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MENZIES AND LEONORA AIRBORNE MAGNETIC AND RADIOMETRIC SURVEY, WA 1964

by

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SUMMARY

An airborne magnetic and radiometric survey of the Menzies and Leonora 1:250,000 areas was flown in 1964. This record deals with analyses of the magnetic and radiometric results.

Interpretation of the magnetic data is primarily qualitative and incorporates the resolution of magnetic trends and subdivision of the survey area into zones of specified magnetic character. The geological significance of these zones has been tentatively ascribed to certain rock types.

A limited interpretation of regional geological structure has been made from a study of zonal configurations and the repetition of intrazonal magnetic anomalies, supplemented by qualitative and quantitative dip analyses.

Seven major east-west dykes have been defined. These dykes generally appear to have widths of 1000 feet, near vertical dip and depth of burial within 100 feet of surface level. Two dykes have remanent magnetisation, the remainder appear normally polarised.

The convergence of magnetic and interpreted geological features at latitude 29°33'S, longitude 120°11'E defines a locality which warrants ground investigation.

A contour presentation of radiometric data reveals a general correlation between variations in gamma radiation and both the known geology and that interpreted from magnetic data.

Sixty four radiometric anomalies of restricted source have been detected of which forty seven are recommended for ground investigation.

1. INTRODUCTION

A programme of airborne magnetic and radiometric surveys in the goldfields region of Western Australia including the Balfour Downs, Roy-Hill, Mt. Bruce, Wyloo, Yarraloola, Dampier, Belele, Meekatharra, Wiluna, Kingston, Edjudina, Menzies, Laverton, Leonora, Youanmi, Duketown, Sir Samuel and Sandstone 1:250,000 areas was requested by the Western Australian Mines Department in February 1959. Following the completion of the airborne survey programme of the 1:250,000 areas Southern Cross, Kalgoorlie, Barlee, Jackson, Kurnalpi, Widgiemooltha, Boorabbin, Norseman and Lake Johnston, which had been commenced in 1956, the request was reviewed in October 1963 by the Geological Survey of Western Australia. As a result the programme was altered to the 1:250,000 areas of Menzies, Edjudina, Leonora, Mt. Egerton, Mt. Phillips, Robinson Range, Belele, Cue, Kirkalocha, Laverton, Youanmi and parts of Glenburg, Byro, Murgo and Yalgoo. Priority was given to the Menzies and Leonora areas as they formed a northerly extension of the work already completed (Plate 1). These two areas which are defined by the 28°00' and 30°00' parallels of south latitude and 120°00' and 121°30' meridians of east longitude were surveyed by the Bureau of Mineral Resources' D.C. 3 aircraft VH-MIN during the period October to November 1964. This report deals with the interpretation of the magnetic and radiometric results.

Geologically the goldfields included in Plate 1 are located in the Pre-Cambrian shield area of Western Australia which is a complex of meta-igneous and meta-sedimentary rocks with a variety of intrusive and replacement rocks.

Forman (1953) classifies the basic meta-igneous and meta-sedimentary rocks of this Pre-Cambrian shield into three series :-

1. The Older Greenstones
2. The Whitestones
3. The Younger Greenstones

These series have a dominant structural trend in a north-north-west to north-west direction. A further subdivision has been made, (Low 1959) of the Older Greenstones into basic lavas and a suite of ultra basic rocks. Both the Older Greenstones and the Whitestones contain minor developments of banded iron formations or jaspilites.

Mineralisation, of which gold has the greatest economic importance, is predominately confined to the Greenstones though bearing an association with intrusive granite. The concept of "favourable beds" and "gold lines" is supported in most geological reports on the goldfields.

The objective of this survey was to provide data to assist in the future regional mapping of the area, rather than an attempt to detect economic mineralisation directly.

2. PREVIOUS GEOPHYSICAL INVESTIGATIONS

There is no reference to any previous geophysical work in the Menzies or Leonora 1:250,000 areas; however limited work is at present being carried out by Western Mining Corporation.

The use of the airborne magnetic survey method in the goldfields area was advocated by Miles 1953 with the object of delineating the banded iron formations which might serve in establishing the control on geological structures and ore genesis in areas of extensive alluvium cover. It was not suggested that direct detection of economic mineralisation would be possible in this locality.

Airborne magnetic and radiometric surveys have been flown over the Kalgoorlie, Southern Cross, Barlee and Jackson (Spence 1958), Kurnalpi and Widgiemooltha (Carter 1959), Boorabbin and Norseman (Forsyth 1963) and Lake Johnston (Wells 1962) 1:250,000 areas, (Plate 1).

It has now been shown (Quilty, 1964) that the banded iron (jaspilite) formations within the Archaean metamorphosed sediments and lavas are clearly delineated in these maps of total magnetic intensity, and furthermore do serve as marker horizons in tracing the major fold axes. The correlation of aeromagnetic data with geological mapping of Soufoulis (1960) in the Boorabbin 1:250,000 area, showed that here the more intense anomalies are associated with ultra-basic rocks and basic lavas of the Greenstone Phase, and also meta-dolomitic rocks of the

Whitestone Phase. At the present stage of mapping, Quilty is uncertain whether all these iron-rich rocks are interbedded units of the metamorphic belts. He considers that their general conformity with the typical pattern of jaspilite outcrops suggests that this is the case.

Suites of basic intrusives occupying fissures produced by cross folding of the metamorphic belts have also been recognised by their distinctive magnetic properties.

A review of geophysical surveys in the Norseman area (Daly, 1963) indicates that the reconnaissance airborne magnetic method is not successful in providing direct information on the occurrence of ore-bodies. In the Mararoa area, taken as typical of ore-bodies not closely associated with banded iron formations, it did not appear that this type of magnetic survey could be relied upon to give definite information on the geological structure in the greenstones.

In the case of the Iron King ore-body, which is associated with structure in the banded iron formation, ground magnetic surveys showed a feature correlating with the structure; however this feature is not visible on the aeromagnetic contour map produced by lines spaced at ¼ mile intervals across the magnetic strike.

Interpretation of the airborne radiometric data in these same areas has indicated the presence of numerous anomalies which markedly exceed the average intensity of gamma radiation. Many of these anomalies are attributed to outcrops of granite; however in the Southern Cross-Kalgoorlie Regions (Mulder, 1958), 84 anomalies were recommended for ground investigation following a low-level airborne radiometric survey.

3. GEOLOGY

The geology of the region about and to the south of the survey area is of ancient, strongly folded and highly metamorphosed igneous and sedimentary rocks which have been subjected to granitic intrusion, granitisation and invasion by dyke suites typical of a Pre-Cambrian shield area.

The metamorphic rocks are generally exposed in belts which show a regional north-north-west trend. Major folding of the meta-igneous and meta-sedimentary rocks, ~~of an anticlinorial and synclinorial nature~~, generally parallels this axis with the subsidiary folds being tightly packed and often isoclinal with some overturning.

A system of subordinate folding whose axial trend is east-north-east to north east is superimposed on the major regional folding and has had a significant role in localising mineralisation (Ellis, 1939; McMath, 1953).

In the Yilgarn Goldfield a suite of late basic intrusive rocks show an east-north-east trend and bears a close relationship to the axis of cross folding in the metamorphic belts (Quilty, 1964).

The geological mapping of the Menzies and Leonora 1:250,000 areas involves little more than a distinction of regions as either granitic or greenstone types.

<u>Menzies 1:250,000 area</u>.

The geology shown in Plate 2 is based on data compiled by Talbot (1912) and the Tectonic Map of Australia (1960). Little geological information other than major rock type divisions is available. Detailed or semi-detailed mapping is confined to small areas about mining townships such as Menzies (Woodward, 1906), Mulline, Riverina and Ularring (Feldtmann, 1915), Kookynie, Niagara and Tampa (Jutson, 1921), Comet Vale (Jutson, 1921) and Mount Ida (Gibson, 1907 and Tomich, 1953), and is discussed briefly below.

In the western part of the Menzies area Talbot (1912) makes the broad division of rock types into granitic and greenstone areas often on a basis of vegetation or soil type due to the limited exposures of rock in situ.

The greenstones mainly occur in long comparatively narrow belts which trend north-north-west. According to Talbot (1912) these greenstones consist principally of epidiorites with some amphibolites, the latter due to metamorphosed dykes of no great extent.

High serrated ridges formed by ferruginous quartz schists are found in all the greenstone areas; in some localities the bands occur across the full width of the greenstone belts, in others only at one edge.

Talbot is unsure whether these ferruginous quartz schists represent shear zones or whether they may be highly metamorphosed sediments. They are usually inclined at a very high angle and folding is very marked in the Brooking Range.

Numerous acidic dykes, which probably emanated from the main mass of intrusive granite, have been noted by Talbot in several localities in the different greenstone areas.

Geology of Mining Centres

Menzies Rock types distinguished are recent alluvium and laterites, crystalline and altered rocks which are subdivided into basic and acidic groups, and igneous rocks occurring as dykes.

Mulline, Riverina and Ularring Rocks of the district are classified as amphibolites (including epidiorites and hornblende schists), granite, acidic dykes, basic dykes and recent superficial deposits.

Kookynie, Niagara and Tampa The rocks of the area are almost wholly, if not entirely, of igneous origin. They form a comprehensive group, varying in composition from moderately basic rocks to highly acid ones, ultra basic rocks being almost entirely absent. The rocks have been generally classified as basic and intermediate rocks of igneous origin, acid rocks of igneous origin, schistose rocks of uncertain origin and recent superficial deposits.

The geological trend of the area is generally east-north-east, faulting not being discovered to any extent.

Comet Vale The rocks of the district are divided into three main groups: basic and ultra basic rocks, the acid rocks and the recent superficial deposits.

As in other mining areas auriferous mineralisation is mainly confined to quartz reefs and lode formations which are frequently contained in the fine grained epidiorites and amphibolites of the basic and ultra basic rock group.

Mt. Ida In general the district is one of greenstones (clastic and igneous), basic intrusives, porphyries, jaspilites and erosion sediments intruded by three more-or-less separate masses of granite.

The interbedded rock formations are steeply inclined and strongly folded and exhibit a high degree of metamorphism, although the metamorphic grade varies.

The oldest rocks are a series of meta-sedimentary and basic flows or tuffs of high metamorphic grade. Interbedded in this series is a band of coarse grained hornblende-feldspar rock which is considered to be a sill (Tomich, 1953). All known auriferous mineralisation occurs in this greenstone series which is also intruded by a suite of basic dykes with north-east to north-north-east trend.

Another series of interbedded igneous greenstones and sediments occurs with strong folding along north-west to north-north-west axis.

Jaspilites are associated with both series of metamorphic rocks; however they are more ferruginous and less massive in the latter series.

Of the granitic masses the central and eastern granites are concordant, foliated or gneissic types in which the foliation is parallel to that of the enclosing greenstones, whereas the western granite appears to be discordant.

A number of olivine dolerite dykes with uniform east-west strike transgress all rock formations including the granite.

Structurally the central granite mass occupies the core of a southerly pitching anticline. No large faults have been recognised in the area, ore bodies have however been influenced in deposition by a shear pattern.

Leonora 1:250,000 area

The geology shown in Plate 3 is based on data compiled by Talbot (1912) and Clarke (1925), little geological information other than the broad rock type divisions being known. Detailed mapping is again confined to small areas about mining townships such as Lawlers (Gibson, 1907) and Leonora (Noldart and Bock, 1959).

The geology of the western part of the Leonora area is similar to that of the region immediately to the south which has been dealt with already (western part Menzies area).

The eastern part of the area consists mainly of a north-north-west trending greenstone belt which passes through Lawlers and Leonora and thence continues into the Edjudina 1:250,000 area. Clarke states "the greenstone belt includes a wide assortment of rocks of which the most important are the various epidiorites, amphibolites, chlorite-carbonate rocks etc., to which the terms "greenstone" or "diorite" are generally applied. The present character of these rocks results from great local and regional metamorphism. A minor but by no means insignificant feature of the greenstones is the development of more acid rocks both intrusive and effusive varying from andesites and porphyrites to rhyolites and quartz porphyries". What are apparently metamorphosed sediments are also included in this group.

