installation in VH-MIN was commenced. This involved an investigation into the use of printed circuits which are likely to find increasing use in BMR equipment.

A ground station proton magnetometer built to BMR design by contract was tested and several faults corrected. Work on upgrading this unit is in progress.

An experimental proton magnetometer detector was constructed for airborne use. This detector is to be used with a preamplifier mounted in the towed bird. Final design is not yet complete.

Other tasks for the year included the design of a pulsing system for the helicopter gravity camera; the design of a sweep generator and high voltage amplifier for density recording on a Speedomax recorder; investigation of remote pressure measurement using mechanisms barometers; training of operators for VH-GEO; and modifications of an oscilloscope amplifier for the Central Playback Office.

Technical advice was given to various sections on numerous matters.

Maintenance and Testing Group

Setting up of facilities for the group following the move from Melbourne, has progressed slowly and is still not complete. Remoteness of suppliers of materials and services has created some difficulties and delays in maintaining instruments.

Equipment was prepared for field parties as required, although there were some delays.

Instruments were prepared for the BUMP and CRUMP projects, a camera constructed for the Helicopter Gravity Group, well logging equipment installed in a new vehicle, the towed bird scintillometer in the DC-3,

VH-MIN, was replaced, and modifications to the magnetogram scaler were completed for the Observatory Group.

Other Branches and Sections within the Bureau have found that the Group has facilities and skills useful to them and several small jobs have been done for them. This service has been put on an official basis and forms for other Branches requesting services are now in use.

7. WORKSHOPS

New equipment was constructed and existing units were modified and repaired as necessary by the Geophysical Workshops. Their output was curtailed by loss of staff - all instrument making staff except the Foreman and the Senior Instrument Maker resigned before the Branch moved from Melbourne to Canberra - and by a long delay while the Department of Works installed and connected the workshop machine tools in the new workshops.

Several new machines have been installed, during the year. Recruiting of instrument makers was partly successful in that half the positions of instrument maker are now filled.

As was the case in the laboratories, the workshops can provide services and skills not available in other Branches of the Bureau, and a number of jobs has been done for them. The call on these services is likely to increase.

FLINDERS RIVER, QLD SEISMIC SURVEY 1966

PLATE 1

5 0 5 10 15 20 25 30 35 40 45 MILES

5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 KILOMETERS

142°00

20°00'

143°00'

143°45'

"LARA DOWNS"

FLINDERS

Saxby River

Express Creek

"ELMORE"

"RUNNYMEDE"

"LINDFIELD"

RIVER

Julia Creek

JULIA CREEK

GREAT NORTHERN RAILWAY

TRAVERSE D

Nelia

LANDSBOROUGH

TRAVERSE D

Talmoi

HIGHWAY

Gemoka

Alick Creek

Rupert Creek

21°00

"HELEN DOWNS"

"ROSEVALE"

"GLENBERVIE"

"CLARAFIELD"

"HANWORTH"

142°00

"DOORKE"

N

"BURLEIGH"

Stowell

WOOLGAR ROAD

RICHMOND ROAD

"WALKER PARK"

"COALBROOK"

River

or

"STAWELLTON"

Cambridge Cr

SP227

SP200 "RICHMOND DOWNS"

Dutton River

SP183

SP175

B.M.R. Camp

RICHMOND

SP150

SP146

SP133

Moselle

FLINDERS RIVER HIGHWAY

LANDSBOROUGH

"MARATHON"

Barabon

Marathon

Mumu

Duniuce

O'Connell

Traverse A

Creek

Glenalvon H.S.

SP100

Rowen Lynn No. 2 Bore

WINTON ROAD

Creek

Warianna Creek

STAMFORD

PLATE ~~3~~2

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics K55/B1-32

To Accompany Record No

PLATE 3

1966
Sedimentary Gravity

A – Helicopter Gravity Training Survey.

B – Helicopter Gravity (By Contract) (as at 14-10-66)

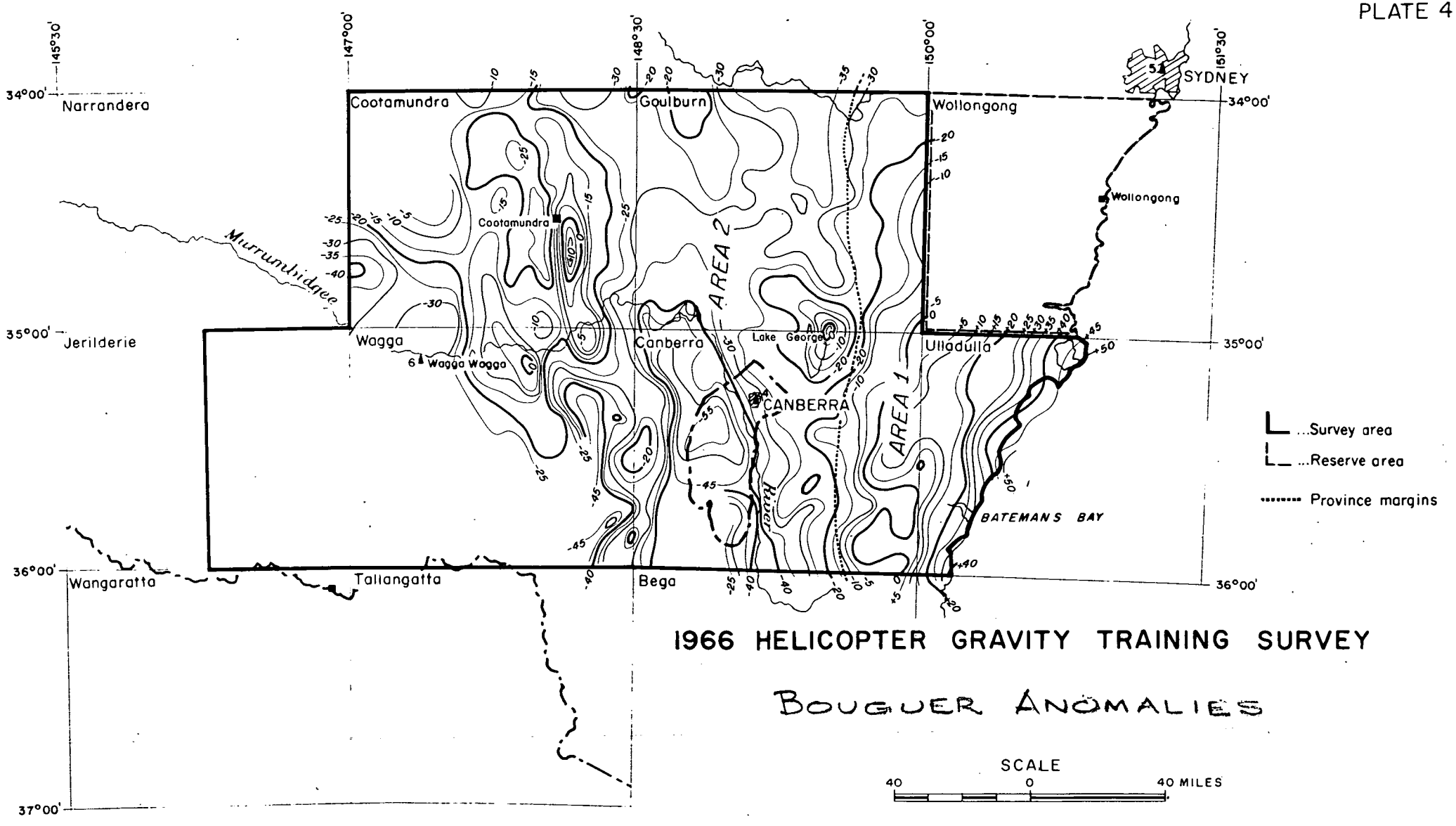
C – Helicopter Gravity (By Contract) (to be completed, as at 14-10-66)

