COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1968 / 65

Herberton Airborne Magnetic and Radiometric Survey,

Queensland 1967

by

D.R. Waller

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1968/65

SUMMARY

An aeromagnetic and radiometric survey of the Herberton one-mile map area, Queensland, was flown by the Bureau of Mineral Resources in November 1967. The main purpose of the survey was to evaluate the application of the airborne magnetic and radiometric methods in distinguishing different granites. The survey was preceded by detailed geological mapping.

Interpretation of the data is qualitative; geological strikes and the boundaries of major rock units have been interpreted by delineating magnetic trends, subdividing the area into zones of specified magnetic character, and assessing the significance of these zones with reference to mapped geology.

Correlation between the magnetic data and geology is generally poor, partly owing to the low intensity of magnetic anomalies encountered in the area. Four magnetic anomalies attributed to dykes have been delineated. The radiometric data are useful in delineating areas of Elizabeth Creek Granite, which has been found to have a high radioactivity.

1. INTRODUCTION

An airborne magnetic and radiometric survey was flown by the Bureau of Mineral Resources, Geology and Geophysics over the Herberton one-mile map area in North Queensland during November 1967. Detailed geological mapping of the area had been carried out previously by the Geological Branch of the BMR. The survey was requested by the Geological Branch to evaluate the application of airborne methods in distinguishing different types of granite. In particular, areas of Elizabeth Creek Granite, with which mineralisation is associated, were sought.

Original specifications for the survey called for flight lines spaced at 1-mile intervals to be flown at a nominal altitude of 500 ft above ground level. Owing to the rugged nature of the terrain, survey elevation was raised to a nominal altitude of 1000 ft above ground level. Navigation problems encountered in this area necessitated the flying of additional lines which resulted in an average flight line spacing of ½ mile.

A generalised geological map of the ATHERTON 1:250,000 map area has been published (Best, 1963). There has been little previous geophysical coverage of the survey area. An aeromagnetic and radiometric survey has been flown over a small region of ATHERTON to the west of the present survey (BMR, 1959). Part of the survey area was covered by an airborne scintillograph survey in 1955 (BMR, 1955).

The chapter on geology is derived from information provided by the Geological Branch, specifically for this survey (Blake, in prep).

2. GEOLOGY

The geology of the area is shown in Plate 3 and is summarised below in terms of the major stratigraphic units.

Silurian to Devonian

The rocks of this age are confined to the Hodgkinson Formation, which consists of greywacke, shale, siltstone, massive sandstone, chert, conglomerate, and limestone. The Hodgkinson Formation is intruded by the Elizabeth Creek Granite and other granites, and is unconformably overlain by Upper Palaeozoic acid volcanics. The formation is extensively mineralised.

Carboniferous

The Silver Valley Conglomerate, which is of Middle Carboniferous age, consists of boulder and pebble conglomerate, tuffaceous sandstone, welded tuff, siltstone, and carbonaceous beds. The formation is generally flat-lying, and lies with strong unconformity on steeply dipping beds of the Hodgkinson Formation. It is overlain, possibly conformably, by Glen Gordon Volcanics of Upper Carboniferous age. An irregular body of porphyritic microdiorite intrudes the formation. There is no mineralisation associated with the Silver Valley Conglomerate.

The Upper Carboniferous Featherbed and Glen Gordon Volcanics consist of acid welded tuffs, lavas, and bedded tuffs. The Featherbed Volcanics are intruded by Elizabeth Creek Granite in the adjacent Almaden 1-mile map area, and are the host rocks for the lead and silver mineralisation near Stannary Hills in the Herberton map area. The Glen Gordon Volcanics are also intruded by Elizabeth Creek Granite, but are not mineralised.

The oldest granitic rock in the area is probably the Kalunga Granodiorite of Carboniferous age, which intrudes the Hodgkinson Formation, and is itself intruded by the Elizabeth Creek Granite.

The Elizabeth Creek Granite, which is of Upper Carboniferous age, is believed to be the source of the tin, copper, lead, silver, tungsten, zinc, and antimony mineralisation in the area.