A series of acid rocks have intruded the greenstone areas to form the granitic areas enclosing the greenstone belts.

Dykes ranging from camptonites to basaltic dolerites have been found to intrude both granite and greenstone.

Rather siliceous ferruginous quartzites are exposed in the greenstone belt between Gwalia and Mt. Newman. Shear planes and quartz veins striking more or less at right angles to the main north-north-west shearlines and veins were noted by Clarke in the Leonora-Duketown area in addition to some ferruginous quartzites which have an east-west course.

No continuation of the north branch of the Mt. Celia-Yundamindera fault (Honman, 1917, Edjudina 1:250,000 area) is known in this area.

Geology of Mining Centres

Lawlers The rocks have been divided into two main classes, the granites and the greenstones.

Acidic dykes are found most largely developed close to the junction of the granite and greenstones varying from coarse-grained granite through aplites and quartz-porphyries to fine-grained compact felsites and rocks having the appearance of quartzites.

Basic dykes (dolerite) intrude the granite but cannot be distinguished in the greenstones.

Leonora Rock types in an area of 400 square miles centred on Leonora are classified into Quaternary alluvium, surface cements and laterites, Tertiary? iron cappings, Pre-cambrian intrusive and meta-sedimentary and igneous rocks of the Margaret "System". The Pre-Cambrian intrusives include granitic rocks and quartz reefs. The Margaret "System" includes sediments, jaspilites, quartz-kyanite schists, sericitic schists, basic lavas and epidiorites. Noldart and Bock made the following comments regarding the structural and economic geology of this district.

"Major faulting was not observed ..... although small scale faulting is present .... The area forms portion of the western flank of a large synclinorium extending in a general north-north-west direction from Kookynie (Menzies 1:250,000 area) through Leonora to beyond Mt. Clifford ..... Variations in the trends of the jaspilitic horizons suggest strong west-north-westerly trending anticlinal cross-folding through the point of maximum flexure of the main range. A similar, and probably stronger crossfold, is postulated following approximately along the drainage channel occupied by Lake Raeside .....

Easterly of the main range is a system of sub-parallel anticlines and synclines trending in the same general direction as the range ..... Repetition of the jaspilite beds by isoclinal folding has probably taken place but no evidence is available ....."

4. MAGNETIC RESULTS AND INTERPRETATION

Magnetic profiles, which have been reduced to an east-west scale of 1:250,000 are shown for all flight lines in the Menzies and Leonora areas in Plates 4 and 5. A north-south scale of 1:62,500 has been used to improve data presentation. The magnetic profiles are accurately positioned near the longitudes 120° 22½'E and 121° 07½'E. The maximum probable error, at longitudes 120° 00'E, 120° 45'E and 121° 30'E is ± ½ mile east-west.

Every fourth magnetic profile together with magnetic trends are shown for the Menzies and Leonora 1:250,000 areas in Plates 6 and 7 respectively. In order to illustrate the magnetic trends which strike east-west, Plates 7 and 8 also show the magnetic profiles obtained from the tie-line systems.

Due to the sparsity of geological information available in the Leonora and Menzies 1:250,000 areas, a basically qualitative interpretation of the magnetic data has been applied. Magnetic trends have been resolved and the survey area has been zoned by consideration of magnetic character

(Plates 2 and 3). Well defined anomalies have been analysed quantitatively assuming the magnetisation is wholly induced, and a qualitative assessment of structural dip has been made. Listed below are the zones with a brief description and their magnetic character.

Zone	Magnetic character
1	Random magnetic disturbance less than 50 gammas
2	" " " " " 150 gammas
3	" " " " " 250 gammas
4	" " " greater than 250 gammas
5	Magnetic lineations with amplitudes less than 150 gammas
6	" " " " " " 250 gammas
7	" " " " " " 500 gammas
8	" " " " greater than 500 gammas

Geological significance of zones

Zones 1 and 2 are interpreted as either relatively homogenous acidic igneous rocks or non-magnetic sedimentary sequences. This interpretation is based upon the magnetic profiles being generally smooth, the lack of linearity of magnetic feature between adjacent flight lines, and the generally lower magnetic intensity as compared with neighbouring zones.

Zone 1 regions are irregularly shaped; nevertheless either individually or in groups they show some evidence of elongation trending NNW to NW. If these regions are the magnetic expression of an igneous source-rock, this elongation may be interpreted as evidence for NNW trending fold axes.

Zone 2 regions cover much of the area, and are extremely irregular in shape. It is probable that a number of rock types are represented possibly including slightly more basic variations of the rocks of zone 1.

Zone 3 regions are restricted to the western parts of the Leonora and Menzies 1:250,000 areas. This zone is interpreted as the magnetic expression of heterogeneous igneous bodies which are of greater basicity than rocks included in zones 1 and 2.

Zone 4 includes magnetic anomalies characterised by high amplitudes and random shape. Such anomalies are typical of major basic intrusions.

Zones 5 and 6 are transitional between the 1-2 and 7-8 zones. The linearity and moderately low amplitudes of the anomalies evident in zones 5 and 6 suggest stratigraphic sequences possibly comprising lavas and sediments. Regions of both zones show a somewhat elongated character. The division between zones 5 and 6 is based on average anomaly amplitudes. It is not implied that the two zones necessarily represent two distinct geological provinces, but rather a gradation in basicity.

Zone 7 has a high degree of linearity and elongation of regions. This is interpreted as being due to a series of basic lavas and sediments.

Zone 8 is characterised by very high amplitudes and very pronounced linearity. The anomalies may be conveniently grouped into two distinct categories, those of the order of 1000 gammas and those many times greater. Estimates of susceptibilities range from 2×10^{-3} to 3×10^{-3} and 25×10^{-3} to 40×10^{-3} c.g.s. units for the two groups respectively. The former anomalies are interpreted as being due to serpentinite bodies and the latter due to banded iron formations. Quilty (1964) records susceptibility values as high as 200×10^{-3} c.g.s. units which is comparable to the value obtained for the magnetic anomaly evident in the extreme south west of the Menzies area.

Analysis of magnetic trend lines oriented north-south

The resolution of trend lines bears in general a direct relationship to anomaly amplitude. The isolated trend lines within zones 1 and 2 are relatively short and are possibly caused by either dykes or granitisation of pre-existing magnetic bodies. Trend lines become pronounced in zones 5 and 6. The continuous strong lineations are almost wholly confined to the intense anomalies of zones 7 and 8 in the Menzies area and the moderately intense anomalies of zone 6 in the Leonora area.

Within zone 2 and the transitional zones 5 and 6, it is not uncommon for a trend line to pass from one zone to another. This illustrates the lack of well defined interzonal contacts and the limited difference of geological significance between these zones. Conversely, trends within zones 7 and 8 remain, with very few exceptions, confined to their respective zones suggesting distinct ~~geological~~ lithologies.

Menzies 1:250,000 area. The greatest concentrations of trend lines occur in the western half of the area and are directed NNW to NW. This general direction, paralleled by most other trends, is indicative of the regional strike for the entire area. Whilst individual trend lines follow the general pattern there are local variations, most, but not all of which are located near the western boundary of the area where positional accuracy is at a minimum.

Leonora 1:250,000 area. Trend lines are most concentrated in the north and eastern parts of the area with a dominant trend direction NNW indicative of the regional strike. An exception to this is the group of NNE directed trend lines in the north west of the area. This major local variation possibly results from outcrop controlled by intersection of major fold axes. Immediately to the south the east-west trend lines probably result from dykes.

Sharp flexures in trend lines are again probably related to positional inaccuracies of the magnetic data.

Analysis of magnetic trend lines oriented east-west

The tie-line profiles shown in Plates 6 and 7 reveal the presence of seven major dykes of similar character to those reported by Quilty (1964). Quantitative analysis of three major dykes in the Menzies area show them to be identical in form, having widths of approximately 1000 ft. and depth of burial 50 to 100 ft below ground level. The pronounced magnetic lows, associated with dykes A and B, have been interpretated as the effect of /Plate 2 remanent magnetisation inclined at an angle -60° to the horizontal, whereas the anomaly associated with dyke C has been produced primarily by induction. Based on this interpretation, the three dykes are calculated to dip southerly at 80°. Calculated values of apparent intensities of magnetisation for the dykes are as follows :-

Dyke A	0.017×10^{-3} c.g.s. units
Dyke B	0.004×10^{-3} c.g.s. units
Dyke C	0.012×10^{-3} c.g.s. units

Inspection of the magnetic anomalies associated with the remaining 4 dykes indicates that these dykes are in general similar to dyke C.

Analysis of dips

There is no direct evidence that remanent magnetisation is associated with meridional trending magnetic anomalies; accordingly interpretation is based on the assumption that sources are magnetised by induction only. Magnetic features are characterised by pronounced north-south elongation, and a high degree of east-west symmetry. The magnetic anomalies are therefore interpretated as being produced by two-dimensional thin sheet structures with high dip angle. Calculations of dip for typical anomalies yield, with few exceptions, angles ranging from 70°W through vertical to 70°E. This result is comparable with that obtained by Quilty (1964).

The absence of magnetic lows flanking positive anomalies is indicative of sources with large vertical extent.

A comprehensive calculation of dip angles has not been made due to the uncertainty which exists regarding the basic assumption that remanent magnetisation is negligible. When regional geological mapping is carried out, reinterpretation of aeromagnetic data would be invaluable as the presence of remanent magnetisation could be ascertained by reference to the geological data.

Regional Geological Structure

A few major structural features have been interpreted from the magnetic data by a combined study of zonal configuration, magnetic anomaly repetition and major displacements of magnetic trend lines. This is a development of the approach advocated by Ellis 1939, and adopted by Quilty 1964, which involved the study of magnetic patterns produced by arcuate remnants of banded iron formations. Interpreted fold axes are shown on Plates 2 and 3 together with the locations of major dykes.

Menzies 1:250,000 area. The limited geological control at present available in the northern part of the Kalgoorlie 1:250,000 (Kreiwaldt, 1964) indicates that major anticlinal axes are commonly defined by outcropping granite and minor synclinal axes by basic rocks of the greenstone series.

The major fold axis determined in the south-central part of the Menzies 1:250,000 area is interpreted as anticlinal. Evidence for this is the large region of zone 1 flanked on both sides by areas of zone 6 through zone 7 to zone 8. The closure of magnetic trend lines south of Lake Ballard, indicates a northerly pitch to this anticline. Two possible major anticlines sub-paralleling this central anticline are also shown on Plate 2.

A number of probable and possible associated minor synclines of probable isoclinal form, have been interpreted throughout the area.

The convergence of the minor synclinal axes north of Lake Ballard defines a possible crossfold axis which is interpretated as being synclinal. This is coincident with the major dyke striking N 70°E. The postulated crossfold axis coupled with the three synclinal axes in the north-east quadrant of the area, is considered responsible for the symmetrical zonal configurations.

Leonora 1:250,000 area. The south western part of this area shows a continuation of the relatively simple zonal configuration apparent in the Menzies area. The high degree of zonal complexity in the remainder of the area will however require extensive geological control to reveal its significance.

A few short fold axes have been resolved as shown in Plate 3. The possibility of additional folding is recognised from the magnetic data; however the limited degree of certainty does not warrant the display of these axes.

There is no magnetic or geological evidence to suggest the cause for the trend line convergence in the north of the area, although it almost certainly results from intersection of major fold axes.

The two major dykes do not appear to have had any recognizable control on the geological structure.

5. RADIOMETRIC RESULTS AND INTERPRETATION

Inboard Scintillometer results

Change in level of radiometric intensity (CILORI) profiles have been adjusted to an east-west scale of 1:250,000 and are shown for the

Leonora and Menzies areas in Plates 8 and 9. A north-south scale of 1:62,500 has been used to improve data presentation. Errors incurred in the positioning of the CILORI data are identical to those already stated for the presentation of magnetic data. Contour presentations of the CILORI data for the Leonora and Menzies areas are shown in Plates 10 and 11 together with the known geology. Some smoothing of the contours has been carried out in an attempt to minimise contour distortions produced by a combination of errors which include the variation in aircraft to terrain clearance, heading error associated with instrument response time produced by the 10 second time constant, curvilinear record, temperature affected instrumental drift, and variation in instrument sensitivity.

