COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1971/19

Mann-Woodroffe Aeromagnetic Survey, South Australia, 1969

by

E. P. Shelley and D. N. Downie

Record 1971/19

MANN-WOODROFFE
AEROMAGNETIC SURVEY, SOUTH AUSTRALIA 1969

by

E.P. Shelley and D.N. Downie

CONTENTS

ILLUSTRATIONS

SUMMARY

During the period March to July 1969, an aeromagnetic survey was flown by the Bureau of Mineral Resources, Geology & Geophysics in the MANN and parts of WOODROFFE, BIRKSGATE, LINDSAY and PETERMANN RANGES 1:250,000 map areas. The main purposes of the survey were to assist geological mapping in the area and to locate areas where rocks of the Giles Complex may be near to the surface.

The interpretation of the magnetic results as presented in this record is qualitative and involves the delineation of magnetic trends and the subdivision of the area into zones of specified magnetic character. The significance of the magnetic trends and zones is discussed with reference to mapped geology.

Correlation between the geology and magnetic data is quite good over the sedimentary rocks of the Officer Basin and basic rocks of the Giles Complex. The latter, which crop out south of the Mann Fault, are thought to be continuous at depth. The existence of a large region of basic intrusives and shearing has been postulated in the south-east part of the MANN area and it is suggested that this may be a major tectonic feature.

Both the Mann and Hinkley Faults have recognizable magnetic expressions. The edge of the Officer Basin has been delineated several miles north of its earlier postulated position, and magnetic evidence suggests that the contact with the basement rocks is faulted.

1. INTRODUCTION

An airborne magnetic survey was flown by the Bureau of Mineral Resources, Geology & Geophysics (BMR) in the MANN and parts of the WOODROFFE, BIRKSGATE, LINDSAY and PETERMANN RANGES 1:250,000 map areas (Plate 1) during the period March to July 1969. The survey was requested by the South Australia Department of Mines as an extension of a similar survey flown by BMR over the area to the east in 1967 (Waller, 1968).

The survey was made to assist geological mapping in the area and to locate areas where potentially mineralliferous rocks of the Giles Complex occur at shallow depths. The PETERMANN RANGES* area had been flown in 1965 during the Amadeus Basin survey (Young & Shelley, 1966) but part of it was reflown in the present survey with a different line orientation at the request of BMR's Geological Branch.

Crystalline basement in the survey area comprises granulite, gneiss, and metaquartzite of the Musgrave-Mann Metamorphics and associated intrusive granites and mafic and ultramafic bodies of the Giles Complex. These latter are associated with major regional fault and shear structures trending across the northern part of the survey area. The margin of the basement in the south is probably bounded by major faults and shears.

During the Eucla Basin reconnaissance survey in 1954 (Quilty & Goodeve, 1958), two lines were flown into the survey area. The recorded magnetic profiles displayed anomalies up to 1500 gammas in amplitude, and these were interpreted as being due to near-surface sources. In 1957 some short lines were flown over the Giles Complex near Mount Davies. Anomalies up to 1000 gammas were recorded. This work is discussed by Goodeve (1961).

In 1960 an airborne magnetic and radiometric survey was made over the MANN area (Wells, 1962). Lines spaced at 8 kilometres were flown north-south at an altitude of 150 metres above ground level. The generally disturbed nature of the magnetic profiles suggested the presence of magnetic rocks at or near the surface, but because of the wide spacing of the flight-lines the results of the survey were inconclusive.

* Throughout this Record the names of 1:250,000 map areas are written in capital letters to distinguish them from place names.

The PETERMANN RANGES part of the survey area flown in 1965 during the Amadeus Basin survey (Young & Shelley, 1966). The east-west lines were spaced at 3.2 kilometre intervals and flown at 250 metres above ground level.

During 1965, the South Australia Department of Mines requested some low-level surveying over part of the Giles Complex between Mount Davies and Mount Caroline (Tipper, 1967). The aim was to determine whether some basic and ultrabasic outcrops in the region were continuous beneath Cainozoic cover. Sixty-three traverses oriented NE and NW were made at 1.6 kilometre spacing and at an altitude of 75 metres above ground level. It was found that the intrusives did not have a specific recognizable character, and extrapolation of any geologic/magnetic correlation beyond the limits of any one outcrop was strongly hampered by lithological variations.

Also in 1965 an aeromagnetic survey of part of the Officer Basin was made by Adastra Hunting Pty Ltd for Exoil Pty Ltd (Exoil, 1965). The results showed that magnetic basement in the south of BIRKSGATE is about 300 metres above sea-level. This is within 300 metres of ground level.

In 1967, an airborne magnetic and radiometric survey was made to the east of the present area (Waller, 1968). The survey covered the ALBERGA and parts of the WOODROFFE, ABMINGA, LINDSAY, EVERARD and WINTINNA 1:250,000 map areas. Numerous trends were delineated and the area was subdivided into zones of specified magnetic character. The significance of these was assessed with reference to mapped geology, and correlation between the magnetic data and geology was found to be generally fair.

A regional gravity survey of the MANN and WOODROFFE areas was made in 1965 and 1966 by the South Australia Department of Mines. The results of this survey and also of BMR's 1965 low-level survey have been summarized by Rowan (1967). Data indicate that a gravity ridge trends ESE across MANN and possibly across WOODROFFE. It is thought to be a continuation of a gravity ridge which extends to the northwest across Western Australia. Rowan (1967) believes that the gravity ridge is caused partly by some major crustal feature and partly by the Giles Complex intrusion. A fault system (Median Belt) associated with this gravity ridge is a major crustal structural feature (Thomsom, 1966), which extends across South Australia to the Broken Hill area in New South Wales.

Geological information and other assistance given by the Department of Mines staff are gratefully acknowledged.

2. GEOLOGY

Introduction

This geology is based on a report prepared by Messrs B.P. Thomson and R.B. Major of the Geological Survey of South Australia (Thomson & Major, 1968). Unpublished mapping by R.B. Major, J. Teluk, and G. Krieg of the Geological Survey, as well as published maps of the Geological Survey, were used. A generalized geological map of the survey area has been used as a base in Plates 4 and 5.

Previous work

Pioneer geological investigations were made in the area by Streich (1893) and Basedow (1905).