The mineralisation is mainly restricted to areas of secondary alteration. The Elizabeth Creek Granite intrudes the Hodgkinson Formation, the Featherbed and Glen Gordon Volcanics, and the Kalunga Granodiorite. It is itself intruded by acid porphyries related to the Walsh Bluff Volcanics and Slaughter Yard Creek Volcanics, by the Watsonville and Hales Siding Granites, and the Bakerville Granodiortie, all of which are discussed below.

Permian

The Walsh Bluff Volcanics and Slaughter Yard Creek Volcanics, of Lower Permian(?) age, consist of grey porphyritic acid lavas, welded tuffs, bedded tuffs, and high-level intrusive porphyries. The porphyries of the Slaughter Yard Creek Volcanics occur as dykes and more irregular intrusions cutting Elizabeth Creek Granite and Hodgkinson Formation sediments near Watsonville and Herberton. Borth formations are unmineralised. The Walsh Bluff Volcanics unconformably overlie Hodgkinson Formation sediments and weathered Elizabeth Creek Granite, and are intruded by the Watsonville Granite.

Cropping out north of Bakerville and Watsonville is a large mass of biotite granite, the Watsonville Granite, of Lower Permian age. This intrudes Elizabeth Creek Granite, Walsh Bluff Volcanics, and Hodgkinson Formation sediments. The Watsonville granite appears to be intruded near Bakerville by the Bakerville Granodiorite. Exposures of Watsonville Granite and Bakerville Granodiorite, unlike those of Elizabeth Creek Granite, are characterised by spheroidal weathering.

A small body of leucogranite, the Hales Siding Granite, crops out west of Bakerville. It appears to intrude the Bakerville Granodiorite. Both the Bakerville and Hales Siding Granites are of Middle Permian(?) age.

A number of relatively small bodies of diorite, dolerite, and microgranite occur in the area. Their contact relationships are generally obscure, but they are thought to be younger than the Elizabeth Creek Granite.

Cainozoic

The Cainozoic Atherton Basalt unconformably overlies the older rocks. Basalt flows of this formation have infilled many of the old river valleys on the eastern side of the sheet, and near Herberton have buried rich alluvial tin deposits (the Herberton and Bradlaugh Deep Leads). The basalt flows appear to have been derived from shield volcanoes situated near the eastern margin of the area.

Scattered patches of sand, laterite, and frequently stanniferous alluvium occur in the Herberton area.

Structure

The Hodgkinson Formation has been tightly folded, and dips mostly at angles greater than 45°. The Silver Valley Conglomerate and the late Palaeozoic acid volcanics, on the other hand, are generally flat-lying or gently dipping. Faults are abundant, but few show large displacements.

Economic geology

Over 2000 lode mines occur in the survey area. Most of these are tin mines, but there are also many copper, tungsten, and silver-lead mines. The vast majority of the mines are small, and only a few have produced more than 1000 tons of concentrates. The mineralisation appears to be entirely associated with the Elizabeth Creek Granite, and no mineralisation has been found in rocks younger than this granite. The ore minerals show a broad zonal arrangement around the granite, an inner zone of tin or tungsten passing outward into successive zones of copper and lead.

3. GEOPHYSICAL RESULTS AND INTERPRETATION

Magnetic

The magnetic data ate displayed in Plates 2 and 3. Plate 2 shows profiles of total magnetic intensity reduced to an east-west scale of 1:126,720 related to a series of east-west lines which approximate the flight paths. A north-south scale of 1:31,680 has been used to improve data presentation. In areas where flight lines crossed due to navigation difficulties, certain profiles have been omitted for ease of presentation. The line numbering system involves integral numbers for pre-planned line system, and decimal numbers for infilled lines. 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 $\pm \frac{1}{4}$ mile, is a function of the distance from the control longitudes 145°05' and 145°24'.

Plate 3 shows selected magnetic profiles spaced at an average interval of one mile together with geological mapping to facilitate correlation.

The interpretation of the magnetic data is shown in Plate 5. This interpretation is primarily qualitative and involves the delineation of magnetic trends and the subdivision of the area into zones of differing magnetic character. The magnetic parameter used as a criterion to determine the zone type is the dominant amplitude range representative of each zone. The limitations of this classification are discussed in Appendix 1.