– Covered by Surveys

NMP/59/151-1

G112-5

PLATE 4



1966 HELICOPTER GRAVITY TRAINING SURVEY

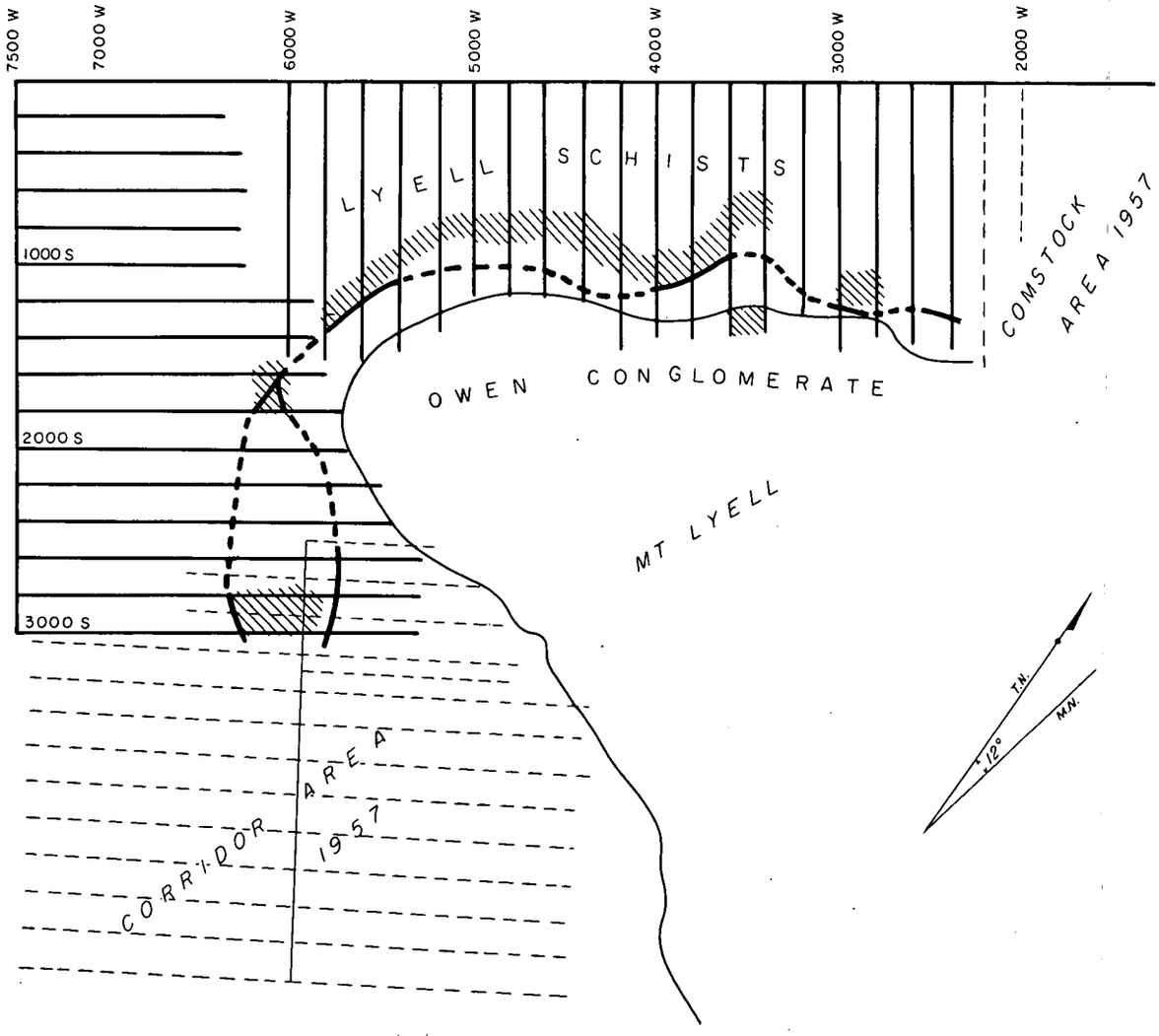
BOUGUER ANOMALIES

SCALE

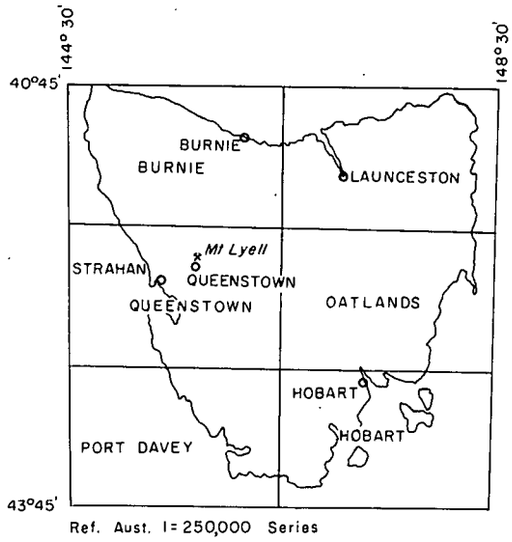
40 0 40 MILES

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G442-6

PLATE 5



FEET
500 0 1000



Ref. Aust. 1=250,000 Series

BMR GEOPHYSICAL SURVEY

CAPE HORN AREA

QUEENSTOWN, TAS.

LOCALITY MAP AND GEOPHYSICAL INDICATIONS

LEGEND

Traverse surveyed by any geophysical method 1966

Traverse of previous BMR Survey

WEAK — STRONG Axis of Turam Anomaly

Zone of IP Anomaly

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G442-2

TO ACCOMPANY RECORD No.

PLATE 6

10,000 E
20,000 E
30,000 E
40,000 E
50,000 E
60,000 E

60,000 N
50,000 N
40,000 N
30,000 N
13° 0'
20,000 N
10,000 N
0
10,000 S
20,000 S
30,000 S

North Australia Railway
to Darwin
to Darwin

Rum Jungle Granite
Rum Jungle Granite
Waterhouse Granite

Giant's Reef Fault

1965 SURVEY
WOODCUTTERS

Highway

L3 AREA
1966 Geophysical
test survey

Stuart

L5 AREA
1966 Geophysical test survey

HUANDOT NORTH 1966
IP Test traverse

COOMALIE GAP WEST 1966
IP Test traverse

COOMALIE GAP WEST
1965

Coomalie Creek

Batchelor

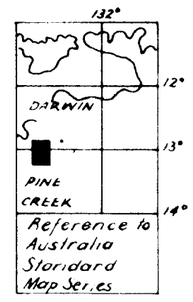
Finniss River

GOULD 1965 SURVEY

1966 SURVEY

Mt Minza area
1965

WATERHOUSE
1966



True North

LOCALITY MAP

GEOPHYSICAL AND GEOCHEMICAL SURVEYS

1965-1966

RUM JUNGLE AREA, NT

Scale

1 0 1 2 MILES

TEP Mine Grid

Bureau of Mineral Resources Geology and Geophysics, Darwin 1965

(D52/B7-181)