The discovery of extensive nickel mineralization in the vicinity of Mount Davies, Tomkinson Ranges, in 1953 by a South Australian Mines Department field party, under R.C. Sprigg, led to the undertaking of a major exploration campaign in the area between 1955 and 1958 by South Western Mining Ltd, a subsidiary of International Nickel Company (Thomson & Mirams, 1961). The MANN sheet was mapped in 1960 by the South Australian Geological Survey (Mirams, 1964). MANN and WOODROFFE sheets have been published and BIRKSGATE and LINDSAY have been mapped (Major, 1968).

Topography

The Musgrave, Mann, and Tomkinson Ranges form prominent E-W mountain chains rising to over 1200 metres above sea-level in an area of gently sloping plains between 450 and 600 metres above sea-level. Isolated hills occur in the centre of the plain area, the highest of these being Mount Kintore 1070 metres above sea-level. In the southwest part of the survey area, the rounded tor-like Birksgate Ranges rise to a maximum of 771 metres at Mount Sir Thomas. Drainage consists of ephemeral creeks on the margins of the ranges. Away from the ranges these creeks dissipate amongst sand dunes or strings of claypans.

Stratigraphy

The survey area covers part of the Musgrave Block, which comprises a mobile Precambrian core flanked to the north by the Amadeus Basin, to the east by the Great Artesian Basin, and to the south by the Officer Basin. The stratigraphic succession within this area consists of a crystalline basement, probably of Proterozoic to early Carpentarian age, overlain in places by Carpentarian and Adelaidean sediments.

Older Precambrian Musgrave-Mann Metamorphics and Granites. A large part of the crystalline basement is composed of a complex of metamorphic rocks known as the Musgrave-Mann Metamorphics. This complex comprises layered granulite, gneiss, metaquartzite and occasional marble. Traces of iron formation have been observed 15 kilometres southwest of Mount Caroline. The granulites pass gradationally into potassium feldspar gneisses and, in turn, into apparently anatectic granite. The age of the granulite metamorphism has been provisionally dated at Australian National University at 1370 million years (P. Arriens, personal communications). For the purposes of mapping however, the rocks have been assumed to be a Lower Proterozoic sedimentary sequence which has undergone metamorphism and associated granite anatexis in the late Carpentarian.

Extensive suites of granite are developed in the region and are of several types. Firstly there is the high-temperature charnockitic variety (hypersthene adamellite) which is confined to the central high-grade metamorphic belt and which contains xenoliths of the metamorphics. Flanking this and apparently intruding the metamorphics in the central part of the region are the low-temperature hornblende granites. These granites occur along the Northern Territory border north of the Mann Fault, to about longitude 131°E. They appear to grade into and to be overthrust by granulite facies rocks from the south and the east in this area and farther east, where they re-occur north of the Woodroffe Thrust. Hornblende-biotite granites are associated with granitic gneisses of the amphibolite facies in the Birksgate Ranges. Foliation trends are northeasterly in this area.

Although the lower-temperature granitic rocks intrude the high-temperature metamorphics farther north, the spatial and zonal distribution of the two types of granite suggests that the granites and the regional metamorphism may have been pene-contemporaneous.

Giles Complex and basic dyke swarms. The granitic suite was apparently followed by a mafic and ultramafic intrusive suite known as the Giles Complex. This complex consists largely of norite and gabbro with a smaller proportion of later pyroxenite, peridotite, and other olivine-rich rocks. In the northwest part of the survey area the Giles Complex rocks are flanked by areas of anorthosite, which is thought to have been some genetic relationship to the Giles Complex intrusives.

The distribution of the Giles Complex rocks in the survey area is believed to be associated with a deep fracture system of crustal faults or shears (Thomson, 1966; Rowan, 1967). Mapping and geophysical evidence indicates that a chain of pipe-like or steep trumpet-shaped intrusive centres extends across the northern part of the survey area. Generally the attitudes of the Giles Complex masses are steep, but there is also some sheet-like development of these intrusives, e.g. in the Michael Hills and Woodroffe Thrust areas. Rocks of the Giles Complex have also been found in the Blyth Range, west of the WA/SA border, and it is thought that a belt of these rocks may extend NNE from there into the survey area. Generally the Giles Complex is not markedly magnetic, although locally there are intensely magnetic norite varieties on the margins of some intrusive centres.

Swarms of doleritic dykes occur throughout the region. The dominant dyke direction is northwesterly though some east and northeast dykes are also known in the area. Major (1968) noted that the northwest dykes are olivine-bearing, but to date no olivine has been noticed in the northeast or east-trending dykes. It is believed that the dyke swarms are genetically related to the Giles Complex.

Sedimentary Rocks of the Officer Basin. The southwest corner of the survey area encroaches on Adelaidean sediments of the Officer Basin. These are sandstones with very minor limestone and dolomite which rest non-conformably on the gneisses and granites of the Musgrave Block. They have been gently folded with dips up to 20°.

Structure

Planetary faults and shears of the Median Belt (Thomson, 1966) such as the Mann and Hinkley Faults, which are associated with major intrusions of the Giles Complex, extend across the northern part of the survey area north of 26°30'S. A WNW-trending fault may exist from a point 10 kilometres south of Mount Poondinna to the survey boundary and beyond.

3. RESULTS AND INTERPRETATION

The magnetic data are displayed in Plates 2, 3, and 4. Plates 2 and 3 show all profiles of total magnetic intensity reduced to a north-south scale of 1:500,000 and related to a series of north-south lines which approximate to the flight paths. East-west scales of 1:62,500 have been used to improve data presentation.

For the reduction of the original profiles by pantography, the aircraft ground speed was considered constant along any one traverse. Departures from this constant speed introduce a positional error in the presentation of the data, which is manifested by a herring-bone pattern in the magnetic trends and zonal boundaries. The probable positional error of ± 0.8 kilometres is a function of the distance from the control latitudes of 26°15'S and 27°15'S.

Plate 4 shows every eighth profile together with the geology, to facilitate correlation.

The interpretation of the magnetic data is shown in Plate 5. This interpretation is qualitative and involves the delineation of magnetic trends and the subdivision of the area into zones of different anomaly amplitude range. The interpretation procedure is discussed in Appendix 1.