Outboard Scintillometer results

Radiometric anomalies detected in the Leonora and Menzies areas are listed in tables 1 and 2, appendix 2, and shown on Plates 10 and 11 respectively. The interpretation applied for acceptance of these anomalies involved the criteria listed in appendix 2.

Interpretation

CILORI Plates 10 and 11 show that generally low gamma radiation is associated with areas mapped as greenstones. Areas of significant anomalous amplitude have a well defined association with either the mapped rock outcrops which commonly occur in zones 1, 2 or 3, or salt lake deposits. The former group of anomalies are interpreted as indicative of granitic rocks. The latter group is more interesting although the source of the gamma radiation is not known. A significant correlation was observed between colour and anomalous gamma radiation of the small salt lakes and clay pans to the immediate north of 19 Mile Rocks/. Anomalous gamma radiation was / Plate 10 seen to be greatest over the evaporites coloured brown, and least over those coloured white. Detailed photographic coverage has been made for some of these anomalies to assist ground surveying.

Radiometric Anomalies

It is not possible to determine the significance of the outboard radiometric anomalies in either the Leonora or Menzies 1:250,000 areas due to the lack of detailed geological information. To make such a determination it would be necessary to carry out a ground radiometric survey; however only anomalies of categories A and B warrant investigation as types C and D may prove very difficult to detect by ground work and their significance is marginal.

6. CONCLUSIONS AND RECOMMENDATIONS

The magnetic trend assessment and zonal interpretation of the survey area should be of considerable value to regional geological mapping. However, the significance of each zone can only be ascertained during the course of such mapping.

Dip angles calculated from meridional magnetic anomalies range from 70° to 90° and compare favourably with results obtained from previous airborne surveys in this locality. Remanent magnetisation has again been found to be associated with some, but not all, of the east-west dykes.

It is advocated that reinterpretation of the magnetic data, in particular dip analysis be made in conjunction with future regional geological mapping. This would test the validity, and possibly lead to the expansion of the limited interpretation of geological structure.

The convergence of magnetic, and interpreted geological, features at latitude 29°33'S, longitude 120°11'E warrants detailed ground investigation to determine whether economic mineralisation exists.

Data obtained from the inboard scintillometer (CILORI) has been successfully contoured, using a contour interval of 50 counts per second. There is a general correlation between the CILORI anomalies and both the known geology and that interpreted from the magnetic data. The anomalies commonly associated with salt lake evaporites require ground investigation to ascertain the radioactive sources and their economic significance.

The outboard scintillometer detected 64 point source anomalies of which 47 warrant investigation to determine any possible economic significance.

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APPENDIX

OPERATIONAL DETAILS

STAFF

Party Leader	:	G.A. Young
Geophysicist	:	D.B. Tipper
Senior radio technician	:	P.B. Turner
Draughting assistant	:	P. Kersulis
Geophysical assistants	:	K.A. Mort D. Park I. Parkinson
Pilots	:	Capt. T. Newman First Officer D. Brown First Officer J. Rollston
Aircraft maintenance engineer	:	B. Hall

(Pilots and aircraft maintenance engineer: T.A.A.)

EQUIPMENT

Aircraft	:	D.C.3 VH-MIN
Magnetometer	:	MFS-5 saturable core fluxgate, tail-boom installation coupled to 'Speedomax' and digital recorders
Scintillographs	:	Twin crystal MEL scintillation detector heads inboard and outboard (the latter suspended from a cable 200 feet below aircraft). Outputs coupled to Kelvin Hughes recorders.
Camera	:	"Aeropath', 35 mm strip
Radio Altimeter	:	STR30B, frequency modulated type
Air Position Indicator	:	Track recorded by Esterline Angus recorder.
Magnetometer	:	MFD-3 saturable core fluxgate, ground installation for storm warning.

SURVEY SPECIFICATIONS

Altitude	:	500 feet above ground level
Line spacing	:	1 mile
Line orientation	:	East

Tie system	:	Single lines spaced 15 miles apart, double lines at eastern and western boundaries of individual 4-mile areas.
Navigation control	:	Aerial photographs
Record sensitivity		
MFS-5	:	100 gammas/in
Inboard (CILORI) scintillometer	:	100 c.p.s./cm
Outboard scintillometer	:	100 c.p.s./cm
Scintillometer time constants	:	
Inboard (CILORI)	:	10 secs
Outboard	:	1 sec.

APPENDIX 2

OUTBOARD RADIOMETRIC ANOMALIES

Anomaly Interpretation Criteria

Amplitude For an anomaly to be resolved from the normal gamma ray background noise the amplitude of the anomaly must be statistically significant. The acceptance level is set at

Anomaly amplitude to be $>$ 3 x standard deviation of gamma ray background noise

Gamma ray background noise Two distinct types of gamma ray background noise are recognised which are produced by :-

1. Statistical variation of the recorded gamma ray intensity from a homogeneous source, the standard deviation of the count rate being determinable from the equation

$$S.D. = \sqrt{\frac{N}{2 T}} \quad \text{where } N = \text{count rate}, \quad T = \text{time constant of counter}$$

2. Variation of the gamma ray intensity from a heterogeneous source which may be produced by a geological environment involving variations in overburden above a homogeneous source.

The envelopes containing both forms of gamma ray background noise have a height of 4 x standard deviation of that noise, typical records illustrating noise and anomalies are shown in Plate 12.

Form Anomaly shape depends upon the configuration of the source and its location relative to the aircraft. The width of an anomaly at half peak amplitude is related to these factors and the acceptance limits set are :-

Anomaly width at half peak amplitude to be $>$ 3 seconds and $<$ 4 seconds. This width criterion results in the acceptance of a continuous series of sources which is limited by sources with radius 300 feet centred on the aircraft's line of flight, and point sources located within 300 feet of the aircraft's line of flight.

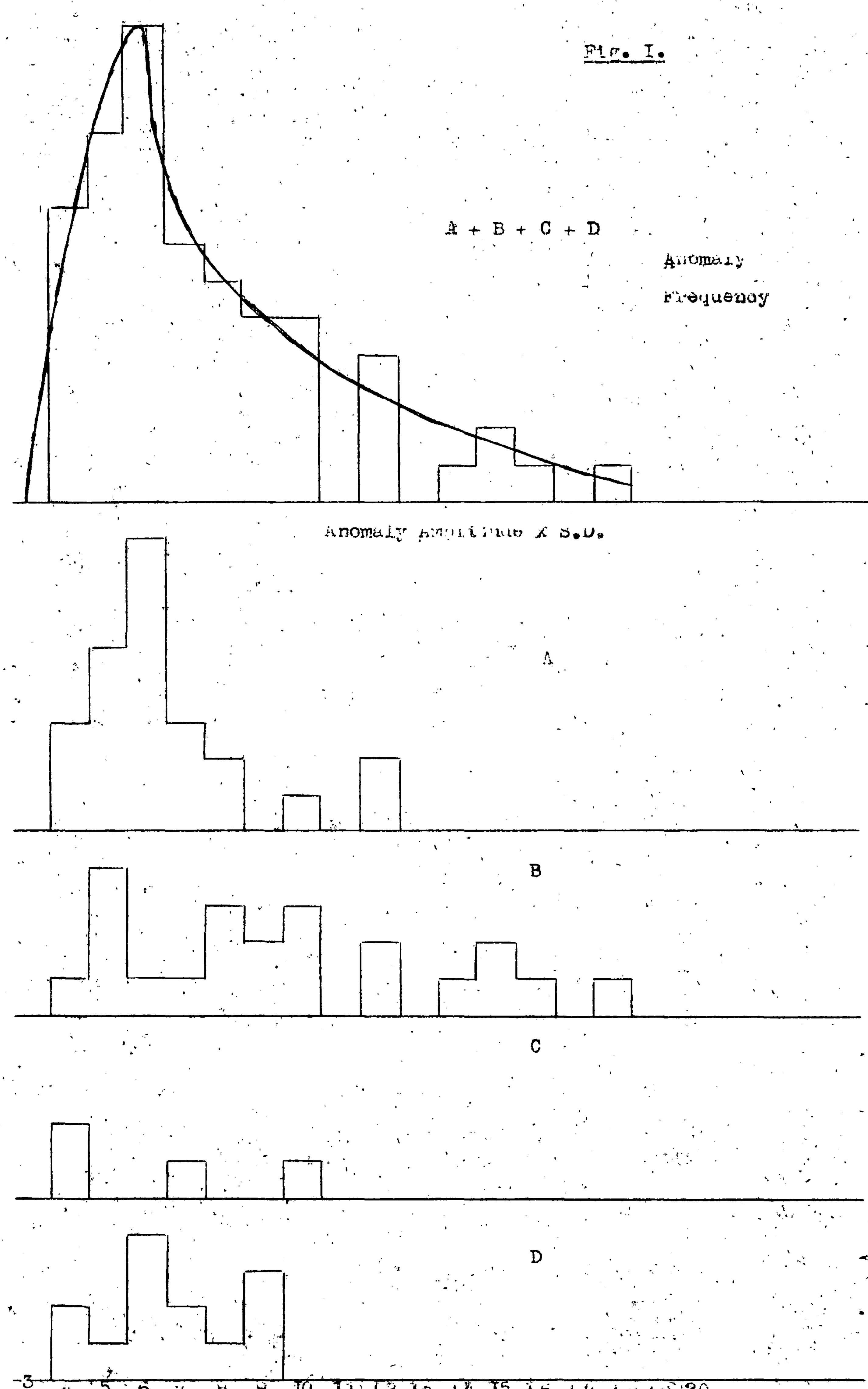
Table 1. Outboard radiometric anomalies Menzies 1:250,000 area

Anomaly No.	Line No.	Fiducial No.	Half Peak width (secs)	Amplitude (x.S.D.)	Anomaly Classification
1	78 W	854.8	4.0	9	D
2	78 W	849.5	4.0	9	D
3	80 W	318.7	3.5	5	A
4	84 W	795.0	3.0	8	B
5	85 E	511.1	3.5	5	B
6	86 W	290.0	3.0	8	B
7	89 W	233.1	3.0	7	A
8	91 W	599.7	3.0	8	B
9	94 E	506.6	4.0	9	B
10	94 E	528.6	3.0	7	B
11	96 E	030.2	3.0	6	A
12	97 W	805.4	3.0	4	A
13	103 E	825.5	4.0	9	B
14	103 E	974.8	4.0	10	A
15	106 W	088.3	3.0	16	B
16	108 W	753.6	3.5	6	A
17	108 W	693.9	4.0	10	B
18	110 W	167.4	3.5	12	A
19	112 W	749.3	3.0	10	C
20	114 W	139.0	4.0	12	B
21	116 E	885.0	3.5	14	B
22	116 E	922.4	4.0	6	A
23	119 W	189.8	3.5	15	B
24	120 E	885.6	3.0	4	C
25	120 E	042.4	3.5	10	B
26	121 W	820.0	3.0	7	A
27	121 W	654.1	3.0	12	B
28	122 E	430.5	4.0	7	C
29	123 W	298.8	3.5	5	A
30	123 W	297.8	4.0	6	A
31	123 W	294.3	3.5	18	B
32	128 W	184.0	4.0	7	A
33	129 E	842.0	3.5	4	A
34	133 E	944.3	4.0	6	A
35	137 E	639.2	4.0	6	A
36	137 E	686.6	4.0	8	A
37	140 W	167.1	4.0	6	A

Table 2. Outboard Radiometric Anomalies : Leonora 1:250,000 Area

Anomaly No.	Line No.	Fiducial No.	Half Peak width (secs)	Amplitude (x.S.D.)	Anomaly Classification
1	4 W	179.8	3.5	4	D
2	5 E	364.3	3.5	7	D
3	6 W	624.7	4.0	4	C
4	7 E	764.5	3.5	4	D
5	8 W	234.0	3.5	6	D
6	12 W	144.7	3.5	7	D
7	15 E	749.8	3.0	4	A
8	17 E	256.3	3.0	6	B
9	23 E	799.6	3.5	5	B
10	27 E	743.5	4.0	9	D
11	28 W	176.5	4.0	4	B
12	29 E	316.2	4.0	6	D
13	31 E	902.6	3.0	5	B
14	32 W	134.0	4.0	5	B
15	44 E	378.0	3.5	5	A
16	48 E	194.1	4.0	8	A
17	51 E	709.6	3.0	6	D
18	55 E	692.1	4.0	26	B
19	57 E	718.3	4.0	6	D
20	57 E	739.7	3.0	5	A
21	59 E	144.5	4.0	10	B
22	60 W	934.4	4.0	12	A
23	61 E	691.7	3.5	6	A
24	62 W	511.7	4.0	15	B
25	62 W	474.4	3.0	8	D
26	64 E	209.7	4.0	5	A
27	66 E	820.6	3.5	5	D

STATISTICAL ANALYSIS OF OUTBOARD RADIOMETRIC ANOMALIES



HISTOGRAMS OF AMPLITUDE AND FREQUENCY OF OCCURENCE OF OUTBOARD RADIOMETRIC ANOMALIES

PROBABLE RELATIONSHIPS BETWEEN ANOMALY AMPLITUDE, FREQUENCY AND RESOLUTION.