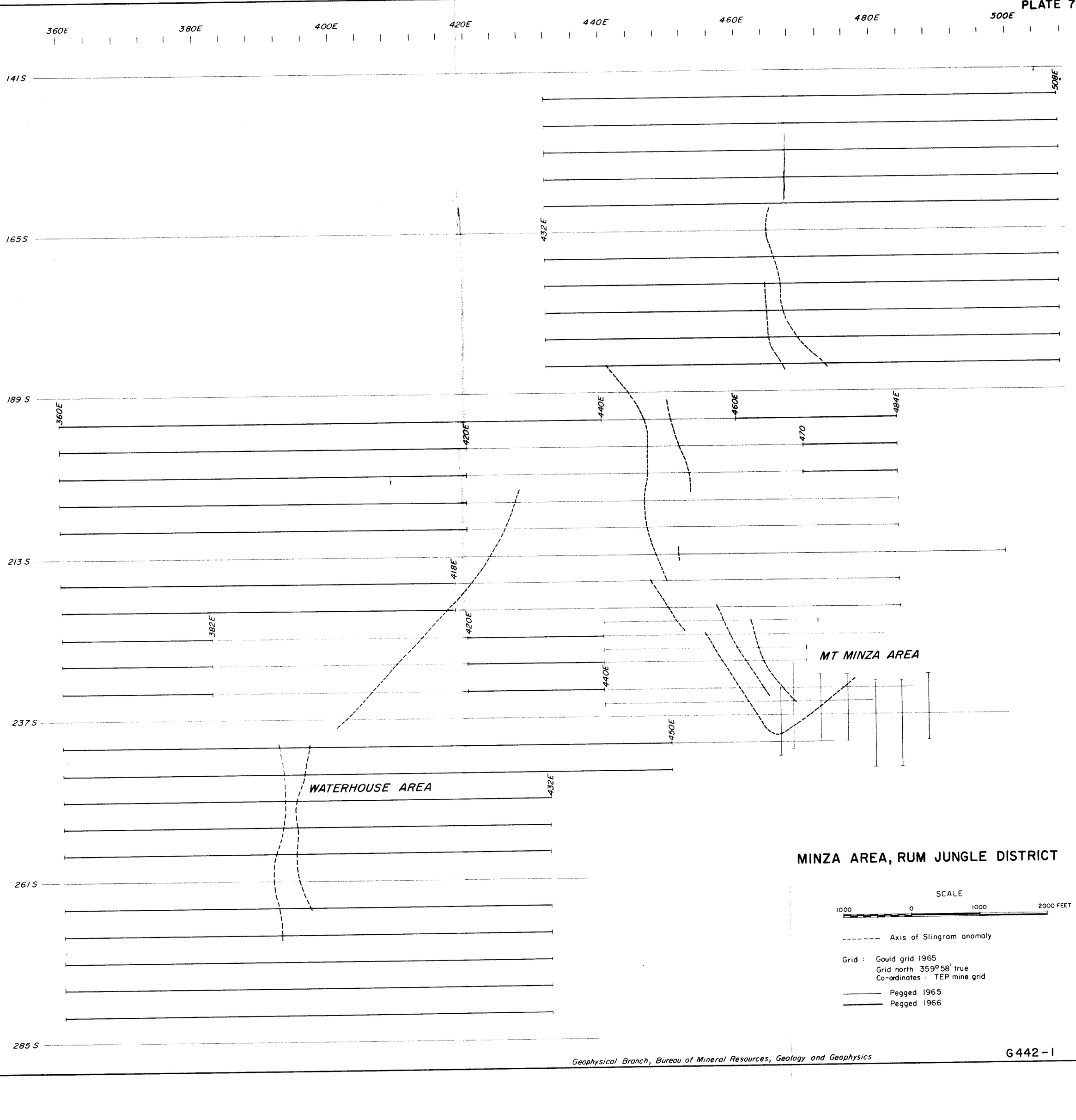
G442-3

TO ACCOMPANY RECORD No

D52/B7-181

G442-3

PLATE 7



MINZA AREA, RUM JUNGLE DISTRICT

SCALE

1000 0 1000 2000 FEET

------- Axis of Slingram anomaly

Grid : Gould grid 1965
Grid north 359°58' true
Co-ordinates : TEP mine grid

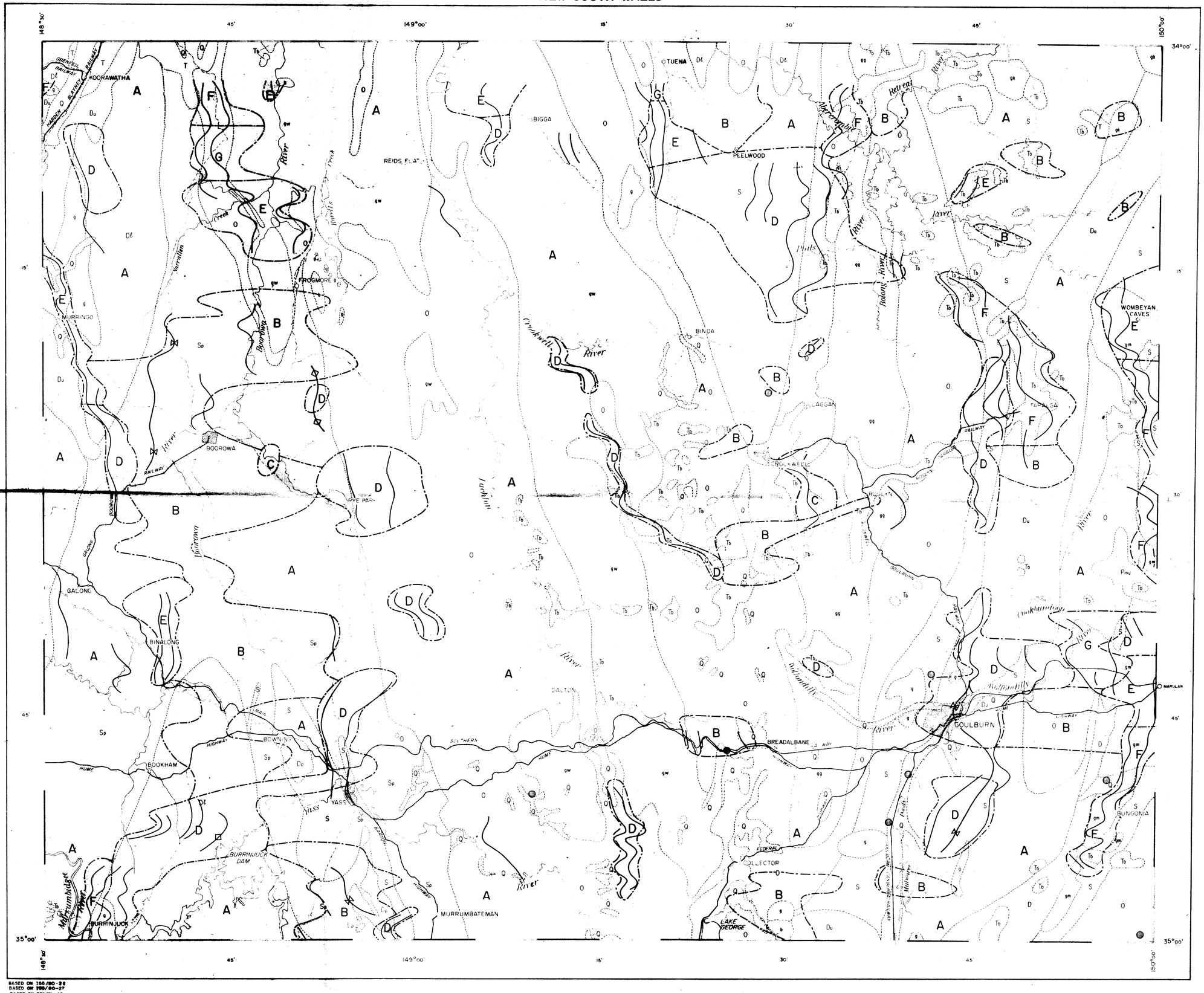
——— Pegged 1965
——— Pegged 1966

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

G442-1

AUSTRALIA 1:250,000

GOULBURN
NEW SOUTH WALES



BASED ON 155/BI-38
BASED ON 155/BI-47
BASED ON 155/BI-48

GEOLOGICAL LEGEND

CAINOZOIC	QUATERNARY	Q	Alluvial gravel, sand, silt, clay.
	TERTIARY	Tb	Volcanics, mainly basalt.
		T	Undifferentiated sediments, mainly continental
PALAEOZOIC	PERMIAN	Pmu	Conglomerate, sandstone. Shoalhaven Group
	DEVONIAN	Du	Upper Devonian. Conglomerate, quartzite, sandstone, clayshale, mudstone.
		Dl	Middle to Lower Devonian. Lavas, tuff, conglomerate, limestone, andesite. Murrumbidgee and Black Range Series
		Dp	Quartz felspar porphyry, rhyolite, agglomerate
		D	Undifferentiated strata mainly marine
	SILURIAN	S	Slate, quartzite, shale, sandstone, limestone tuff, conglomerate and lavas.
		Sp	Quartz felspar porphyry, lavas.
	ORDOVICIAN	O	Slate, shale, sandstone, quartzite, siltstone tuff, andesite and limestone.

IGNEOUS

g	Mainly granite, granodiorite and granite porphyry
gg Goulburn batholith / gw Wyangala batholith	Granite, granodiorite and granite porphyry
gm Koninbla batholith / gk Marulan batholith	Granite, granodiorite and granite porphyry
b	Basic intrusives

Geological boundary

Approximate position of iron ore deposits

TOPOGRAPHICAL LEGEND

River or creek
Highway
Secondary road
Road or track
Railway
Built-up area
Named place
Railway station

GEOPHYSICAL LEGEND

Magnetic trend
Zone boundary
Syncline
Anticline

LOCATION DIAGRAM

INDEX TO ADJOINING SHEETS

FORBES	BATHURST	SYDNEY
COOTA-MUNDRA	GOULBURN	WOLLONGONG
WAGGA	CANBERRA	BEGADULLA

AIRBORNE SURVEY, GOULBURN, NSW, 1965

GEOPHYSICAL INTERPRETATION
AND
GEOLOGY

MILES 5 0 5 10 15 20 MILES

KILOMETRES 5 0 5 10 15 20 25 30 KILOMETRES

Topography after 1:250,000 scale map Royal Australian Survey Corps.
Geology after Geological Map of New South Wales, Geological Survey of New South Wales, Division of Regional Geology, 1962.
Transverse Mercator Projection.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics
To Accompany Record No 1966/65

AUSTRALIA 1:250,000

COPLEY
SOUTH AUSTRALIA

PLATE 9

LEIGH CREEK

18,400 20,800 20,400 20,000 18,500 17,500 16,000 17,000 16,000 16,600 17,300 17,000

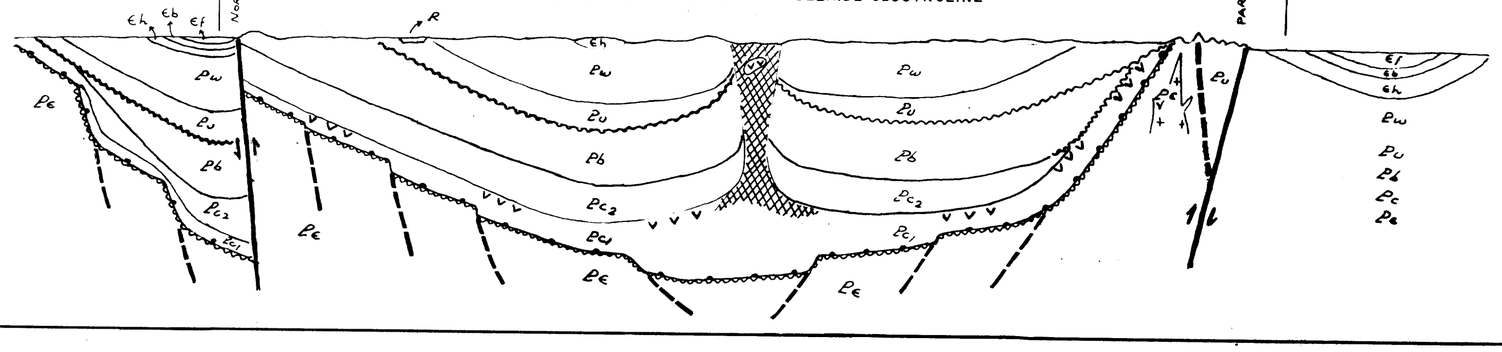
23,000 23,000 23,000

18,200 18,000 22,200 20,700 17,600 21,000

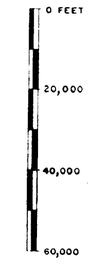
GEOLOGICAL LEGEND

- R TRIASSIC
- Ef LAKE FROME GROUP
- Eb BILLY CREEK FORMATION
- Eh HAWKER GROUP
- Pw WILPENA GROUP
- Pu UMBERATANA GROUP
- Pb BURRA GROUP
- Pc1,2 CALLANNA BEDS
- Pε OLDER PRECAMBRIAN
- UNCONFORMITY
- PROBABLE HINGE LINE
- FAULT
- PROBABLE DECOLLEMENT
- + GRANITES UNDIFFERENTIATED
- v VOLCANICS
- BASICS UNDIFFERENTIATED
- APPROX. LIMIT OF METAMORPHISM
- DIAPIRIC STRUCTURE

IDEALISED W-E SECTION OF THE ADELAIDE GEOSYNCLINE

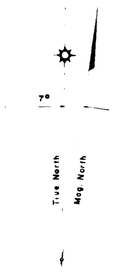


VERTICAL SCALE



BASED ON H54/80-13 BASED ON H54/81-38 BASED ON H54/81-39

LOCATION DIAGRAM



INDEX TO ADJOINING SHEETS

CURDIMURKA	MARREE	CALLABONNA
ANDAMOOKA	COPLEY	FROME
TORRENS	PARACHILNA	CURNAMONA

GEOLOGICAL AND PLANIMETRIC MAPPING, REF. No 66-206/6 COMPILED AND DRAWN BY DEPARTMENT OF MINES, SOUTH AUSTRALIA

AIRBORNE SURVEY, CENTRAL SOUTH AUSTRALIA, 1966

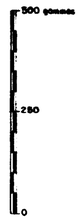
TOTAL MAGNETIC INTENSITY PROFILES

MAGNETIC INTERPRETATION AND GEOLOGY

5 0 5 10 15 20 MILES

5 0 5 10 15 20 25 30 KILOMETRES

APPROX. PROFILE SCALE



GEOPHYSICAL LEGEND

- MAGNETIC TREND-SHALLOW SOURCE
- MAGNETIC TREND-DEEP SOURCE
- ZONE OF SMALL MAGNETIC ANOMALIES
- ZONE OF NEGATIVE MAGNETIC ANOMALIES
- 2000 BASEMENT DEPTH ESTIMATE CORRECTED FOR MAGNETIC STRIKE. DEPTH IN FEET BELOW SEA LEVEL.

EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A DC-3 AIRCRAFT AT AN ALTITUDE OF 500 FEET ABOVE GROUND LEVEL ALONG LINES SPACED ONE MILE APART. THE FLIGHT-LINES ARE IDEALISED, AND SERVE AS BASELINES TO THE PROFILES. THEY APPROXIMATE THE ACTUAL FLIGHT PATH WITH A PROBABLE ERROR OF ± 1 MILE.