The following table describes the four zone types adopted, and describes their geological significance.

Zone type	Description	Geological significance
1	Anomalies with amplitudes less than 100 gammas and with few trends	Sedimentary rocks and possibly some granitic rocks. Any trends that are delineated probably represent sedimentary bedding or reflect underlying basement layering. They may also represent slightly basic parts of granitic rocks
2	Anomalies in the range 100 to 500 gammas with some trends	Granitic rocks, acid granulites of the Musgrave-Mann Metamorphics. Trends probably represent layering in the granulites, basic layers in granites, or minor dykes

Zone type	Description	Geological significance
3	Anomalies in the range 500 to 1000 gammas with many trends, some of them strong	Basic granulites, amphibolites of the Musgrave-Mann Metamorphics, and intermediate to basic intrusives. Trends represent layering in the metamorphics and larger intrusive bodies. The stronger trends probably represent dykes
4	Anomalies greater than 1000 gammas with many trends, most of them strong	Basic to ultrabasic intrusives of Giles Complex rocks, major dykes and dyke suites. The trends represent dykes and layering in the intrusives.

The anomaly range quoted for each zone type includes most, but rarely all, of the anomalies in any zone of that type.

Discussion of magnetic zones and trends

The general zonal distribution is one in which zones of types 1, 2, and 4 are superimposed on a background of zone type 3. Only zones of type 4 reflect the westerly geological trends, the other zones being randomly oriented. However there seems to be a tendency for the zone 4 trends to swing around to WSW near Mount Tietkens.

Zones of type 1 are not particularly widespread. The most important zone is in the southwest corner of the survey area, where it occurs over the Officer Basin. The magnetic profiles recorded over this region are rather undisturbed, and anomalies have maximum amplitudes of 150 gammas. The boundary of the zone follows an interpreted fault which is thought to represent the edge of the basin and is many kilometres north of the postulated edge of the basin as shown by the geology. Several magnetic trends occur in this zone and these are interpreted as iron-rich sediments in the Adelaidean sequence.

Another zone of type 1 which has been correlated with sedimentary rocks occurs in the east of the area south of Mount Davenport, and over a region mapped as Levenger Arkose. This formation is thought to be faulted along its northern boundary by the Mann Fault, and this is supported by magnetic evidence. East of the survey area, the Levenger Arkose is thought to extend as far north as the Davenport Fault (Waller, 1968). The occurrence of zones of type 2 and 3 over the southern part of the formation suggests that basement rocks occur at a shallow depth at this location.

A zone of type 1 has been delineated northeast of Mount Moulden over anorthosite rock, and another southeast of Mount Poondinna can be correlated with biotite granite. The large zone of type 1 in the PETERMANN RANGES area north of the Mann Ranges is thought to be correlated with hornblende granite which occurs along the Northern Territory border north of the Mann Fault (Thomson & Major, 1968).

Other zones of type 1 are probably associated with granitic rocks. Very few trends have been delineated in these zones.

Zones of type 2 are fairly widespread and range in area from about 80 square kilometres to greater than 1300 square kilometres. North of the Mann Fault these zones together with zones of type 3 probably represent hornblende granite and granitic gneiss. The zones of type 2 in this region do not generally have strong magnetic lineations and so may be correlated with the less gneissic parts of the granitic rocks. A group of dolerite dykes east of Mount Edwin are not particularly apparent in the magnetic results, probably because they are sub-parallel to the flight-lines.

Elswhere in the survey area the type 2 zones devoid of magnetic trends are thought to represent regions of granite. Such zones exhibiting magnetic trends are interpreted as regions of granite gneiss or acid granulite. The groups of short trends which have been delineated are probably caused by dolerite dykes, especially in the eastern half of the area.

As mentioned earlier, zones of type 3 cover a large part of the survey area. In the northeast of the survey area the zones of this type have been correlated with granulite, probably of basic type. These granulites overthrust the hornblende granite which crops out along the state border farther west. Trends in this region parallel the mapped foliations.

Small zones of type 3, such as those southeast and southwest of Mount Sir Thomas, generally flank zones of type 4. This zonal configuration has been interpreted as representing a gradation from ultrabasic to less basic rock types, possibly where an ultrabasic intrusive has partially assimilated the surrounding host rocks.

Numerous magnetic trends have been delineated in type 3 zones. SSE of Mount Harriet a group of trends are probably associated with dolerite dykes, since they parallel dykes mapped in the area. This is also thought to be the case with the trends near Moolalpinna Hill. Many of the longer trends have been interpreted as delineating the foliation or layering of the intrusives and basic metamorphic rocks.

Zones of type 4 are generally widespread throughout the survey area except in the southeast portion and north of the Mann Fault. The zones range in size from about 25 square kilometres to about 2000 square kilometres and generally parallel the geological strike. Correlation of this zone type with Giles Complex intrusives is very apparent along the southern side of the Mann Fault and in the Tomkinson Ranges. The elongated type 4 zones east and west of Hanging Knoll and the zone trending east from Mount Davies suggest continuity at depth of the intrusive bodies which have been mapped at only a few localities on the surface. The magnetic profiles were too disturbed to be used for depth estimation.

The large type 4 zone between Mount Harcus and Mount Tietkens is thought to be caused by ultrabasic material which has intruded shear zones at depth. These shears are represented by the strong positive and negative magnetic lineations which extend up to 32 kilometres. A very strong negative anomaly of some 6000 gammas in amplitude was recorded on line 46 about 16 kilometres SSW of Mount Harcus. A small outcrop of medium-grained dolerite occurs at this locality. Apart from some minor dolerite dykes, no other basic or ultrabasic rock types have been mapped within this zone.

A number of small zones of type 4 containing one or more magnetic trends have been correlated with dolerite dykes. Examples are the zones at Mount Hardy, Mount Crombie, Mount Harriet and west of Moolalpinna Hill.

It is thought that a belt of Giles Complex rocks may be present in the Blyth Range in the west of the area (Thomson & Major, 1968) but magnetic evidence in inconclusive.

The small ultrabasic intrusives along the Woodroffe Thrust do not give rise to any significant magnetic anomaly. These bodies are thought to belong to the "Woodroffe Type" of intrusive as opposed to the "Giles Type" which occur farther west and have strong anomalies associated with them (Collerson, personal communication). The "Woodroffe Type" are believed to be low-pressure intrusives in which magnetite is not very abundant.