FIG. 2

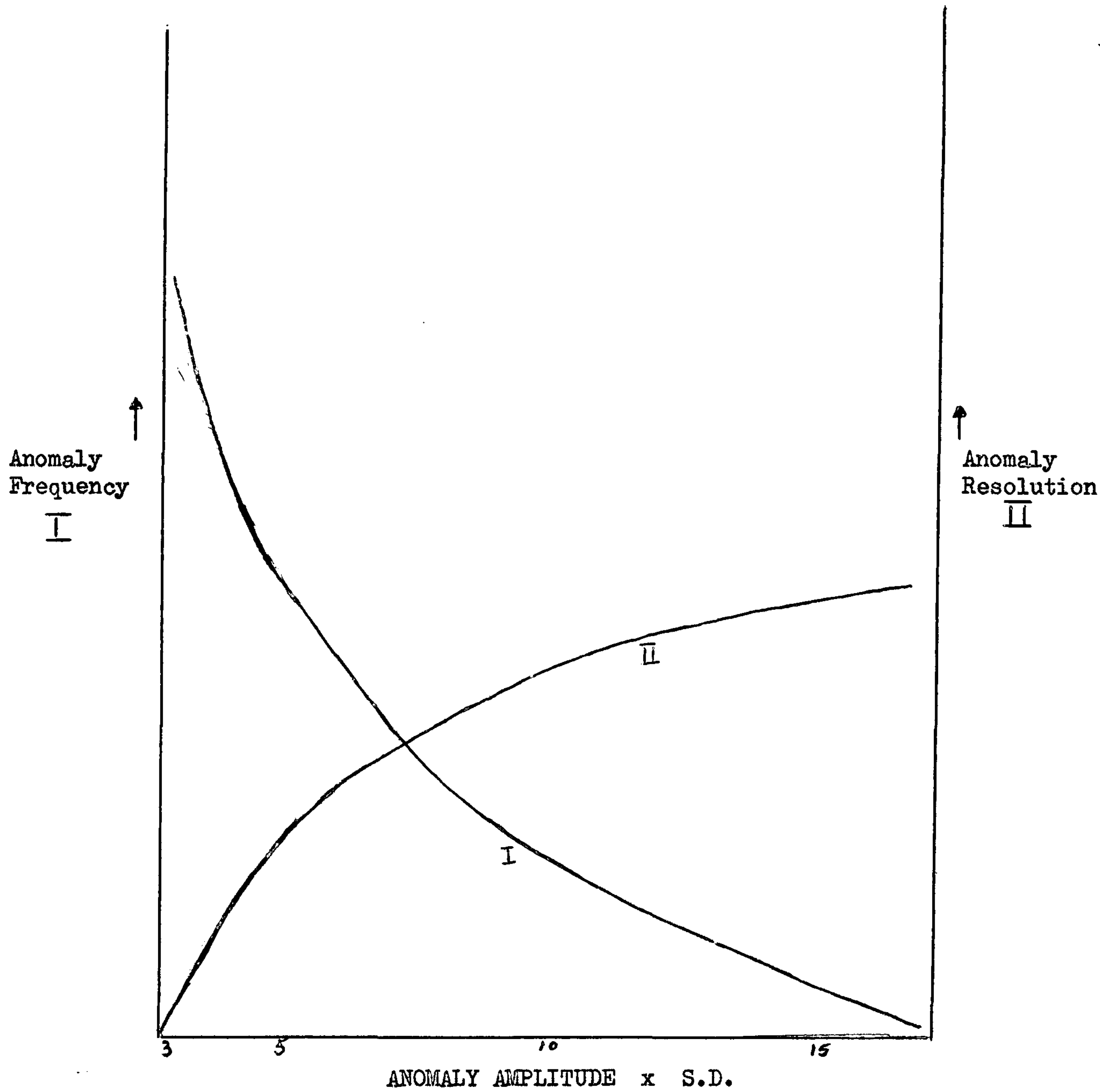
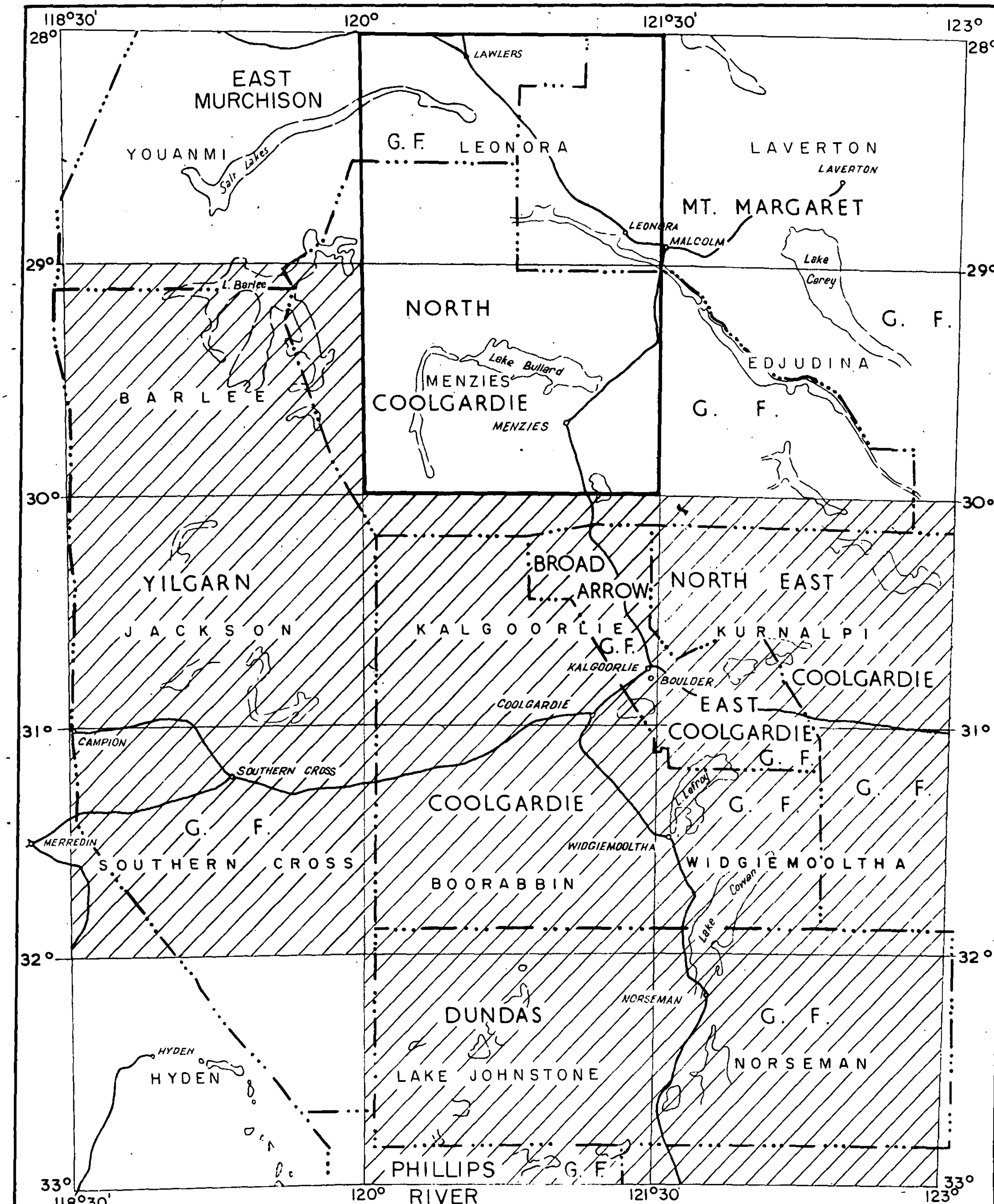


Figure 1 illustrates the distribution of outboard radiometric anomalies in terms of their amplitudes. The cause for peaking of the composite histogram at 6 x S.D is interpreted as the effect of anomaly resolution decreasing rapidly below 7 x S.D., being zero at 3 x S.D. This indicates the subjective nature of the method of anomaly selection coupled with the interference produced by statistical noise on anomaly form. Figure 2 illustrates the probable relationships between anomaly amplitude, frequency and resolution.



LOCALITY MAP

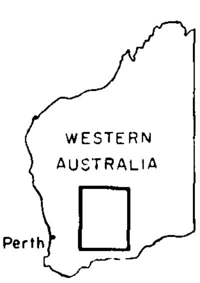
AIRBORNE MAGNETOMETER AND SCINTILLOGRAPH SURVEY 1964

MENZIES - LEONORA AREA WA

SCALE IN MILES

40 0 40 80 120

LOCATION DIAGRAM



AREA PREVIOUSLY SURVEYED

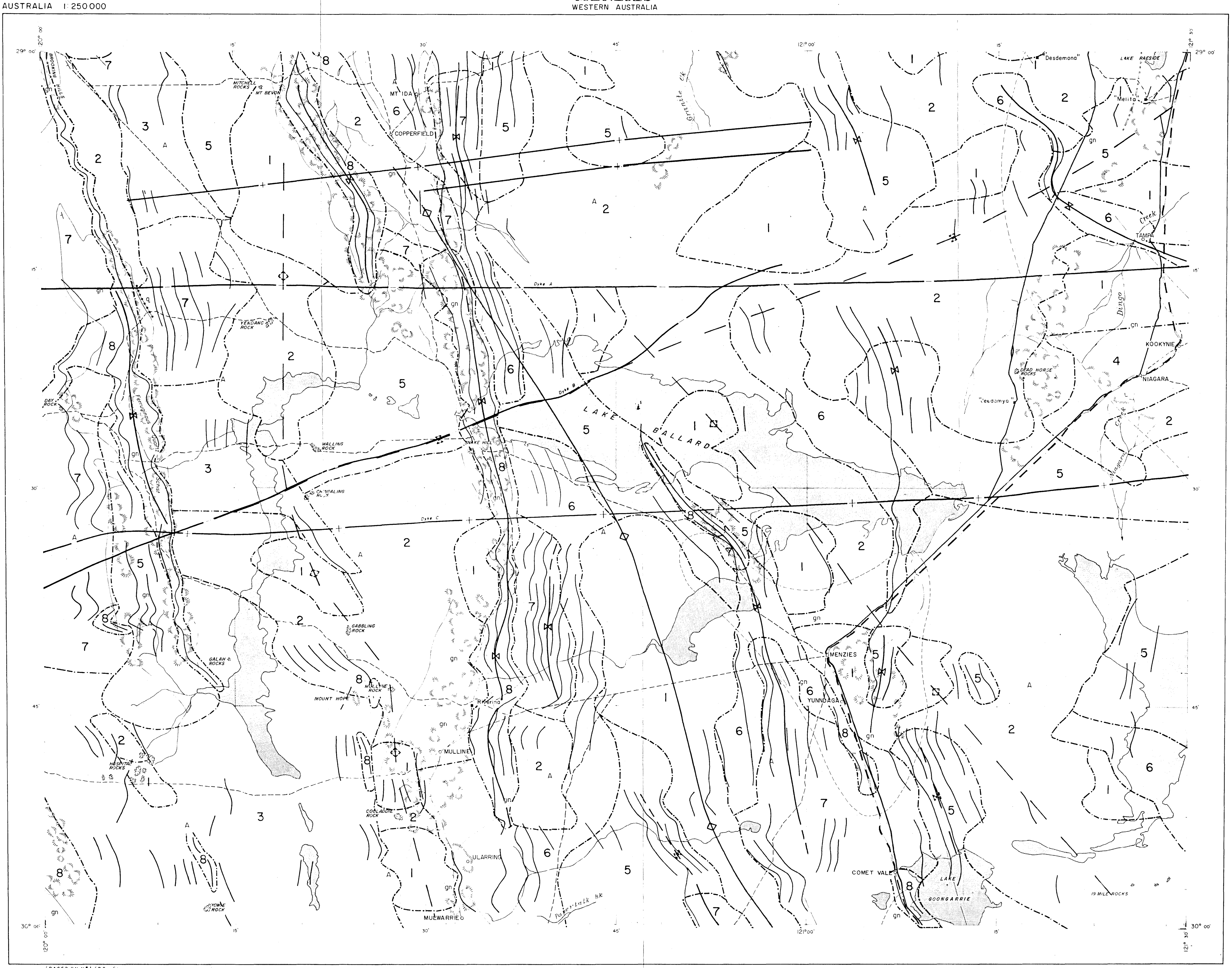
1964 SURVEY BOUNDARY

GOLDFIELDS BOUNDARIES

Geophysical Branch, Bureau of Mineral Resources Geology & Geophysics. H51/B1-21

AUSTRALIA 1:250 000

MENZIES
WESTERN AUSTRALIA



(BASED ON H51/B0-5)