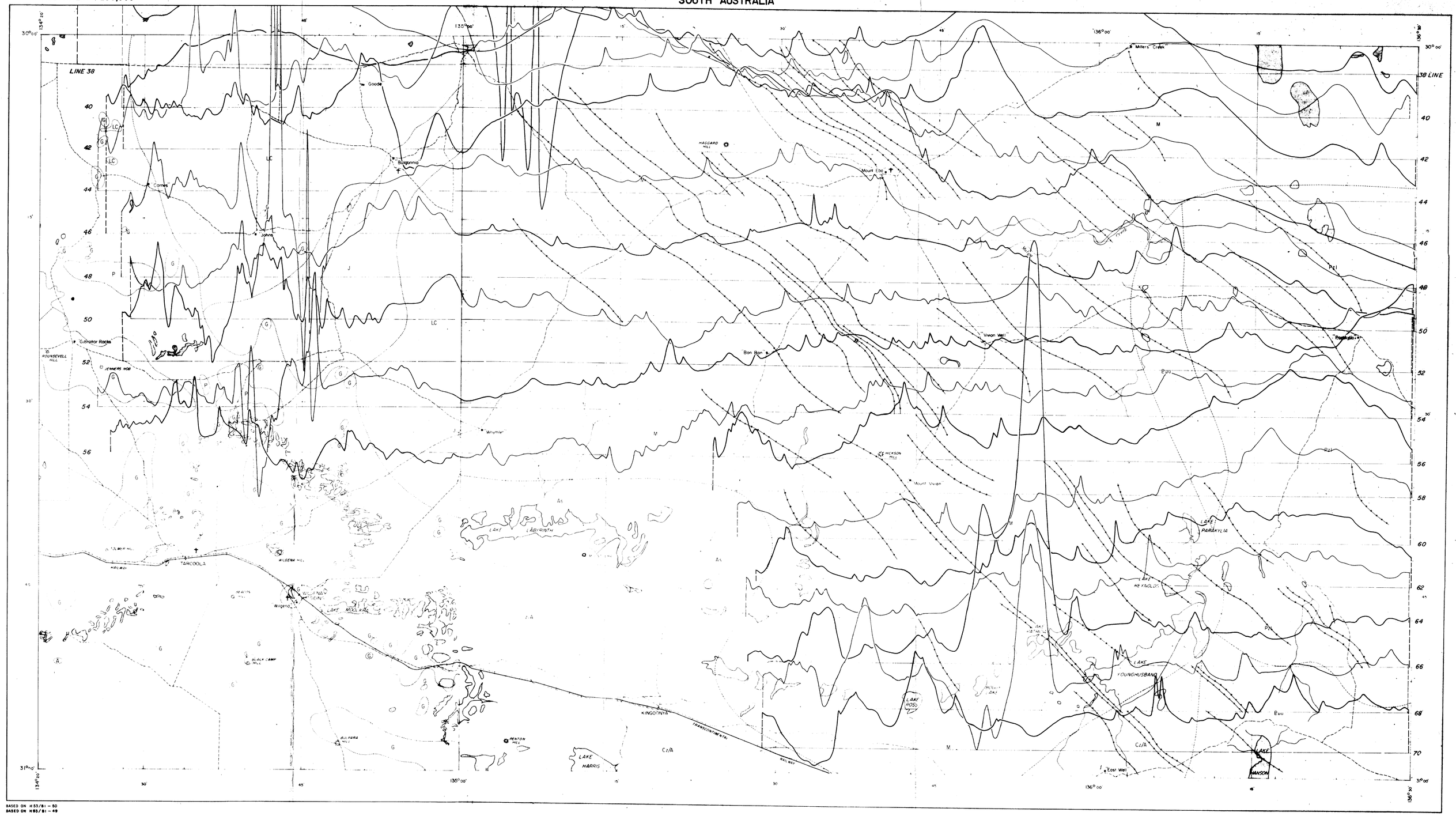
PROFILES RECORDED AT INTERVALS OF 4 MILES ARE SHOWN ON THE MAP.

THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 8.9 GAMMAS PER MILE.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H54/81-41

AUSTRALIA 1:250,000

TARCOOLA – KINGOONYA
SOUTH AUSTRALIA



BASED ON H53/B1 – 50
BASED ON H53/B1 – 49
BASED ON H53/B0 – 10
BASED ON H53/B0 – 11

AIRBORNE SURVEY, CENTRAL SOUTH AUSTRALIA, 1966

TOTAL MAGNETIC INTENSITY PROFILES
MAGNETIC INTERPRETATION AND GEOLOGY

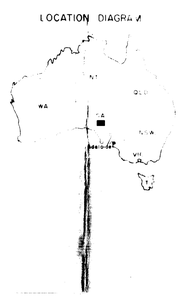
GEOLOGICAL LEGEND

TARCOOLA		KINGOONYA	
LC	MESOZOIC LOWER CRETACEOUS	M	MESOZOIC
J	JURASSIC (?)	Pzl	LOWER PALAEOZOIC
P	PROTEROZOIC	Puu	UPPER UPPER PROTEROZOIC
A	ARCHAEAN	Cz/A	UNDIFFERENTIATED ARCHAEAN
	IRONSTONE	As	ARCHAEAN
G	GRANITE, GNEISS ETC	.....	Geological boundary
P	PORPHYRY		
------	Geological boundary		

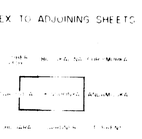
PLANIMETRIC MAPPING AFTER 1:250,000 SCALE MAP OF TARCOOLA SH 53-10, EDITION 1 BY ROYAL AUSTRALIAN SURVEY CORPS. TRANSVERSE MERCATOR PROJECTION. GEOLOGY AFTER 1:253,440 SCALE GEOLOGICAL AND ACCESS PLAN OF TARCOOLA REF. NO. 59-129 BY SOUTH AUSTRALIAN DEPARTMENT OF MINES.

PLANIMETRIC MAPPING AFTER 1:253,440 SCALE MAP OF KINGOONYA BY ROYAL AUSTRALIAN SURVEY CORPS, 1948. TRANSVERSE MERCATOR PROJECTION. GEOLOGY AFTER TECTONIC MAP OF AUSTRALIA.

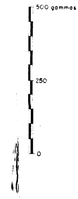
LOCATION DIAGRAM



INDEX TO ADJOINING SHEETS



APPROX. PROFILE SCALE



TOPOGRAPHICAL LEGEND

- Road or track
- Railway with siding
- Railway station
- Homestead
- Aerodrome or landing ground

GEOPHYSICAL LEGEND

- Magnetic trend

EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A DC-3 AIRCRAFT AT AN ALTITUDE OF 500 FEET ABOVE GROUND LEVEL. ALONG LINES SPACED TWO MILES APART. THE FLIGHT-LINES ARE IDEALISED AND SERVE AS BASELINES TO THE PROFILES. THEY APPROXIMATE THE ACTUAL FLIGHT PATH WITH A PROBABLE ERROR OF ± ½ MILE.

PROFILES RECORDED AT INTERVALS OF 4 MILES ARE SHOWN ON THE MAP.

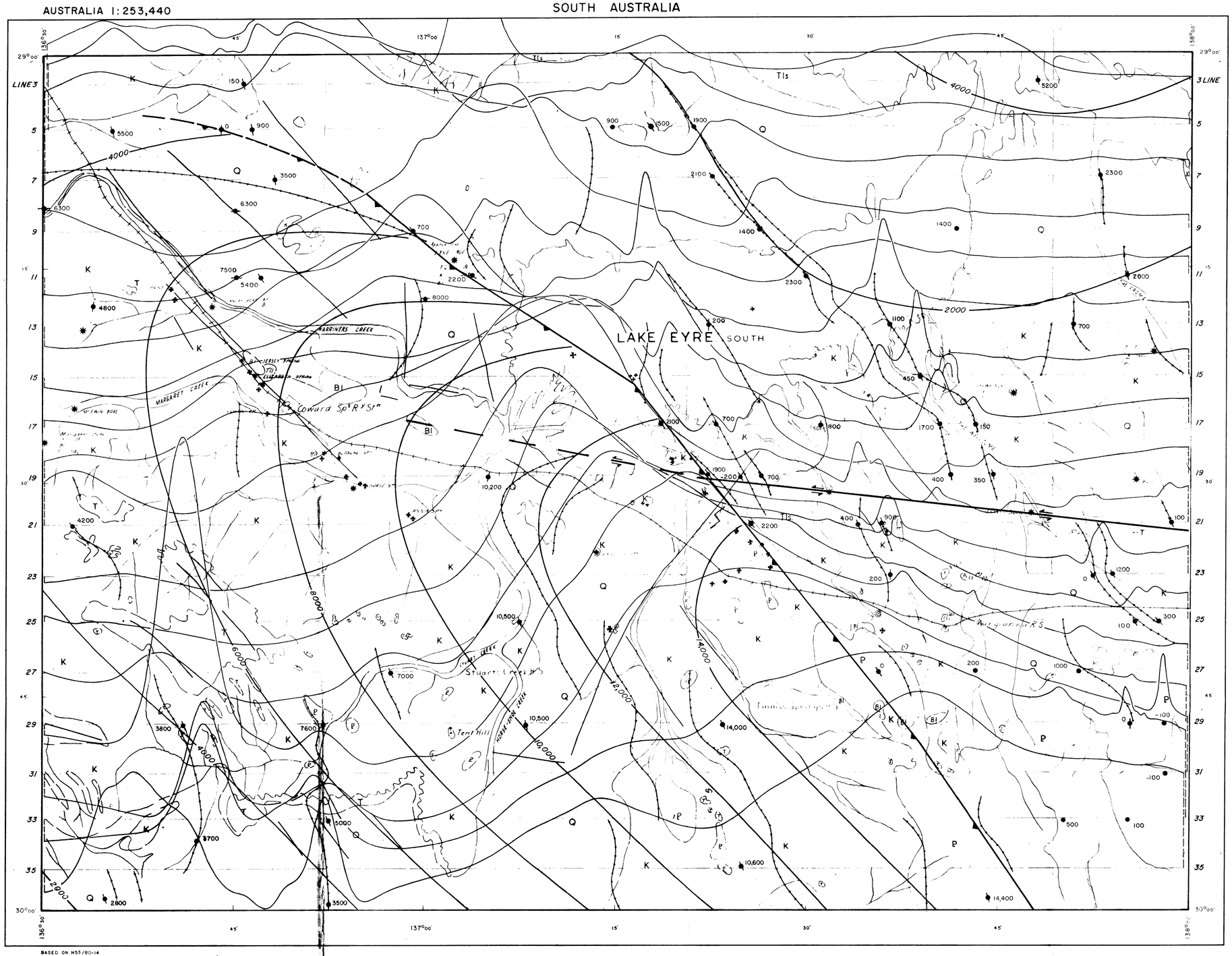
THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 9·0 GAMMAS PER MILE.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics **H53/BI-58**