Structure

Good magnetic evidence was found for the Mann Fault. In the east of the survey area an anomaly ranging in amplitude from 100 to 1000 gammas and with a characteristic shape was found to occur over the Mann Fault where its location is fairly well known. It was traced westwards and coincides quite well with the postulated position of the fault. The anomaly could not be traced any farther east than line 150. No definite magnetic evidence was found for the Mann Fault in the area to the east of the present survey area (Waller, 1968).

A fairly continuous anomaly was also thought to correspond to the Hinkley Fault. In the south west of the area, the Officer Basin is interpreted as being faulted against the basement rocks. In the Musgrave Park region, anomalies were recorded which are thought to reflect the Davenport Fault and the Woodroffe Thrust, but they are not very continuous.

Three other faults have been interpreted in the survey area. These are south of Moolalpinna Hill, east of Mount Poondinna and south-west of Mount Davies. All three occur in undifferentiated metamorphic rocks and do not appear to have ultrabasic intrusives associated with them.

4. CONCLUSIONS

Good correlation between geological data and magnetic zones is most evident in the southwest of the area over the Officer Basin and along the southern side of the Mann Fault. Elsewhere in the survey area, this correlation is only fair. It is recommended that Plate 5 be used in any further mapping of the area. Trends and zones should be used to extrapolate observed zone-type/lithology relationships into areas where soil cover hampers ground investigations.

The interpreted faults require examination in detail as does the postulated continuity of the ultrabasic rocks of the Giles Complex along the southern side of the Mann Fault.

The large zone of type 4 in the Mount Harcus/Mount Tietkens region appears to be caused by basic and ultrabasic material intruding shear zones at depth. This may be a major tectonic feature.

5. REFERENCES

BASEDOW, H., 1905 - Geological report on the country traversed by the South Australian Government northwest prospecting expedition, 1903. Trans. Roy. Soc. Sth Aust. 29, 57-102.

EXOIL PTY LTD, 1965 - Aeromagnetic survey of O.E.L. 28, eastern Officer Basin, S.A. Bur. Miner. Resour. Aust. Petrol. Search Subs. Acts Rep. (unpubl.).

GOODEVE, P.E., 1961 - Rawlinson Range-Young Range aeromagnetic reconnaissance survey, WA 1960. Bur. Miner. Resour. Aust. Rec. 1961/137 (unpubl.).

MAJOR, R.B.,* 1966 - Preliminary notes on the geology of the WOODROFFE 1:250,000 sheet area. Dept Mines Sth Aust. Geol. Surv. R.B. 62/101.

MAJOR, R.B., 1968 - Preliminary notes on the geology of the BIRKSGATE 1:250,000 sheet area. Dept Mines Sth Aust. Geol. Surv. R.B. 64/33.

MIRAMS, R.C., 1964 - Geology of the MANN 4 mile Sheet. Rept. Invest. Geol. Surv. Sth Aust. 25.

QUILTY, J.H., and GOODEVE, P.E., 1958 - Reconnaissance airborne magnetic survey of the Eucla Basin, Southern Australia. Bur. Miner. Resour. Aust. Rec. 1958/87 (unpubl.).

ROWAN, I.S., 1967 - Regional gravity survey of MANN and WOODROFFE 1:250,000 sheet areas. Dept Mines Sth Aust. Geol. Surv. R.B. 64/33

STREICH, V., 1893 - Geological observations taken on the Sir Thomas Elder expedition, 1891. Trans. Roy. Soc. Sth Aust. 16, 74-115.

THOMSON, B.P., 1966 - Report on rifts and major shear faults, South Australia. Sth Aust. Mines Dept Rep. 62/93.

THOMSON, B.P., and MAJOR, R.B., 1968 - Outline of geology of Western Musgrave Block, S.A. - Pre-aeromagnetic Survey Report. Dept Mines Sth Aust. Geol. Surv. R.B. 66/124.

* Consulted, but not specifically mentioned in the text.

THOMSON, B.P., and MIRAMS, R.C., 1961 - Nickel exploration, special Mining Lease No. 33, Tomkinson Ranges. Sth Aust. Mines Dept Rept. 659(b).

TIPPER, D.B., 1967 - Mann-Woodroffe aeromagnetic survey, SA 1965. Bur. Miner. Resour. Aust. Rec. 1967/89 (unpubl.).

WALLER, D.R., 1968 - Musgrave Block airborne magnetic and radiometric survey, SA 1967. Bur. Miner. Resour. Aust. Rec. 1968/51 (unpubl.).

WELLS, R., 1962 - Mann area airborne magnetic and radiometric survey, SA 1960. Bur. Miner. Resour. Aust. Rec. 1962/98(unpubl.).

YOUNG, G.A., and SHELLEY, E.P., 1966 - Amadeus Basin airborne magnetic and radiometric survey, NT 1965. Bur. Miner. Resour. Aust. Rec. 1966/230 (unpubl.).

APPENDIX 1

INTERPRETATION PROCEDURE

The magnetic data have been qualitatively analysed by delineating magnetic trends and zones. A magnetic trend is defined as the line joining the peak positions of anomalies, and is broadly interpreted as indicating continuity of a geological feature over the length of the trend. Thus it may represent a marker horizon, a structure within a mineralogically homogeneous rock, or in some instances a topographic feature. Except for perfectly symmetrical anomalies, however, a trend will not coincide with the apical axis of the body. The axis will generally be situated towards the negative part of the the anomaly by an amount which is a function of the body's dip and strike angles.

Magnetic zones are based on the dominant anomaly amplitude range. Significance of the amplitude criterion should be assessed with the knowledge that the amplitude is a function not only of magnetic susceptbility contrasts but also of the width, depth, and strike of the magnetic body. To be able more accurately to equate zones and lithology, the zones would need to be based on susceptibility values calculated for each anomaly.

Faults were interpreted from the collinear termination of magnetic zones and trends, by abrupt changes in trend direction, and by comparison of magnetic anomalies with those over known faults.

Negative trends are attributed to basic and ultrabasic igneous intrusions which have been reversely magnetized.