GEOLOGICAL LEGEND

AFTER TECTONIC MAP OF AUSTRALIA

- Geological boundary
- Interpolated trends of bedding, foliation etc.
- Syncline

AFTER WESTERN AUSTRALIA, GEOLOGICAL SURVEY, BULLETIN 45

- Geological boundary
- Bedding strike and direction of dip
- Dyke or vein: q – quartz

ARCHAEAN

- A — Undifferentiated (mostly granite or gneiss with some meta-volcanics and meta-sediments)
- gn — "Greenstones"

GEOLOGICAL REFERENCE

A Western Australia, Geological Survey, Bulletin 45

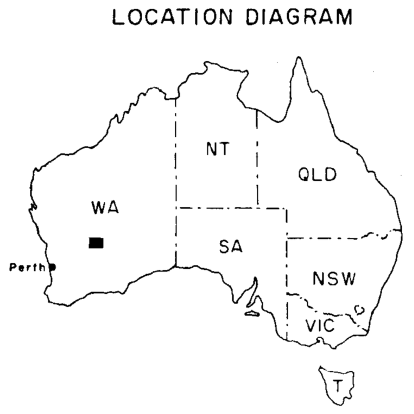
B Tectonic Map of Australia

GEOPHYSICAL LEGEND

TOPOGRAPHICAL LEGEND

- River or creek
- Highway
- Road or track
- Railway
- Named place
- Homestead
- Hill feature
- Rock feature

LOCATION DIAGRAM



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YOUANMI	LEONORA	LAVERTON
BARLEE	MENZIES	EDJUDINA
JACKSON	KALGOORLIE	KURNALPI

GEOPHYSICAL INTERPRETATION
AND
GEOLOGY

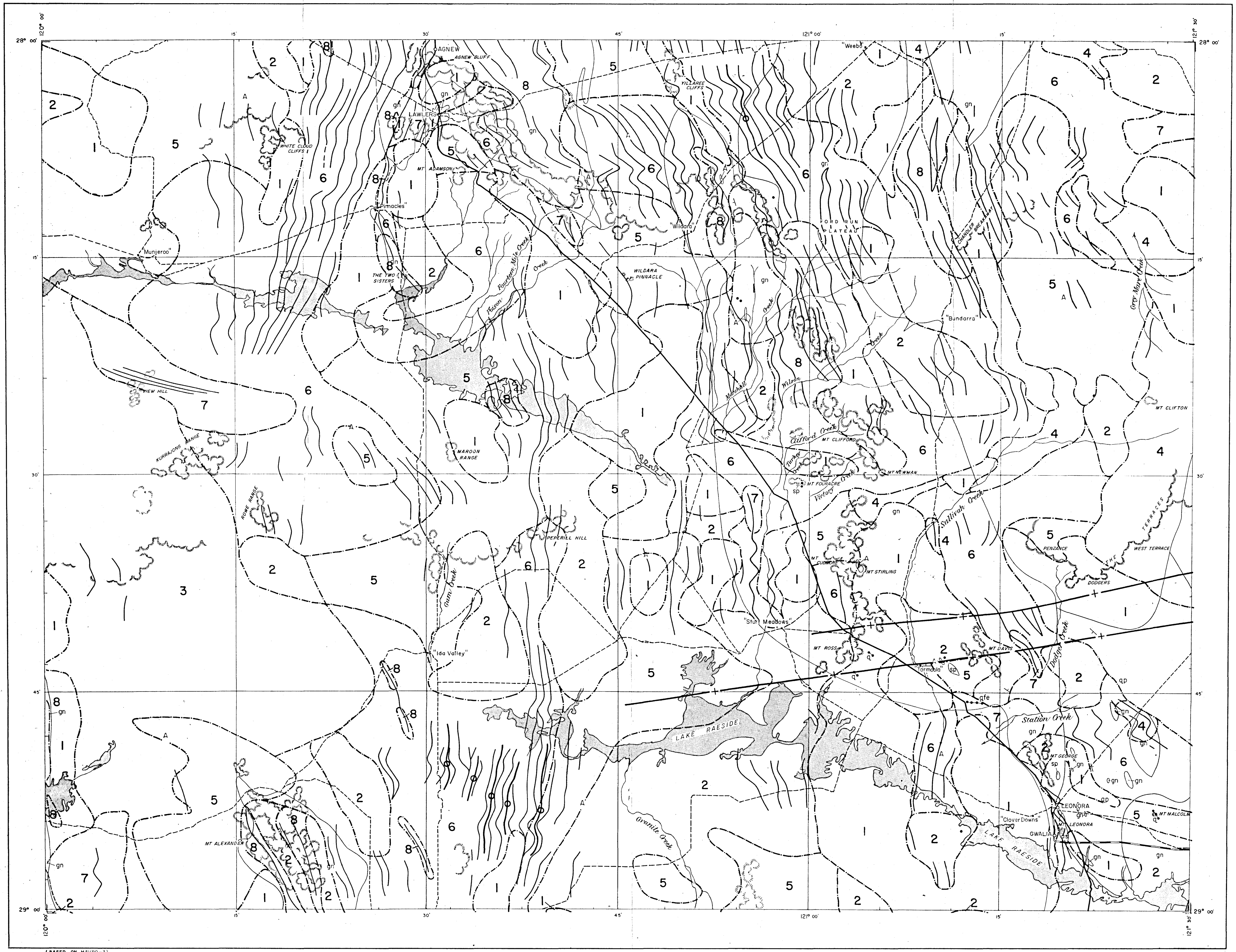
MILES 4 0 4 8 12 16 20 MILES

KILOMETRES 5 0 5 10 15 20 25 30 KILOMETRES

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H51/B1-38

AUSTRALIA 1:250,000

LEONORA
WESTERN AUSTRALIA



(BASED ON H51/B0-3)

GEOLOGICAL LEGEND

AFTER TECTONIC MAP OF AUSTRALIA

- - - - Geological boundary

ARCHAEAN
- A — Undifferentiated (mostly granite or gneiss with some meta-volcanics and meta-sediments)
- gn — "Greenstones"

AFTER WESTERN AUSTRALIA, GEOLOGICAL SURVEY, BULLETINS 45 AND 84

- Geological boundary
- Bedding, strike and direction of dip
- Dyke or vein: quartz - q, jasper - qfe
- Quartz blow

METAMORPHOSED SEDIMENTARY ROCKS
- as — Andalusite

OLDER IGNEOUS ROCKS
- gn — "Greenstones" — Derivatives of dolerites and gabbros
- sp — Serpentine
- qp — Contemporaneous acid rocks — (Foliated quartz porphyries (granite schists))

LATER ACID IGNEOUS ROCKS
- A — Granite and contemporaneous porphyry and porphyrite dykes.

GEOLOGICAL REFERENCE

A. Western Australia, Geological Survey, Bulletin 45
B. Western Australia, Geological Survey, Bulletin 84
C. Tectonic Map of Australia

GEOPHYSICAL LEGEND

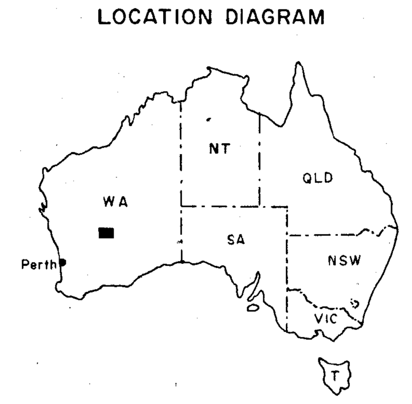
- Magnetic trend
- Zone boundary
- Dyke, induced polarisation
- Probable fold axis

TOPOGRAPHICAL LEGEND

- River or creek
- Named place
- Highway
- Homestead
- Road or track
- Hill feature
- Railway
- Rock feature

True North / Mag. North

LOCATION DIAGRAM



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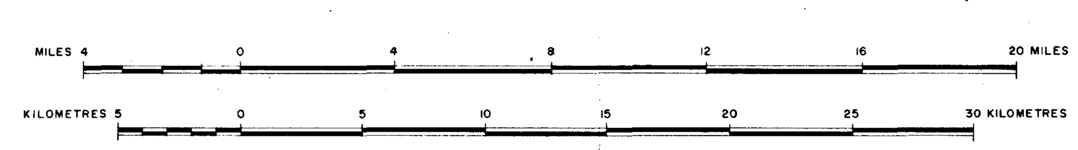
BARLEE	MENZIES	EDJUDINA

AIRBORNE SURVEY, MENZIES - LEONORA, WA 1964

GEOPHYSICAL INTERPRETATION
AND
GEOLOGY



MENZIES
WESTERN AUSTRALIA

AIRBORNE SURVEY, MENZIES-LEONORA, WA 1964

TOTAL MAGNETIC INTENSITY PROFILES

LOCATION DIAGRAM

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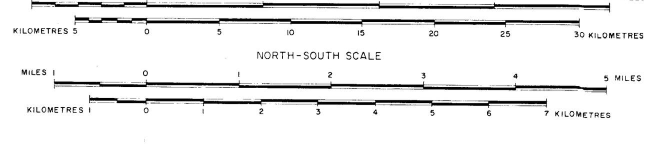
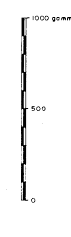
BARLEE	MENZIES	EDJUDINA
JACKSON	KALGOORLIE	KURNALPI



APPROX. PROFILE SCALE



EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A D.C.3 AIRCRAFT AT AN ALTITUDE OF 500 FEET ABOVE GROUND LEVEL ALONG LINES SPACED ONE MILE APART.

THE TOTAL MAGNETIC INTENSITY PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL INTENSITY. THIS COMPONENT AMOUNTS TO 8 GAMMAS PER MILE.

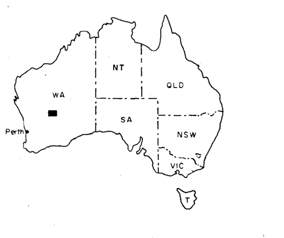
THE FLIGHT-LINES ARE IDEALISED, AND SERVE AS BASELINES TO THE PROFILES. THE MAGNETIC DATA HAVE BEEN POSITIONED WITH A PROBABLE ERROR OF ± 1/2 MILE.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H51/B1-26

PLATE

LEONORA
WESTERN AUSTRALIA

LOCATION DIAGRAM



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AIRBORNE SURVEY, MENZIES-LEONORA, WA 1964

TOTAL MAGNETIC INTENSITY PROFILES

EAST-WEST SCALE

MILES 5 0 5 10 15 20 MILES

KILOMETRES 5 0 5 10 15 20 25 30 KILOMETRES

NORTH-SOUTH SCALE

MILES 1 0 1 2 3 4 5 MILES

KILOMETRES 1 0 1 2 3 4 5 6 7 KILOMETRES

APPROX. PROFILE SCALE

1000 gammas

500

0

EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A D.C.3 AIRCRAFT AT AN ALTITUDE OF 500 FEET ABOVE GROUND LEVEL ALONG LINES SPACED ONE MILE APART.