CURDIMURKA

SOUTH AUSTRALIA

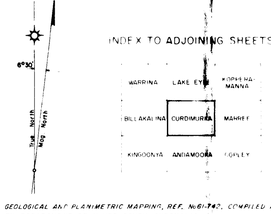
AUSTRALIA 1:253,440



BASED ON H53/BO-14
BASED ON H53/BI-53
BASED ON H53/BI-54

LOCATION DIAGRAM

INDEX TO ADJOINING SHEETS



GEOLOGICAL AND PLANIMETRIC MAPPING, REF. No. BI-747, COMPILED AND DRAWN BY DEPARTMENT OF MINES, SOUTH AUSTRALIA

AIRBORNE SURVEY, CENTRAL SOUTH AUSTRALIA, 1966

TOTAL MAGNETIC INTENSITY PROFILES
MAGNETIC INTERPRETATION
AND
GEOLOGY

4 0 4 8 12 16 20 MILES

5 0 5 10 15 20 25 30 KILOMETRES

APPROX. PROFILE SCALE

500
250
0

EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A DC3 AIRCRAFT AT AN ALTITUDE OF 1500 FEET ABOVE SEA LEVEL ALONG LINES SPACED TWO MILES APART. THE FLIGHT-LINES ARE IDEALISED, AND SERVE AS BASELINES TO THE PROFILES. THEY APPROXIMATE THE ACTUAL FLIGHT PATH WITH A PROBABLE ERROR OF ± ¼ MILE.

PROFILES RECORDED AT INTERVALS OF 4 MILES ARE SHOWN ON THE MAP. THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 9·1 GAMMAS PER MILE.

GEOLOGICAL LEGEND

- Q — Quaternary: alluvium, sandridges
- Tls — Tertiary: dolomite, limestone
- T — Tertiary: Eyrian?
- K — Cretaceous: shale, with minor limestone, sandstone
- Bl — Blythesdale group: sandstone
- P — Lake Eyre System: sites, plants, etc.
- Dip of bedding
- Escarpment
- Old strandline
- Spring
- Watercourse, usually dry
- Permanent waterhole
- Bore Hole

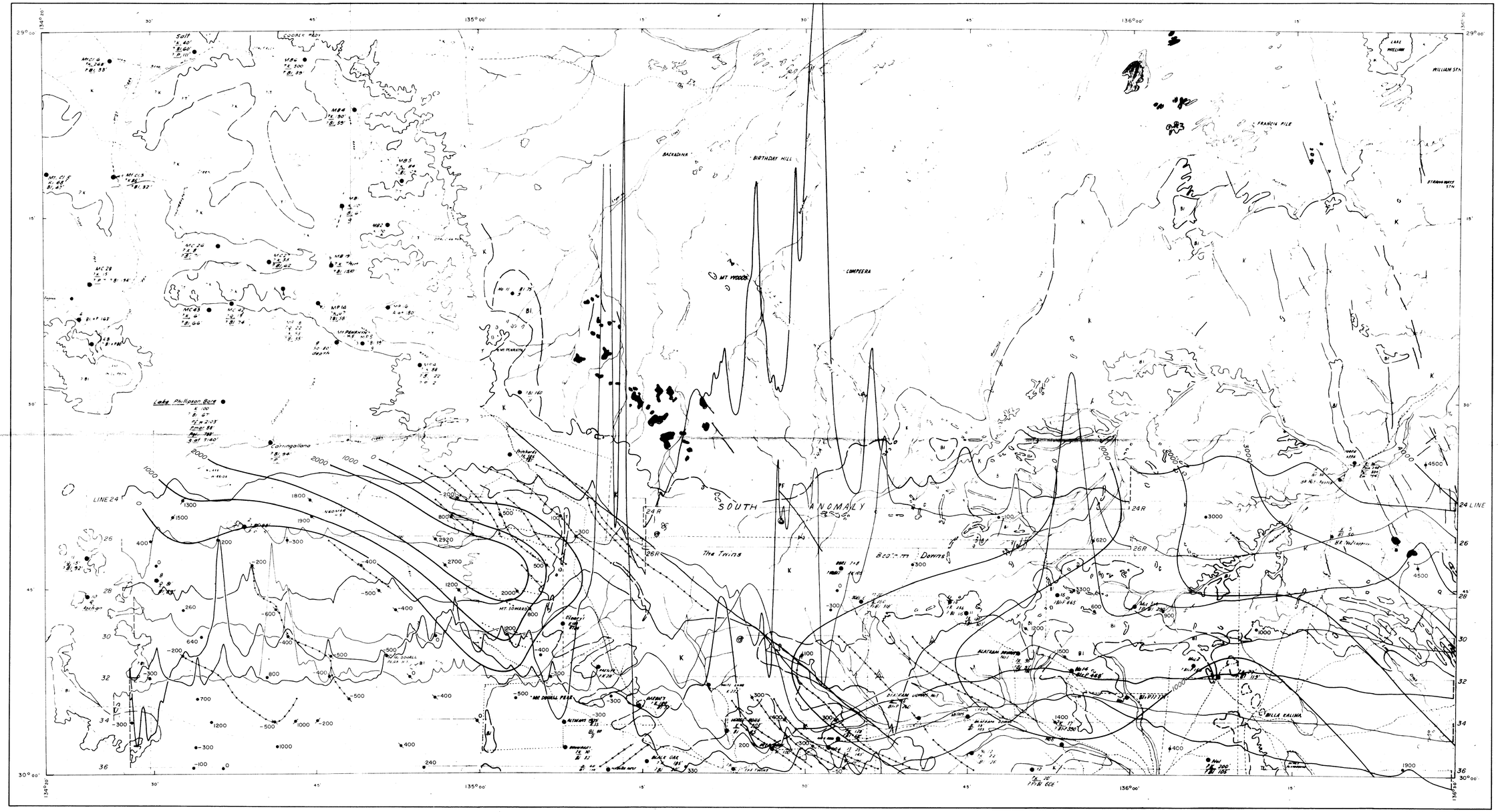
GEOPHYSICAL LEGEND

- MAGNETIC TREND
- FAULT VERTICAL MOVEMENT (BARB POINTS TO DOWNTHROW)
- FAULT TRANSCURRENT MOVEMENT
- 7000 — BASEMENT DEPTH CONTOUR
- 2000 — BASEMENT DEPTH ESTIMATE CORRECTED FOR MAGNETIC STRIKE. DEPTH IN FEET BELOW SEA LEVEL
- • 2000 — BASEMENT DEPTH ESTIMATE UNCORRECTED FOR MAGNETIC STRIKE. DEPTH IN FEET BELOW SEA LEVEL
- – 200 — DEPTH IN FEET ABOVE SEA LEVEL

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H53/BI-5

AUSTRALIA 1:253,440

COOBER PEDY–BILLAKALINA
SOUTH AUSTRALIA



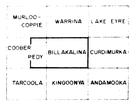
GEOLOGICAL LEGEND

Q	Quaternary alluvium, sandridges
T ℓs	?Pliocene fresh-water limestone
T	Tertiary duricrust
K	Cretaceous shales
Bl	?Blythesdale Group ("Jurassic") sandstone
P	Permian beds
Pfw	Permian "fresh-water" beds
Pma	Permian "marine" beds
Pgl	Permian "glacial" beds
g	Granite
gn	Gneiss
sch	Schist
A	Archaean
	Precambrian
	Lineament
F	Fault

BASED ON H53/80-12
BASED ON H53/80-13
BASED ON H53/81-47
BASED ON H53/81-48

LOCATION DIAGRAM

INDEX TO ADJOINING SHEETS

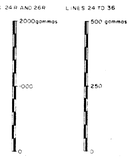


GEOLOGICAL AND PLANIMETRIC MAPPING, SET Nos 61-737 AND 61-74 COMPILED AND DRAWN BY DEPT OF MINES, SOUTH AUSTRALIA

AIRBORNE SURVEY, CENTRAL SOUTH AUSTRALIA, 1966

TOTAL MAGNETIC INTENSITY PROFILES
MAGNETIC INTERPRETATION AND GEOLOGY

APPROX. PROFILE SCALES



GEOPHYSICAL LEGEND

	MAGNETIC TREND
2000	BASEMENT DEPTH CONTOUR
✕ 2000	BASEMENT DEPTH ESTIMATE CORRECTED FOR MAGNETIC STRIKE. DEPTH IN FEET BELOW SEA LEVEL
● 2000	BASEMENT DEPTH ESTIMATE UNCORRECTED FOR MAGNETIC STRIKE. DEPTH IN FEET BELOW SEA LEVEL
−200	DEPTH IN FEET ABOVE SEA LEVEL

EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A DC3 AIRCRAFT AT AN ALTITUDE OF 500 FEET ABOVE GROUND LEVEL ALONG LINES SPACED TWO MILES APART. THE FLIGHT-LINES ARE IDEALISED, AND SERVE AS BASELINES TO THE PROFILES. THEY APPROXIMATE THE ACTUAL FLIGHT PATH WITH A PROBABLE ERROR OF ± ½ MILE.