APPENDIX 2

OPERATIONAL DETAILS

Staff

E.P. Shelley	:	Party Leader
D.N. Downie	:	Geophysicist Class 1
A. Parvey	:	Draftsman Grade 2
R. Curtis-Nuthall	:	Technical Officer Grade 1
H.J. Alexander	:	Technical Assistant Grade 2
First Officer G.E. Brown	:	Pilot (TAA)

Equipment

Aircraft	:	Aero Commander 500U, VH-BMR
Magnetometers	:	MNS-1 proton precession type, with detector head in towed "bird" installation - output to 2-channel Moseley 7100 recorder.
		MNS-1(G) proton precession type, ground installation for magnetic storm warning and diurnal variation monitor - output to Esterline Angus recorder.
Radio altimeter	:	Bonzer - output to DeVar recorder.
Camera	:	Vinten 35-mm single-frame with "fish-eye" lens.
Timing Unit	:	BMR solid state, NTA-1.

Survey specifications

Line spacing	:	1 mile (1.6 km)
Line orientation	:	North-south
Tie system	:	Single lines east-west spaced at 15 miles (24 km)

Altitude	:	500 ft (150 m) above ground level
Navigation	:	Aerial photographs
Record sensitivities	:	MNS-1 - 100 gammas/inch and 1000 gammas/inch MNS-1(G) - 100 gammas f.s.d. Radio altimeter - 2000 ft (600 m) (logarithmic)

Survey statistics

Line mileage flown	:	19,000 miles (30,600 km) includes re-flies)
Area covered	:	17,400 square miles (45,000 square km)
Flying hours used	:	338 hours
Party arrived Musgrave Park	:	13, 14/3/69
Survey flying commenced	:	17/3/69
Survey flying completed	:	14/7/69
Party left Musgrave Park	:	14/7/69

APPENDIX 3

EXPERIMENTAL OPERATION OF GAMMA-RAY SPECTROMETER

During this survey a gamma-ray spectrometer installed in the aircraft was operated in an experimental mode. Two 6" x 4" thallium activated sodium iodide crystals detected gamma-radiation, and the signal was fed into a stabilized 4-channel Hanmer Spectrometer.

Three channels were set to detect gamma radiation from K40, U238 and U282 isotopes and the fourth measured the total count above 1.00 MeV.

Parameters finally adopted for the area are tabulated below.

Channel	1	2	3	4
Isotope	total	K40	U238	Th232
Energy threshold, MeV	1.00	1.30	1.65	2.38
Energy window, MeV	-	0.30	0.60	0.37
Time constant, sec	2	2	2	2
Count range counts/sec	2000	500	200	50

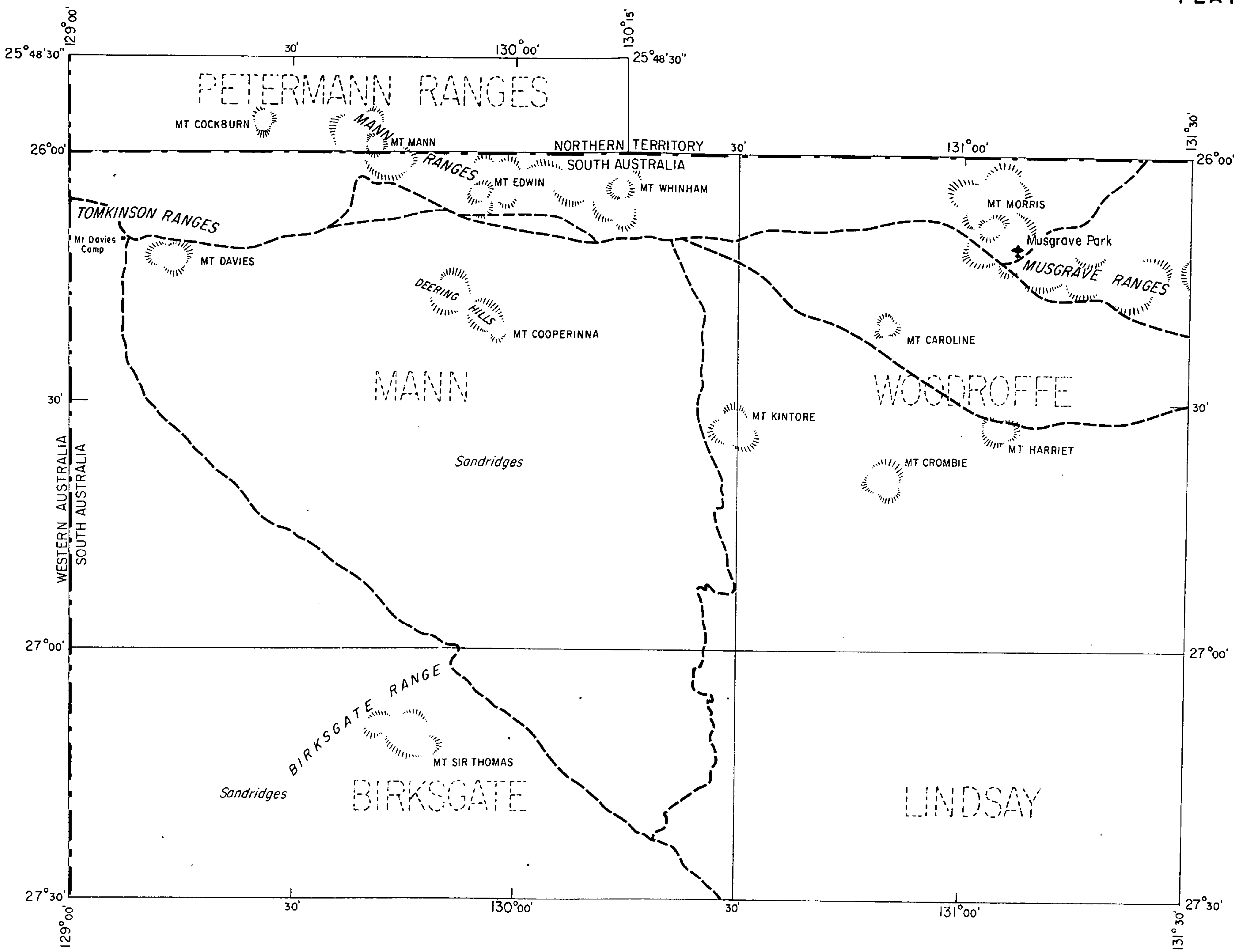
Because of the experimental character of the operation, in that various parameters were changed several times during the survey, no systematic reduction of the data was attempted. However, it is possible to make some qualitative observations on the results.