THE TOTAL MAGNETIC INTENSITY PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL INTENSITY. THIS COMPONENT AMOUNTS TO 8 GAMMAS PER MILE.

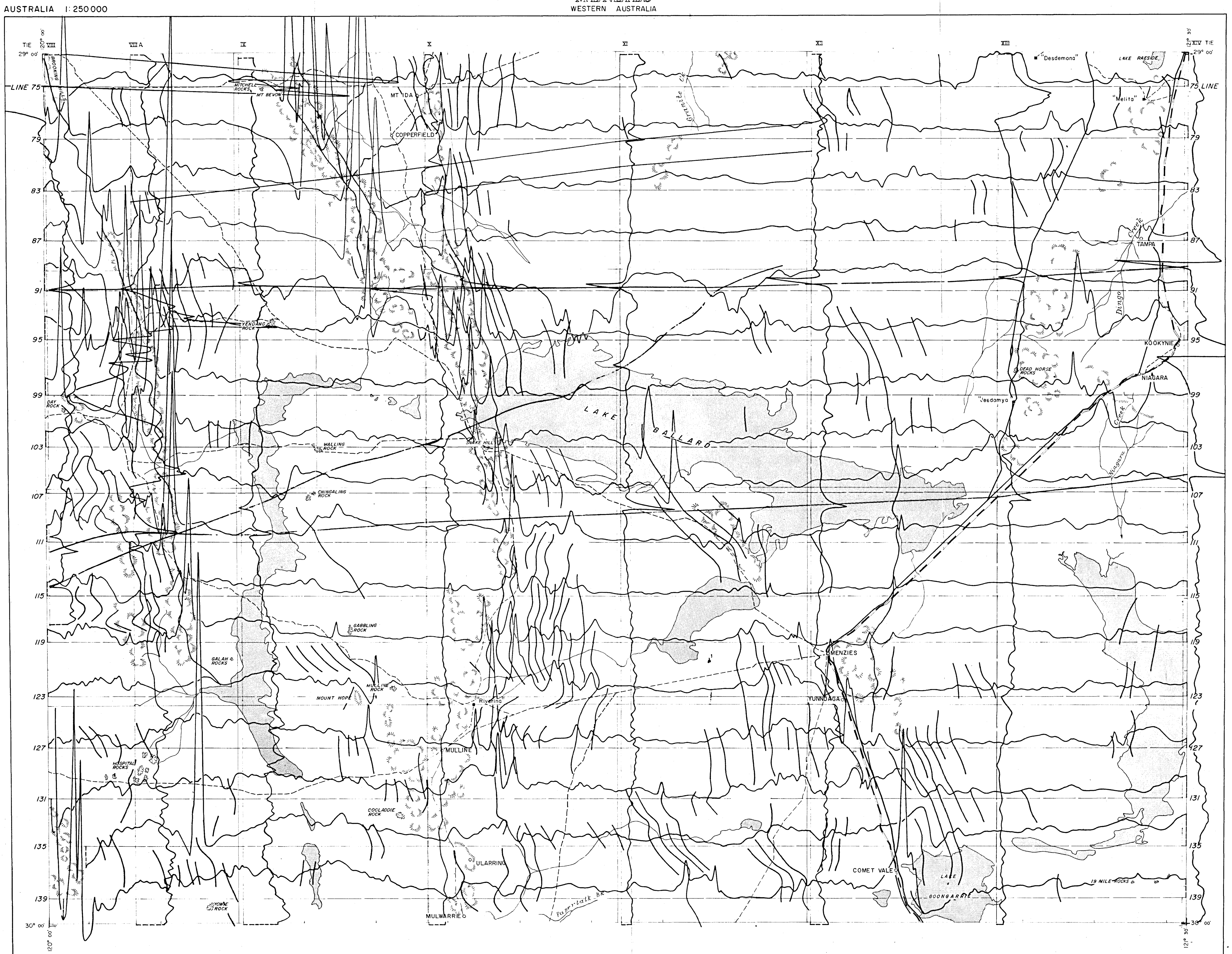
THE FLIGHT-LINES ARE IDEALISED, AND SERVE AS BASELINES TO THE PROFILES. THE MAGNETIC DATA HAVE BEEN POSITIONED WITH A PROBABLE ERROR OF ± 1/2 MILE.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H51/B1-24

AUSTRALIA 1:250 000

MENZIES

WESTERN AUSTRALIA



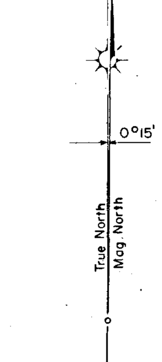
(BASED ON H51/B0-4)

GEOPHYSICAL LEGEND

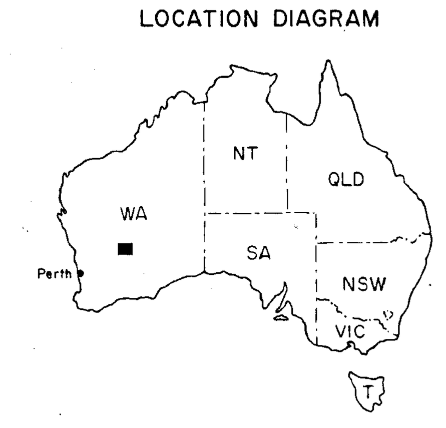
- Magnetic profile
- Flight line
- Magnetic trend

TOPOGRAPHICAL LEGEND

- River or creek
- Highway
- Road or track
- Railway
- Named place
- Homestead
- Hill feature
- Rock feature



LOCATION DIAGRAM



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AIRBORNE SURVEY, MENZIES-LEONORA, WA 1964

TOTAL MAGNETIC INTENSITY PROFILES AND MAGNETIC TRENDS

MILES 4 0 4 8 12 16 20 MILES

KILOMETRES 5 0 5 10 15 20 25 30 KILOMETRES

APPROX. PROFILE SCALE

1000 gammas
500
0

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 TOTAL MAGNETIC INTENSITY PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL INTENSITY.

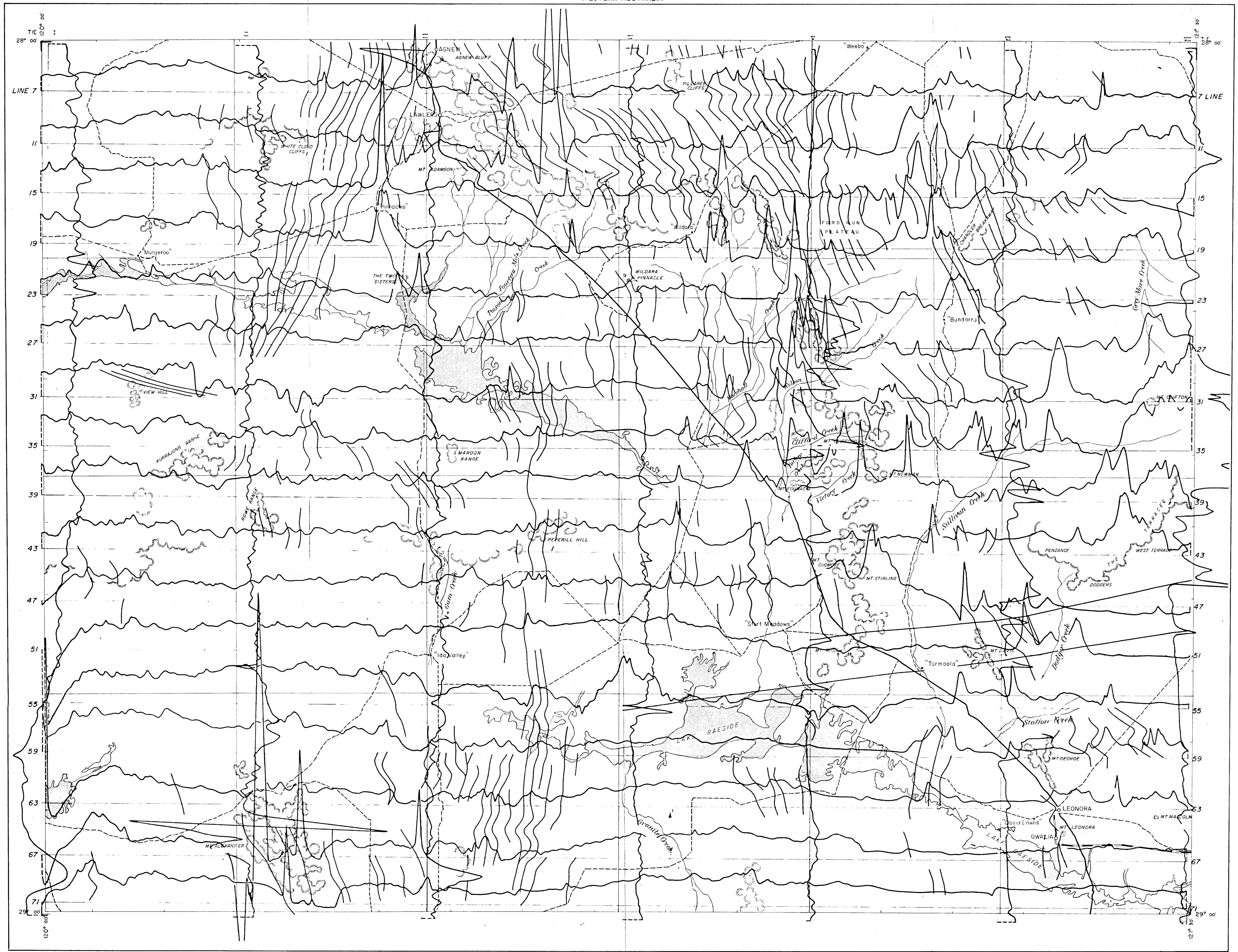
THIS COMPONENT AMOUNTS TO 8 GAMMAS PER MILE.

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

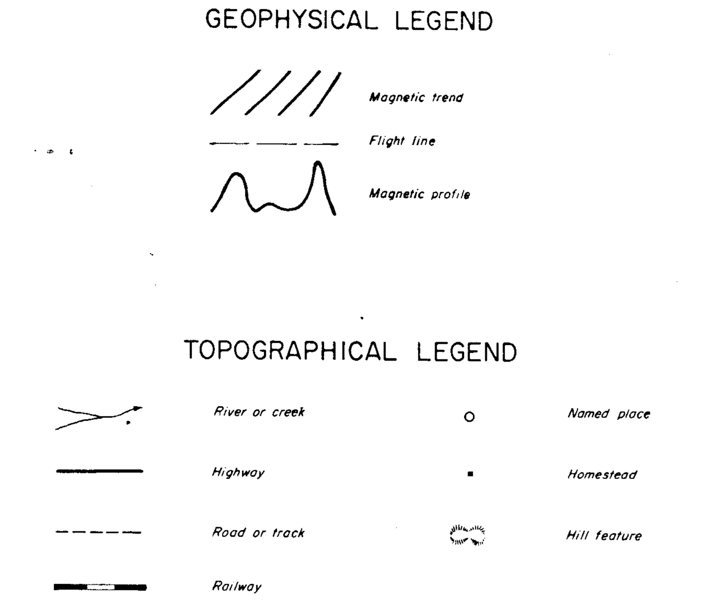
THE FLIGHT-LINES ARE IDEALISED, AND SERVE AS BASELINES TO THE PROFILES. THE MAGNETIC DATA HAVE BEEN POSITIONED WITH A PROBABLE ERROR OF ± ½ MILE.