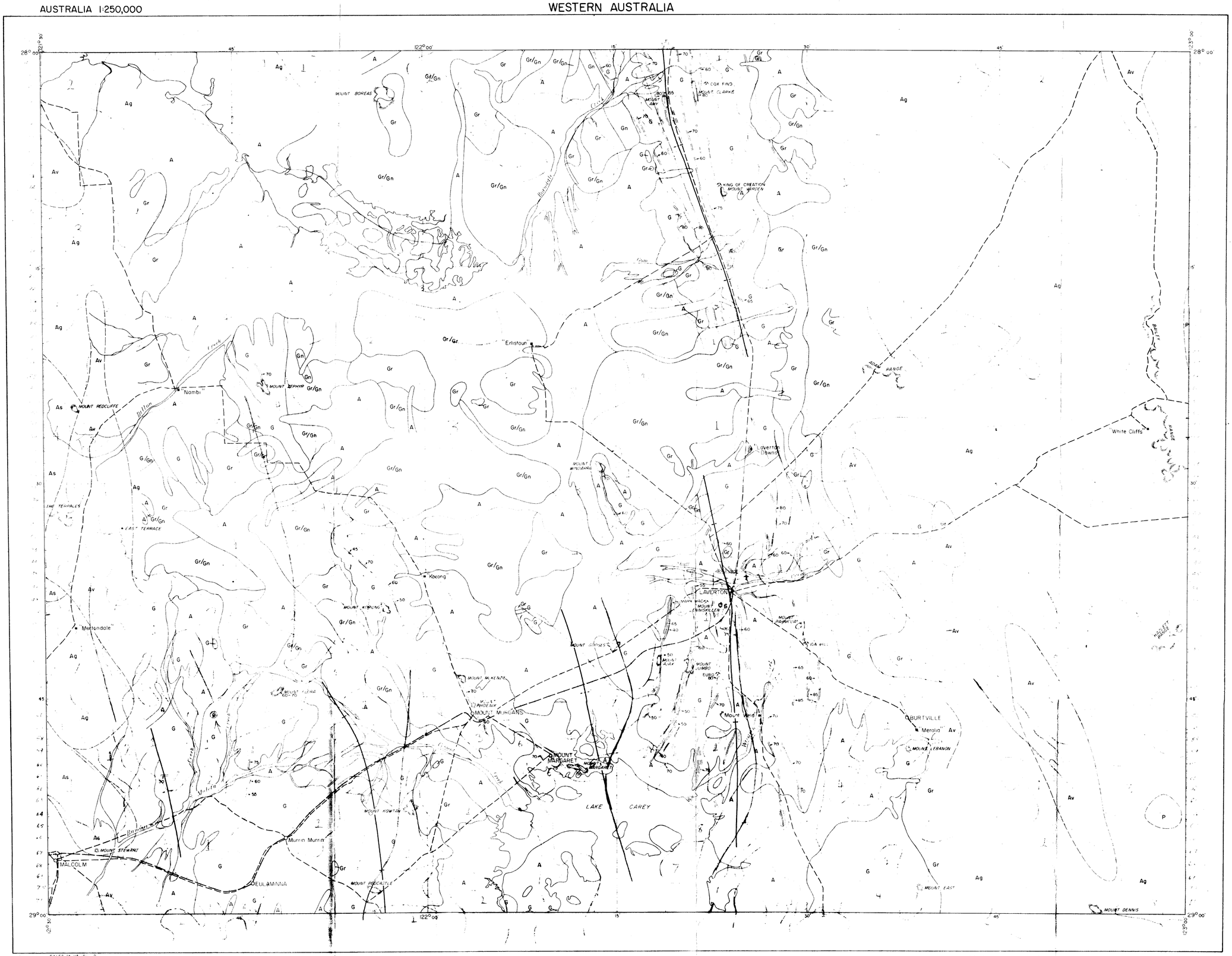
PROFILES RECORDED AT INTERVALS OF 4 MILES ARE SHOWN ON THE MAP.

THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 9·0 GAMMAS PER MILE.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H53/81-56

AUSTRALIA 1:250,000

LAVERTON
WESTERN AUSTRALIA



AIRBORNE SURVEY, LAVERTON-EDJUDINA W.A. 1966

LOCATION DIAGRAM

INDEX TO ADJOINING SHEETS

SIR SAMUEL	DUKETON	THROSSELL
LEONORA	LAVERTON	MASON
MENZIES	EDJUDINA	WINDARRA

MAGNETIC INTERPRETATION
AND
GEOLOGY

MILES 0 5 10 15 20 MILES
KILOMETRES 0 10 20 30 KILOMETRES

GEOLOGICAL LEGEND

AFTER GEOLOGICAL SURVEY OF WESTERN AUSTRALIA BULLETIN 103

RECENT
- A — Alluvium

ARCHAEAN
- Gr — Granite with some granodiorite and syenite
- Gn — Gneiss
- Gr/Gn — Mainly sandy soil which probably largely overlies granite and/or gneiss
- G — Mainly lavas, pyroclastics and sediments with some basic and ultrabasic intrusives. Variable grade of metamorphism
- 60 — Banded iron formations, with dip
- Axis of major anticlinal fold
- Axis of major synclinal fold
- Geological boundary

AFTER GEOLOGICAL MAP OF WESTERN AUSTRALIA 1966

PRECAMBRIAN (UNDIFFERENTIATED) ARCHAEAN PALAEOZOIC
- P — Marine and continental sedimentary rocks
- Av — Sedimentary rocks containing basic igneous rocks
- Ag — Granite
- As — Sedimentary rocks with zones of high grade metamorphism and zones of migmatite and gneiss
- Geological boundary

TOPOGRAPHICAL LEGEND

- River or creek
- Road or track
- Railway (abandoned)
- Named place
- Hill feature
- Homestead
- Mine

GEOLOGICAL REFERENCE

A B A

A Geological Map of Western Australia 1966
B Geological Survey of Western Australia Bulletin 103

GEOPHYSICAL LEGEND
- Magnetic trend
- Interpreted fault
- Magnetic [illegible]
- Interpreted [illegible]

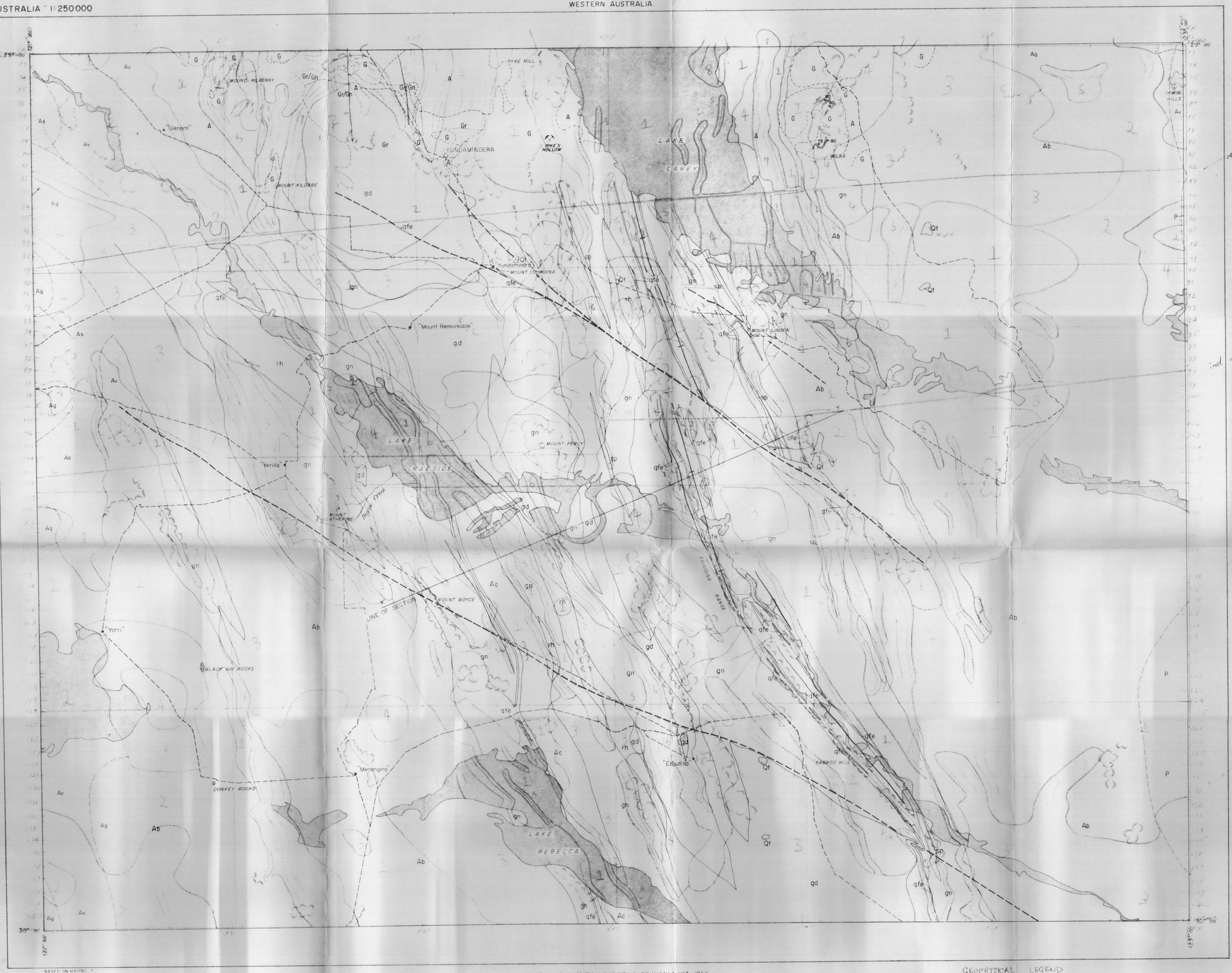
H51/E1-18

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

AUSTRALIA 1:250000

EDJUDINA
WESTERN AUSTRALIA

PLATE 14



RASED ON HS/80-7

AIRBORNE SURVEY LAVERTON-EDJUDINA WA, 1966

MAGNETIC INTERPRETATION AND GEOLOGY

GEOLOGICAL LEGEND

AFTER GEOLOGICAL SURVEY OF WESTERN AUSTRALIA BULLETIN 103

RECENT	A	Alluvium
ARCHAEAN	Gr	Granite with some granodiorite and syenite
	Gr/Gn	Mainly sandy soil which probably largely overlies granite and/or gneiss
	G	Mainly lavas, pyroclastics and sediments with some basic and ultrabasic intrusives. Variable grade of metamorphism
	fe60	Banded iron formations, with dip
		Geological boundary