No significant anomalies were detected over the southern two-thirds of the survey area. This region is mostly covered with soil and sand dunes, and outcrops are very sparse.

In the northern part of the area, anomalies in the potassium and total-count channels were predominant and were obviously due to the granite and gneiss of the Musgrave and Mann Ranges. Uranium and thorium anomalies were very small, ranging from 5 to 15 counts/sec, and were randomly located.

There was an apparent decrease in radioactivity westwards along the ranges, but this may have been caused by the adjustments to the energy levels on the four channels.

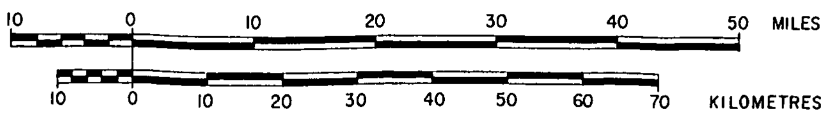
PLATE I



AIRBORNE SURVEY, MANN-WOODROFFE, SA 1969

LOCALITY MAP

LOCATION DIAGRAM



To Accompany Record 1971/19 G 52/B1-35

PLATE 2

AIRBORNE SURVEY, MANN-WOODROFFE, SA 1969

TOTAL MAGNETIC INTENSITY PROFILES

SHEET 1

NORTH - SOUTH SCALE

10 0 10 20 30 40 MILES

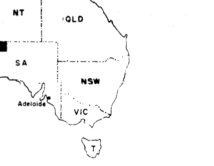
10 0 10 20 30 40 50 60 KILOMETRES

EAST - WEST SCALE

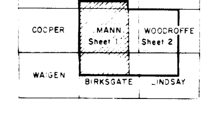
1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 KILOMETRES

LOCATION DIAGRAM



INDEX TO ADJOINING SHEETS



APPROX. PROFILE SCALE

2000 1000 0 GAMMAS

EXPLANATORY NOTES

THE SURVEY WAS MADE WITH AN AERO COMMANDER 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 ± ½ MILE.

THE SOUTH COMPONENT OF THE REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY HAS BEEN REMOVED FROM EACH PROFILE BY ROTATION ABOUT THE POINT WHERE THE PROFILE INTERSECTS THE 26° SOUTH LATITUDE. THIS COMPONENT AMOUNTS TO 7·5 GAMMAS PER MILE.

G52/BI-43

To Accompany Record 1971/19

PLATE 3

AIRBORNE SURVEY, MANN-WOODROFFE, SA 1969

TOTAL MAGNETIC INTENSITY PROFILES

SHEET 2

NORTH-SOUTH SCALE

10 0 10 20 30 40 MILES

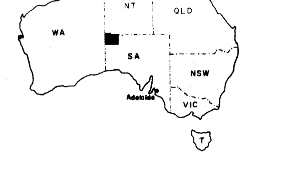
10 0 10 20 30 40 50 60 KILOMETRES

EAST-WEST SCALE

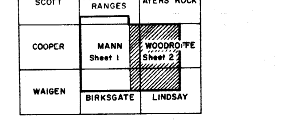
1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 KILOMETRES