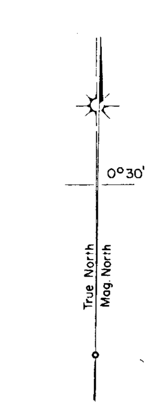
AUSTRALIA 1:250000

LEONORA
WESTERN AUSTRALIA



(BASED ON H51/B0-21)





LOCATION DIAGRAM

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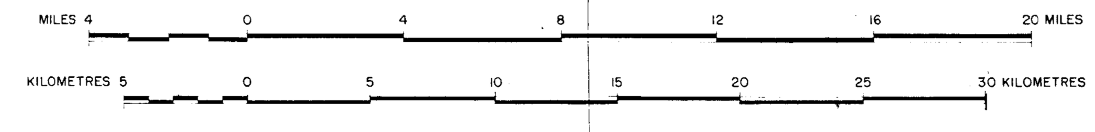
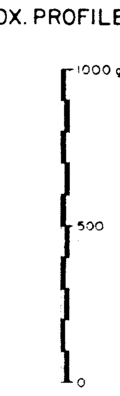
AIRBORNE SURVEY, MENZIES-LEONORA, WA 1964

TOTAL MAGNETIC INTENSITY PROFILES AND MAGNETIC TRENDS



APPROX. PROFILE SCALE



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 TOTAL MAGNETIC INTENSITY PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL INTENSITY

THIS COMPONENT AMOUNTS TO 8 GAMMAS PER MILE

PROFILES RECORDED AT INTERVALS OF FOUR MILES ARE SHOWN ON THE MAP

THE FLIGHT-LINES ARE IDEALISED, AND SERVE AS BASELINES TO THE PROFILES. THE MAGNETIC DATA HAVE BEEN POSITIONED WITH A PROBABLE ERROR OF ± 1/2 MILE

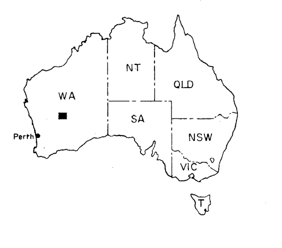
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H51/B1-23

MENZIES
WESTERN AUSTRALIA

AIRBORNE SURVEY, MENZIES – LEONORA, WA 1964

RADIOMETRIC PROFILES

LOCATION DIAGRAM



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YOUANMI	LEONORA	LAVERTON
BARLEE	MENZIES	EDJUDINA
JACKSON	KALGOORLIE	KURNALPI

EAST-WEST SCALE

5 0 5 10 15 20 MILES

5 0 5 10 15 20 25 30 KILOMETRES

NORTH-SOUTH SCALE

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 KILOMETRES

APPROX. PROFILE SCALE

400 counts per second

200

0

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 RADIOMETRIC PROFILES HAVE BEEN CORRECTED FOR THE RADIOMETRIC BACKGROUND MEASURED AT 2000 FEET ABOVE GROUND LEVEL.

THE FLIGHT-LINES ARE IDEALISED, AND SERVE AS BASELINES TO THE PROFILES. THE RADIOMETRIC DATA HAS BEEN POSITIONED WITH A PROBABLE ERROR OF $\pm 1/2$ MILE.

PROFILE INTERPOLATED

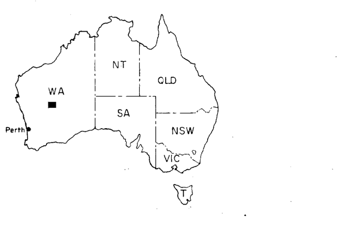
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H51/B1-34

LEONORA
WESTERN AUSTRALIA

AIRBORNE SURVEY, MENZIES – LEONORA, WA 1964

RADIOMETRIC PROFILES

LOCATION DIAGRAM



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SANDSTONE	SIR SAMUEL	DUKETON
YOUANMI	LEONORA	LAVERTON
BARLEE	MENZIES	EDJUDINA

EAST–WEST SCALE

5 0 5 10 15 20 MILES

5 0 5 10 15 20 25 30 KILOMETRES

NORTH–SOUTH SCALE

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 KILOMETRES

APPROX. PROFILE SCALE

400 counts per second

200

0

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 RADIOMETRIC PROFILES HAVE BEEN CORRECTED FOR THE RADIOMETRIC BACKGROUND MEASURED AT 2000 FEET ABOVE GROUND LEVEL.

THE FLIGHT-LINES ARE IDEALISED, AND SERVE AS BASELINES TO THE PROFILES. THE RADIOMETRIC DATA HAS BEEN POSITIONED WITH A PROBABLE ERROR OF ± 1/2 MILE

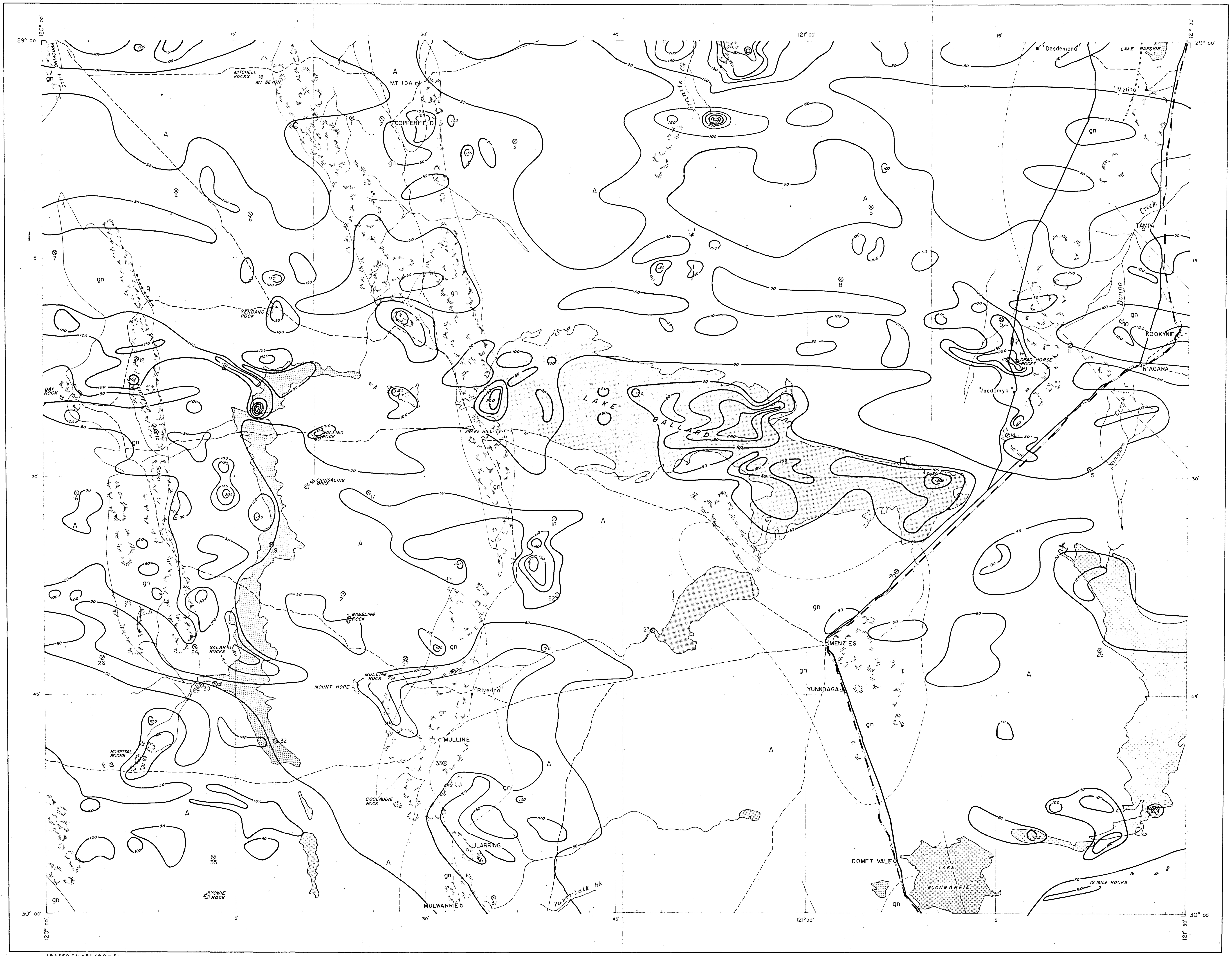
PROFILE INTERPOLATED

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H51/B1-33

AUSTRALIA 1:250000

MENZIES

WESTERN AUSTRALIA



GEOLOGICAL LEGEND

AFTER TECTONIC MAP OF AUSTRALIA

- Geological boundary
- Interpolated trends of bedding, foliation etc.
- Syncline

AFTER WESTERN AUSTRALIA, GEOLOGICAL SURVEY, BULLETIN 45

- Geological boundary
- Bedding strike and direction of dip
- Dyke or vein: q – quartz

ARCHAEAN

- A — Undifferentiated (mostly granite or gneiss with some meta-volcanics and meta-sediments)
- gn — "Greenstones"

GEOLOGICAL REFERENCE

A Western Australia, Geological Survey, Bulletin 45

B Tectonic Map of Australia

GEOPHYSICAL LEGEND

50, 100, 150 — Radiometric contours (no contours are shown where radiometric profiles have been interpolated)

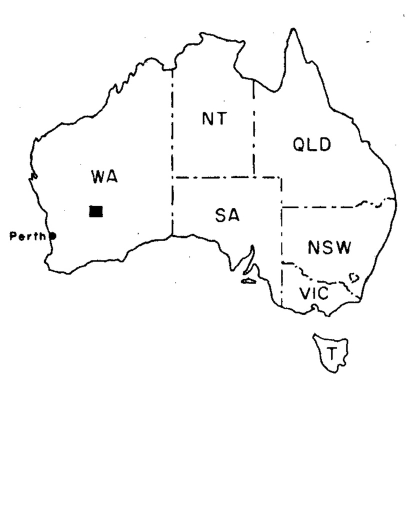
34 ⊗ — Radiometric anomaly restricted source (anomalies are numbered for reference only)

TOPOGRAPHICAL LEGEND

	River or creek		Named place
	Highway		Homestead
	Road or track		Hill feature
	Railway		Rock feature

True North / Mag North 0°15'

LOCATION DIAGRAM



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YOUANMI	LEONORA	LAVERTON
BARLEE	MENZIES	EDJUDINA
JACKSON	KALGOORLIE	KURNALPI