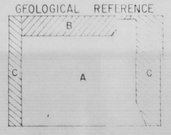
AFTER GEOLOGICAL SURVEY OF WESTERN AUSTRALIA BULLETIN 73

RECENT	Qt	Quartzite
PRECAMBRIAN(?)	gd	Porphyritic granite, granodiorite and syenite
	Ab	Granite with some gneiss
	sp	Peridotites and derivatives
	Ac	Conglomerate, arkose and tuff
	rh	Rhyolite, sheared porphyry and porphyrite
	gn	Mainly basic lavas with interbedded sediments and intrusives. Variable grade of metamorphism
	qfe	Banded iron formations
		Fault planes
		Axis of anticlinal fold
		Geological boundary

AFTER GEOLOGICAL MAP OF WESTERN AUSTRALIA 1966

PALAEOZOIC	P	Marine and continental sedimentary rocks
ARCHAEAN	Av	Sedimentary rocks containing basic igneous rocks
	Ag	Granite
PRECAMBRIAN UNDETERMINED	As	Sedimentary rocks with zones of high grade metamorphism and zones of migmatite and gneiss
		Geological boundary

GEOLOGICAL REFERENCE



A Geological Survey of Western Australia Bulletin 73
B Geological Survey of Western Australia Bulletin 103
C Geological Map of Western Australia 1966

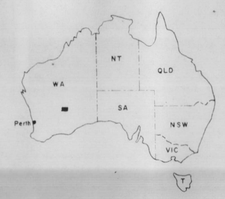
TOPOGRAPHICAL LEGEND

- River or creek
- Road or track
- Named place
- Homestead
- Rock feature
- Mining group

GEOPHYSICAL LEGEND

- Magnetic trend
- Interpretted fault
- Magnetic zone & symbol
- Interpretted dyke

LOCATION DIAGRAM



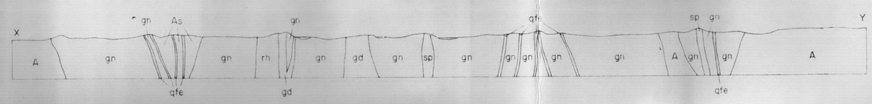
True North
Mag North

INDEX TO ADJOINING SHEETS

LEONORA	LAVERTON	RANSON
MENZIES	EDJUDINA	MINIGWAL
KALGOORLIE	KURNALPI	CUNDEELEE

5 0 5 10 15 20 MILES
5 0 5 10 15 20 25 30 KILOMETRES

SECTION X–Y



H51/21-20

PLATE 4
15

CRESWICK AREA

TOTAL MAGNETIC INTENSITY CONTOURS AND GEOLOGY

1·0 0·5 0 1 2 MILES

1·0 0 1 2 3 KILOMETRES

GEOLOGICAL LEGEND

QUATERNARY	Qa	ALLUVIAL FLATS, SWAMPS, ETC.
QUATERNARY	Qb	SURFACE GRAVEL DEPOSITS
TERTIARY		BASALT ETC.
ORDOVICIAN		SLATES AND SANDSTONE
		GEOLOGICAL BOUNDARY

GEOLOGY AFTER GEOLOGICAL SURVEY OF VICTORIA, MEMOIR 7

TOPOGRAPHICAL LEGEND

- ROAD OR TRACK
- RAILWAY
- RIVER OR CREEK
- LAKE
- DAM
- TOWN

GEOPHYSICAL LEGEND

3000 / 2750 MAGNETIC CONTOURS

MAGNETIC LOW

THE MAGNETIC DATA HAS NOT BEEN CORRECTED FOR THE REGIONAL MAGNETIC GRADIENT

MAGNETIC CONTOUR INTERVAL 50 GAMMAS

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophisics. J 54/81-18

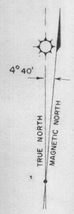
PLATE 16

BASED ON G237/11-14

DETAILED AEROMAGNETIC SURVEY, TENNANT CREEK NT, 1966.

PRELIMINARY INTERPRETATION

LOCATION DIAGRAM



MILES 2 1 0 2 4 6 8 10 12 14 16 18 20 22 MILES

KILOMETRES 2 1 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 KILOMETRES

TOPOGRAPHICAL LEGEND

- River or creek
- Highway or main road
- Secondary road
- Road or track
- Bore
- Mine
- Aerodrome or landing ground
- Hill feature
- Boundary of survey area

GEOPHYSICAL LEGEND

- Magnetic lineament
- Magnetic trend
- Anomaly recommended for further investigation
- Area of intense magnetic disturbance

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics.

E53/BI-20
TO ACCOMPANY RECORD No.

PLATE 17

130°38' 40' 45' 130°47'

13°34' 35' 40' 13°45'

Possible boundary between granite and sediments

"OLD WARRS"

WARRS

WHEAL DANKS NORTH

WHEAL DANKS CREEK

WHEAL DANKS

WALLABY

WHEAL DANKS SOUTH

EMPIRE

DALY RIVER AIRFIELD

DALY

DALY RIVER

RIVER

GEOPHYSICAL LEGEND

MAGNETIC TRENDS

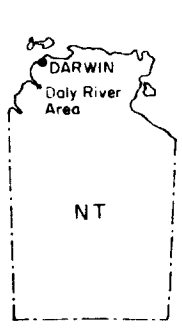
PROBABLE FAULTS

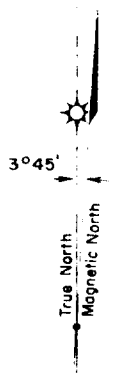
DETAILED AEROMAGNETIC SURVEY, DALY RIVER NT, 1966.

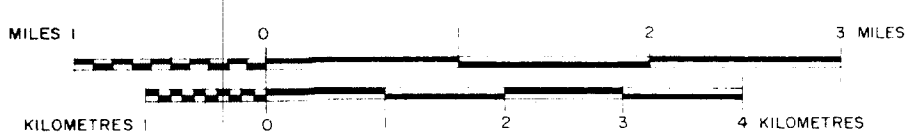
PRELIMINARY INTERPRETATION

LOCALITY MAP

LOCATION DIAGRAM







TOPOGRAPHICAL LEGEND

ROAD OR TRACK

RIVER OR CREEK

FENCE

HOMESTEAD OR HUT

MINE

BOUNDARY OF SURVEY AREA

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

D52/BI-41

TO ACCOMPANY RECORD No.

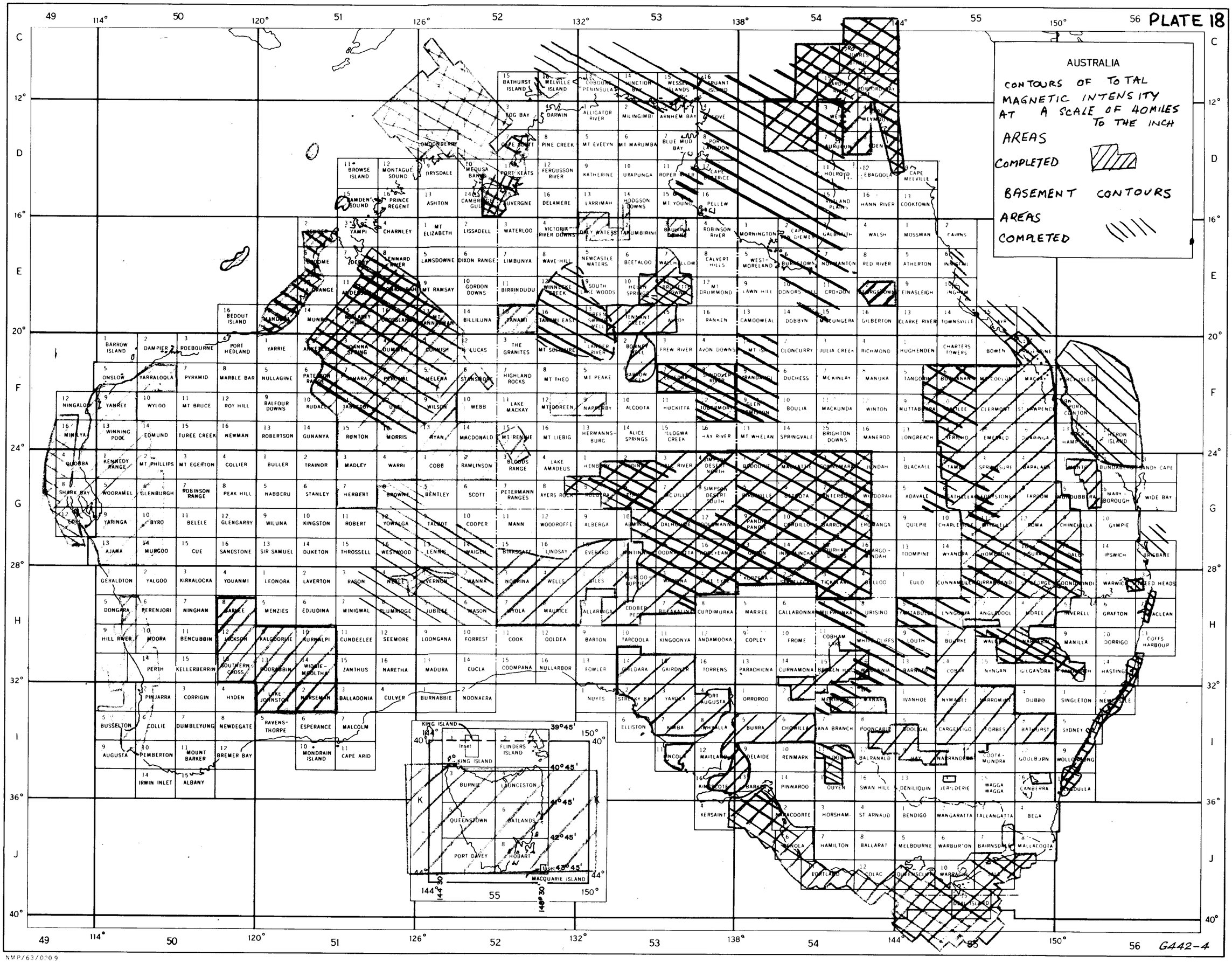
PLATE 18

AUSTRALIA

CONTOURS OF TOTAL MAGNETIC INTENSITY AT A SCALE OF 40 MILES TO THE INCH

AREAS COMPLETED

BASEMENT CONTOURS AREAS COMPLETED



NMP/63/0209

G442-4

PLATE 19

AUSTRALIA

SCALE

100 0 100 200 300 400 MILES

1966 REGIONAL GRAVITY SURVEYS

LEGEND

- Isogal follow-up completed
- Access impossible 1966
- USAF
- Dominion Observatory, Canada
- BMR Isogal
- Regional Gravity Traverses
- Papuan Ultra-Mafic Belt Survey

(BASED ON G20-31)

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

TO ACCOMPANY RECORD NO. G442-8

PLATE 20

NEW BRITAIN

6°00'

Lae

Salamaua

Wau

NO LANDING AREAS

Morobe

Garaina

SOLOMON SEA

NEW GUINEA
(AUSTRALIAN TRUST TERRITORY)

PAPUA
(AUSTRALIA)

Ioma

TROBRIAND OR
KIRIWINA I.