LOCATION DIAGRAM



INDEX TO ADJOINING SHEETS



APPROX. PROFILE SCALE

2000 1000 0 GAMMAS

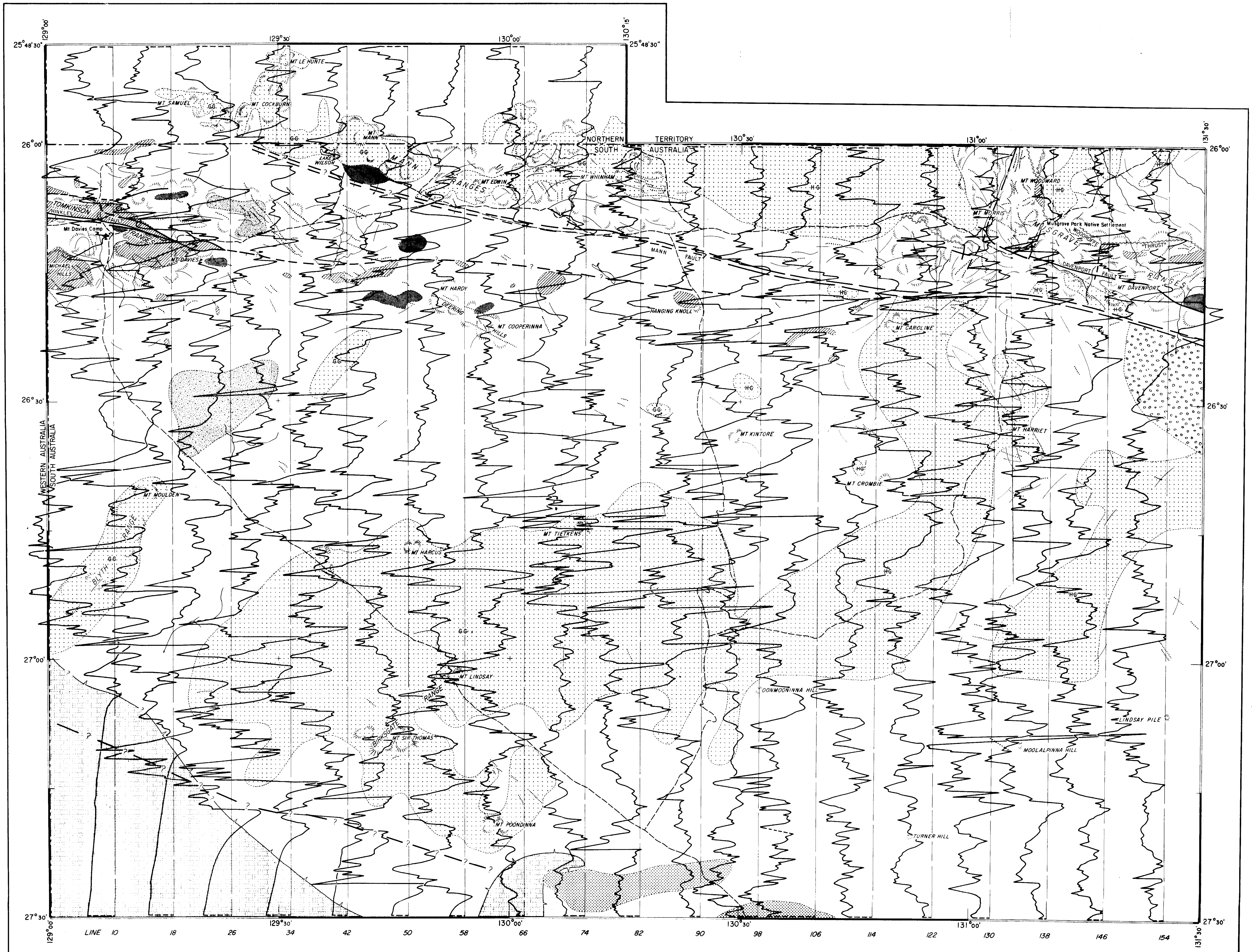
EXPLANATORY NOTES

THE SURVEY WAS MADE WITH AN AERO COMMANDER 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 ±½ MILE.

THE SOUTH COMPONENT OF THE REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY HAS BEEN REMOVED FROM EACH PROFILE BY ROTATION ABOUT THE POINT WHERE THE PROFILE INTERSECTS THE 26° SOUTH LATITUDE. THIS COMPONENT AMOUNTS TO 7·5 GAMMAS PER MILE.

G52/BI-44

To Accompany Record 1971/19



BASED ON G52/80-17
BASED ON G52/81-45

GEOLOGICAL LEGEND

ADELAIDEAN

SANDSTONE, SILTSTONE, ARKOSE

CARPENTARIAN

LEVENGER ARKOSE

CARPENTARIAN AND OLDER PRECAMBRIAN OF MUSGRAVE BLOCK

DOLERITE DYKES

MAFIC AND ULTRAMAFIC ROCKS OF THE GILES COMPLEX INCLUDING THE WOODROFFE NORITE

BIOTITE GRANITE

CHARNOCKITIC GRANITE (HYPERSTHENE-ADAMELLITE)

HG GG HORNBLENDE GRANITE, GRANITIC GNEISS AND INTRUSIVE GRANITE

ANORTHOSITE

UNDIFFERENTIATED MUSGRAVE-MANN METAMORPHICS AND INTRUSIVE ROCKS COVERED BY THIN SAND VENEER

GEOLOGICAL BOUNDARY

FAULT

SHEAR ZONE

FOLIATION

UNCONFORMITY

GEOLOGY AFTER GEOLOGICAL SURVEY OF SOUTH AUSTRALIA
DEPARTMENT OF MINES, ADELAIDE

TOPOGRAPHICAL LEGEND

ROAD OR TRACK

RIVER OR CREEK

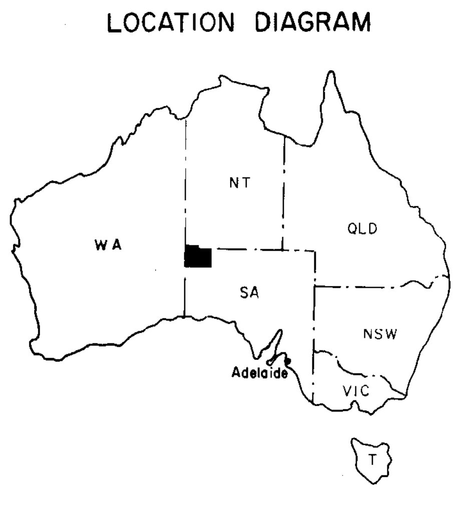
HILL FEATURE

LANDING GROUND

APPROX. PROFILE SCALE

2000 1000 0 GAMMAS

LOCATION DIAGRAM



INDEX TO ADJOINING SHEETS

SCOTT	PETERMANN RANGES	AYERS ROCK
COOPER	MANN	WOODROFFE
WAIGEN	BIRKSGATE	LINDSAY

AIRBORNE SURVEY, MANN-WOODROFFE, SA 1969

TOTAL MAGNETIC INTENSITY PROFILES
AND
GEOLOGY

10 5 0 10 20 30 40 MILES

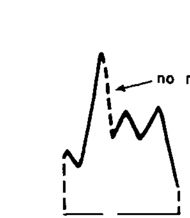
10 0 10 20 30 40 50 60 KILOMETRES

EXPLANATORY NOTES

THE SURVEY WAS MADE WITH AN AERO COMMANDER 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 ± ½ MILE.