AIRBORNE SURVEY, MENZIES-LEONORA, WA 1964

RADIOMETRIC RESULTS

AND

GEOLOGY

MILES 4 0 4 8 12 16 20 MILES

KILOMETRES 5 0 5 10 15 20 25 30 KILOMETRES

RADIOMETRIC CONTOUR INTERVAL 50 COUNTS PER SECOND

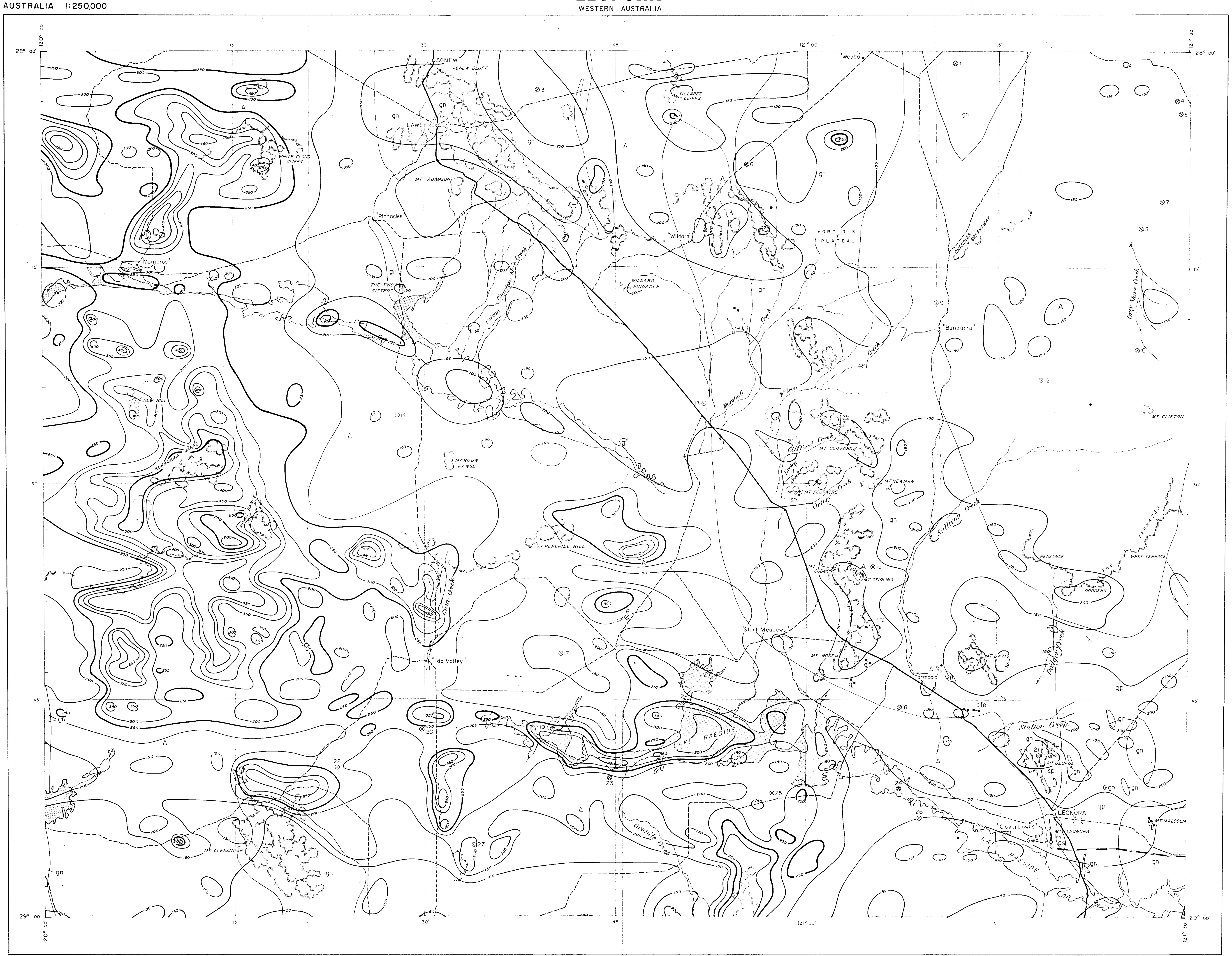
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H51/B1-36

AUSTRALIA 1:250,000

LEONORA

WESTERN AUSTRALIA

PLATE II



[BASED ON H51/B0-3]

GEOLOGICAL LEGEND

AFTER TECTONIC MAP OF AUSTRALIA

Geological boundary

ARCHAEAN
- A — Undifferentiated (mostly granite or gneiss with some meta-volcanics and meta-sediments)
- gn — "Greenstones"

AFTER WESTERN AUSTRALIA, GEOLOGICAL SURVEY, BULLETINS 45 AND 84

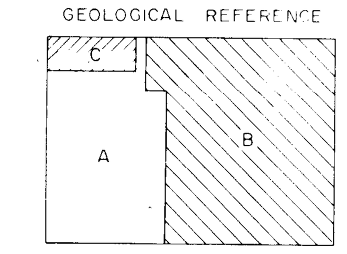
- Geological boundary
- Bedding, strike and direction of dip
- Dyke or vein: quartz – q, jasper – qfe
- Quartz blow

METAMORPHOSED SEDIMENTARY ROCKS
- as — Andalusite

OLDER IGNEOUS ROCKS
- gn, sp — "Greenstones": Derivatives of dolerites and gabbros; Serpentine
- qp — Contemporaneous acid rocks: Foliated quartz porphyries (granite schists)

LATER ACID IGNEOUS ROCKS
- A — Granite and contemporaneous porphyry and porphyrite dykes.

GEOLOGICAL REFERENCE



A. Western Australia, Geological Survey, Bulletin 45
B. Western Australia, Geological Survey, Bulletin 84
C. Tectonic Map of Australia

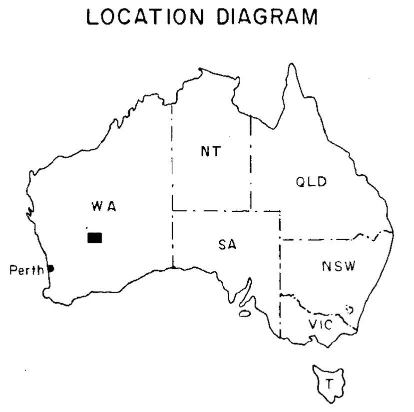
GEOPHYSICAL LEGEND

- 50, 100, 150 — Radiometric contours (no contours are shown where radiometric profiles have been interpolated)
- 15⊗ — Radiometric anomaly restricted source (anomalies are numbered for reference only)

TOPOGRAPHICAL LEGEND

	River or creek	○	Named place
	Highway	■	Homestead
	Road or track		Hill feature
	Railway		Rock feature

LOCATION DIAGRAM



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AIRBORNE SURVEY, MENZIES-LEONORA, WA 1964

RADIOMETRIC RESULTS

AND

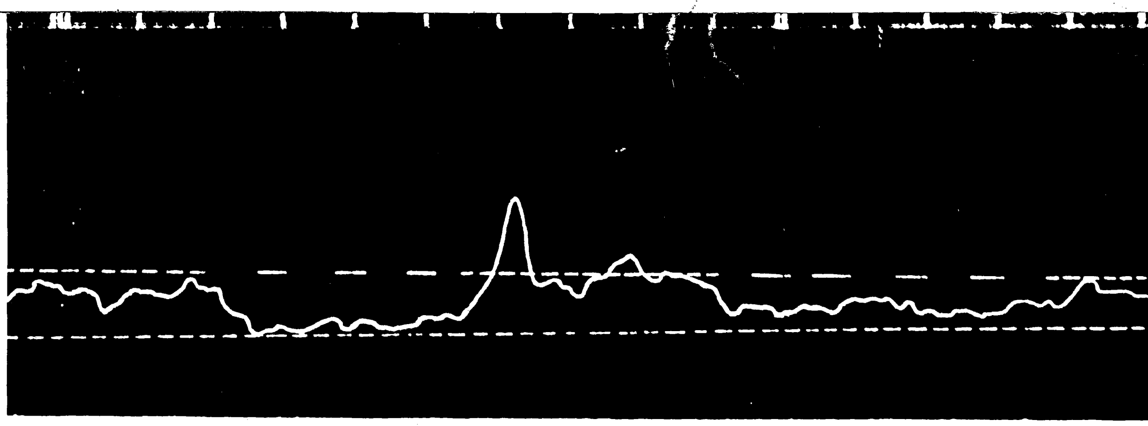
GEOLOGY

MILES 4 0 4 8 12 16 20 MILES

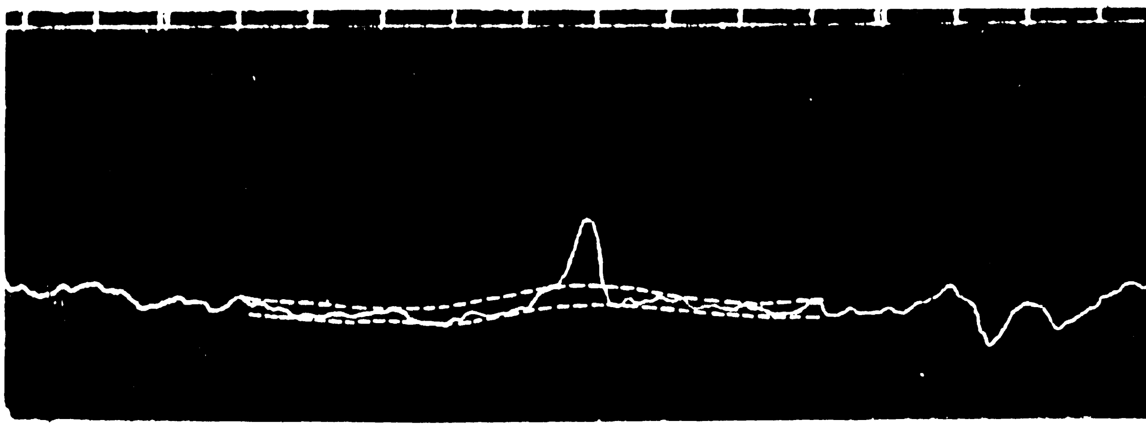
KILOMETRES 5 0 5 10 15 20 25 30 KILOMETRES

RADIOMETRIC CONTOUR INTERVAL 50 COUNTS PER SECOND

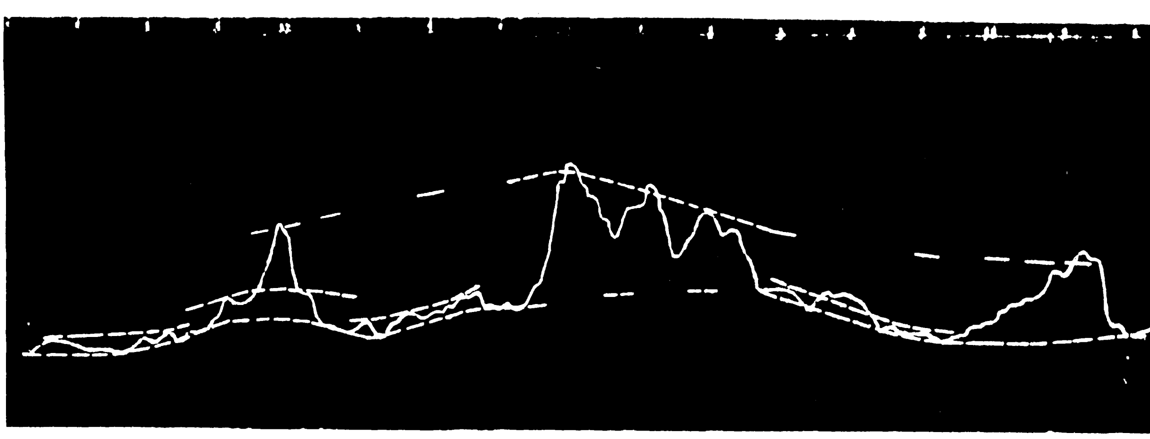
Geophysical Branch, Bureau of Resources, Geology and Geophysics. H51/B1-35



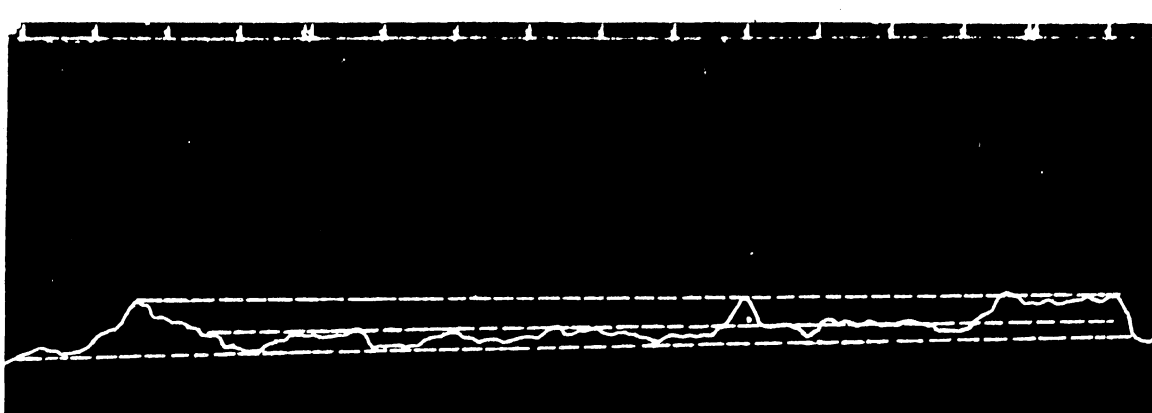
A. Anomaly significant with respect to geological noise envelope.



B. Anomaly significant with respect to statistical noise envelope.



C. Anomaly significant with respect to associated geological noise envelope but insignificant with respect to neighbouring geological noise envelope.



D. Anomaly significant with respect to associated statistical noise envelope but insignificant with respect to neighbouring geological noise envelope.

TYPES OF RADIOMETRIC ANOMALIES