Popondetta

Kokoda

9°00'

OWEN STANLEY RANGE

Wanigela

D'ENTRECASTEAUX
ISLANDS

PORT MORESBY

Safia

Abau

Samarai

CORAL SEA

Boat traverse
(station spacing approx. 3 miles)

Helicopter survey
(station spacing approx. 10 miles)

PAPUAN ULTRAMAFIC BELT GRAVITY SURVEY, 1966
LOCALITY MAP

MILES
50 0 50 100

144°00'

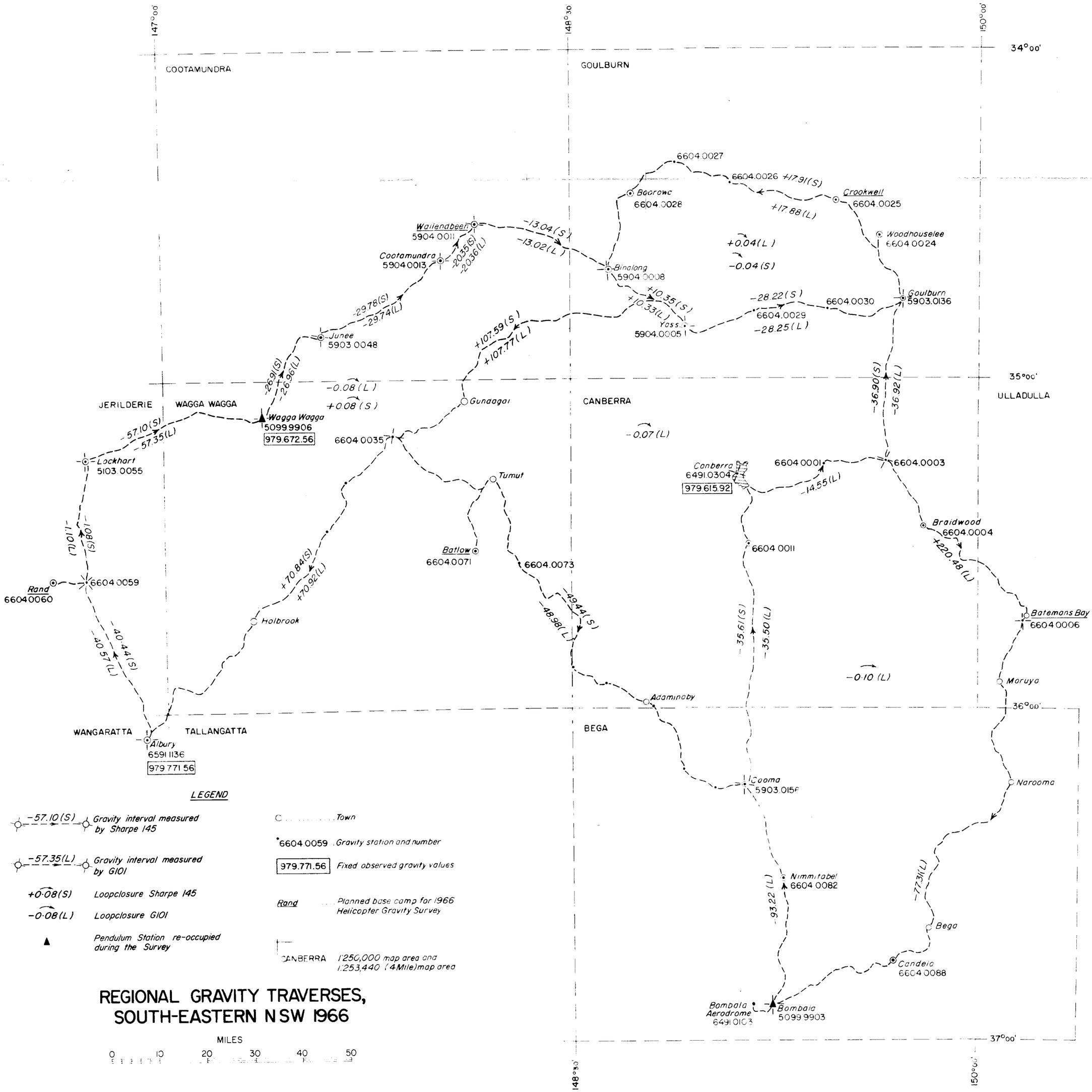
147°00'

150°00'

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. PNG/B2-2

TO ACCOMPANY RECORD No.

PLATE 21



LEGEND

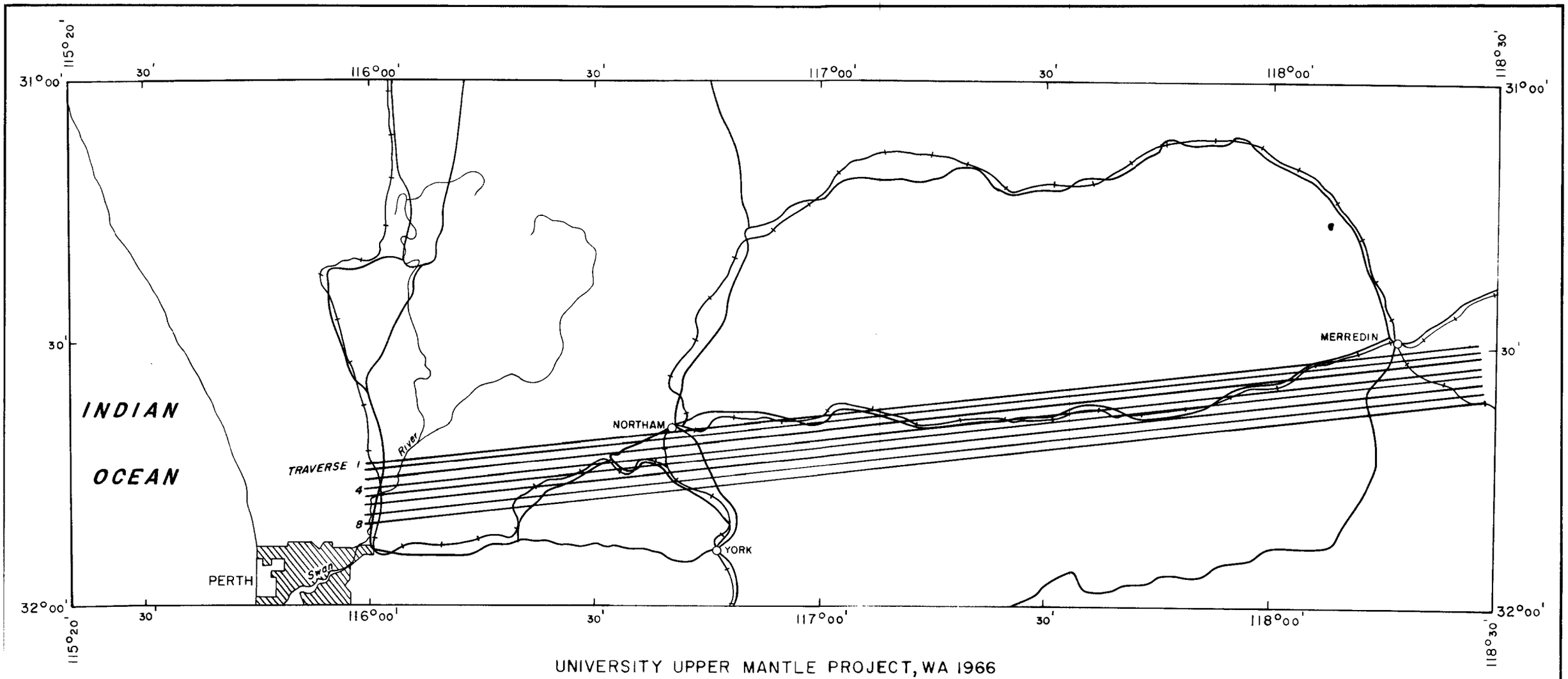
-57.10(S) ○---○	Gravity interval measured by Sharpe 145
-57.35(L) ○---○	Gravity interval measured by G101
+0·08(S)	Loopclosure Sharpe 145
-0·08(L)	Loopclosure G101
▲	Pendulum Station re-occupied during the Survey
C	Town
•6604.0059	Gravity station and number
979.771.56	Fixed observed gravity values
Rand	Planned base camp for 1966 Helicopter Gravity Survey
CANBERRA	1:250,000 map area and 1:253,440 (4 Mile) map area

REGIONAL GRAVITY TRAVERSES, SOUTH-EASTERN N S W 1966

MILES
0 10 20 30 40 50

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

G442-7



UNIVERSITY UPPER MANTLE PROJECT, WA 1966

AEROMAGNETIC TRAVERSES

10 0 10 20 30 40 50 60 70 MILES

PLATE 22

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS H50/B1-21