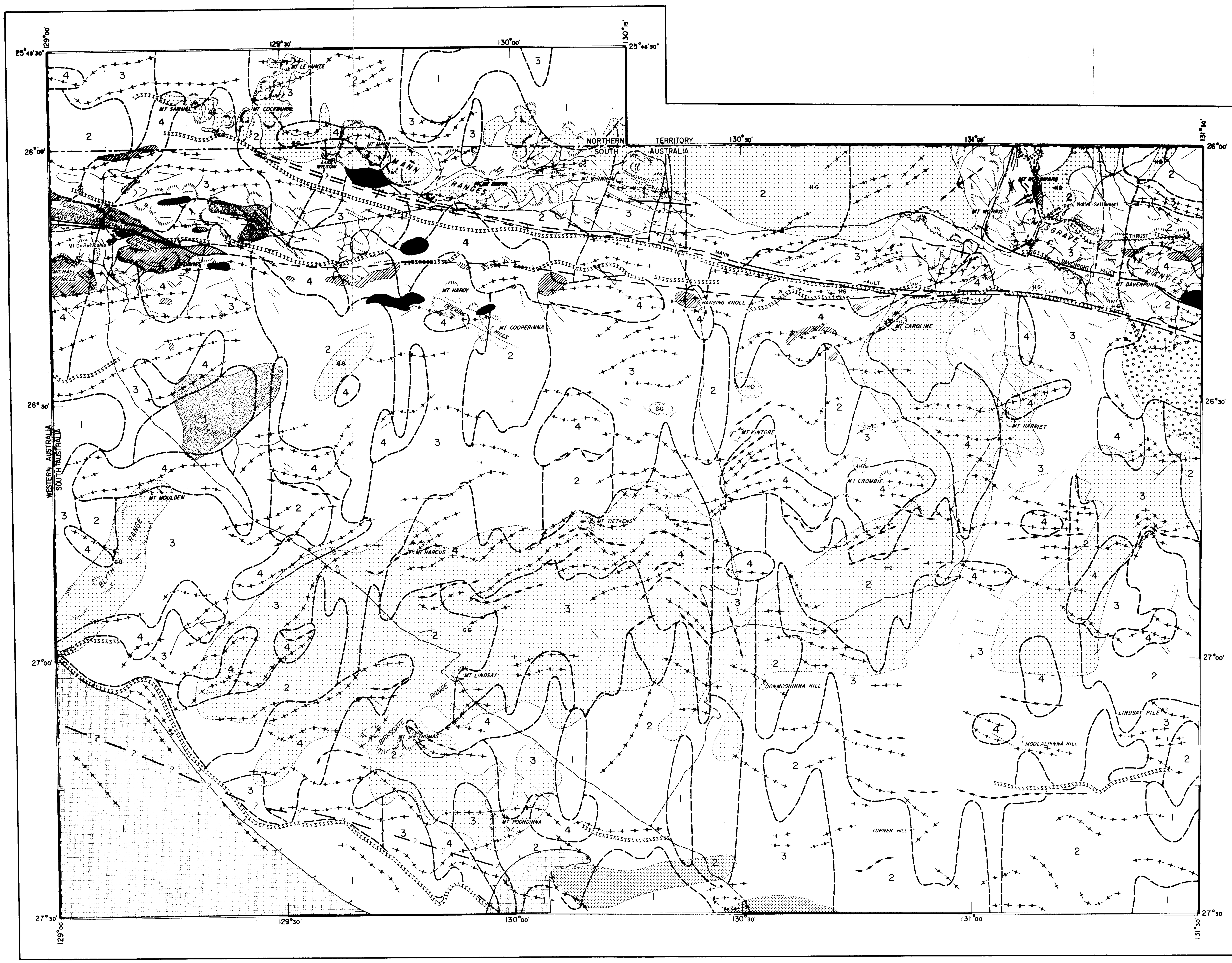
THE SOUTH COMPONENT OF THE REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY HAS BEEN REMOVED FROM EACH PROFILE BY ROTATION ABOUT THE POINT WHERE THE PROFILE INTERSECTS THE 26° SOUTH LATITUDE. THIS COMPONENT AMOUNTS TO 7·5 GAMMAS PER MILE.

GEOPHYSICAL LEGEND



To Accompany Record 1971/19

G52/BI-46



BASED ON G52/80-17-1
BASED ON G52/81-47

GEOLOGICAL LEGEND

ADELAIDEAN

- SANDSTONE, SILTSTONE, ARKOSE

CARPENTARIAN

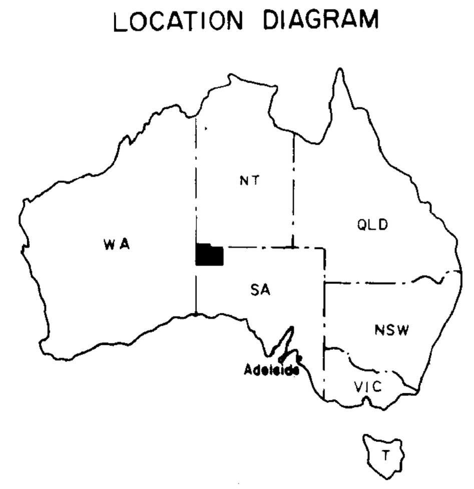
- LEVENGER ARKOSE

CARPENTARIAN AND OLDER PRECAMBRIAN OF MUSGRAVE BLOCK

- DOLERITE DYKES
- MAFIC AND ULTRAMAFIC ROCKS OF THE GILES COMPLEX INCLUDING THE WOODROFFE NORITE
- BIOTITE GRANITE
- CHARNOCKITIC GRANITE (HYPERSTHENE-ADAMELLITE)
- HORNBLENDE GRANITE, GRANITIC GNEISS AND INTRUSIVE GRANITE (HG, GG)
- ANORTHOSITE
- UNDIFFERENTIATED MUSGRAVE-MANN METAMORPHICS AND INTRUSIVE ROCKS COVERED BY THIN SAND VENEER
- GEOLOGICAL BOUNDARY
- FAULT
- SHEAR ZONE
- FOLIATION
- UNCONFORMITY

GEOLOGY AFTER GEOLOGICAL SURVEY OF SOUTH AUSTRALIA DEPARTMENT OF MINES, ADELAIDE

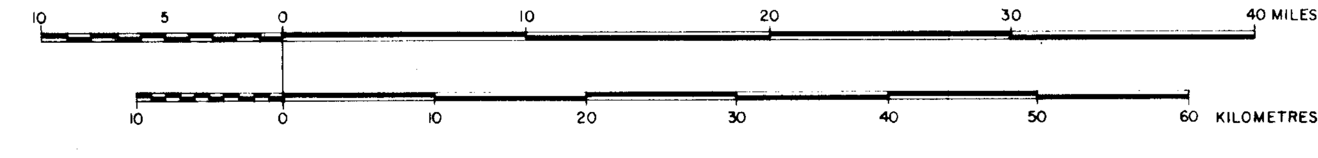
LOCATION DIAGRAM



INDEX TO ADJOINING SHEETS

SCOTT	PETERMANN RANGES	AYERS ROCK
COOPER	MANN	WOODROFFE
WAIGEN	BIRKSGATE	LINDSAY

MAGNETIC INTERPRETATION AND GEOLOGY



GEOPHYSICAL LEGEND

- MAGNETIC TREND POSITIVE
- MAGNETIC TREND NEGATIVE
- MAGNETIC ZONE
- INTERPRETED FAULT

TOPOGRAPHICAL LEGEND

- ROAD OR TRACK
- RIVER OR CREEK
- HILL FEATURE
- LANDING GROUND

To Accompany Record 1971/19

G52/B1-48