Magnetic zones and their significance. Tabulated below are the zone-types and their amplitude ranges. The range quoted for each zone-type includes most, but not necessarily all, of the anomalies in any zone of that type.

Zone type	Anomaly range
1	Negative anomalies
2	No significant anomaly
3	0 - 25 gammas
4	25 - 50 gammas
5	50 - 100 gammas
6	greater than 100 gammas

Zones of type 1 may represent either 'lows' associated with positive anomalies, or remanently magnetised rocks. In the former case the zone of type 1 needs to be considered with a positve zone prior to any correlation of zone type with rock type. Where remanent magnetisation is postulated, zones of type 1 are attributed to specific rock units.

Most of the anomalies in the survey area are characteristic of acid igneous or sedimentary rocks. In general the basicity of rocks may be approximately related to anomaly amplitude with the proviso set out in Appendix 1.

The susceptibility measurements made on rock specimens collected within the survey area (see Appendix 3) indicate that the magnetic method is unlikely to differentiate between the various granites and acid volcanics.

Zones of type 2 are generally associated with non-magnetic granites or sediments and most zones of type 6 occur over areas of Atherton Basalt.

Comparison of zonal configuration, magnetic trends, and mapped geology. An extensive area of Featherbed Volcanics is mapped in the north-west of the survey area. It exhibits a complex magnetic pattern with large fluctuations in anomaly amplitude and few trends. A change in zone type along the southern boundary of this suite indicates that zone-type 3 is characteristic of the Featherbed Volcanics. Zones of other types in this area probably represent thickness or compositional variations of the volcanics, or reflect the magnetic characteristics of the underlying rocks.

In squares A3, A4, B3, and B4 the zonal configuration continues to be complex, and correlation with the geology is poor. The extensive positive trend in the south of square B3 is interpreted to be due to a metamorphic aureole at the contact of the Hodgkinson Formation with the Elizabeth Creek Granite. This indicates that the granite extends north of its mapped position at shallow depth. The adjacent zone of type 5 in square B4 is attributed to Bakerville Granodiorite. Another zone of type 5 is observed in A3 over an area of granite and granodiorite, and may be genetically related to it. Rocks elsewhere in this region exhibit varying magnetic character, and no correlation of zones with geology is possible.

In squares A4, A5, A6, B4, and B5 the Watsonville Granite and Walsh Bluff Volcanics were not magnetically distinguishable at the survey altitude. In square A6 the complex magnetic pattern is attributed to Atherton Basalt. The positive trends may indicate local thickening of the basalt.

The Elizabeth Creek Granite in squares B5 and B6 exhibits a more variable magnetic pattern than it does elsewhere in the survey area. Zones of types 3 and 4 may be due to local concentrations of basic material in the granite, or be related to superficial deposits of Atherton Basalt. A positve trend and zone of type 3 closely follow the western boundary of the Hodgkinson Formation in B5. This is interpreted as a metamorphic aureole.

The Elizabeth Creek Granite and Hodgkinson Formation rocks in squares C1, C2, and C3 are characterised by a zone of type 2. They are bounded to the east by a negative trend which closely follows the mapped geological boundary. Rocks in squares C4, C5, and C6 appear to be more basic, but no close correlation of zones with geology is observed. A tongue of zone-type 5 in C5 is interpreted to be due to a basic intrusion. However, it is also possible that the anomaly is due to thickening of the Atherton Basalt along this line. The zone of type 1 in the south-east corner of the survey area is attributed to remanently magnetised Atherton Basalt. These rocks may therefore be of a different age from Atherton Basalt elsewhere in the survey area.

Radiometric

Radiometric data were recorded by two scintillometers, each adjusted for a specific purpose. The inboard scintillometer, set with a 10-second time constant, was used to record broad fluctuations of radiometric intensity across the area to assist geological mapping. The outboard scintillometer, set with a 1-second time constant, was intended to detect localised sources of radioactivity. Extreme topographic relief and the resultant increase in average ground clearance rendered scintillometer results difficult to interpret and, in particular, anomalies from point sources, normally detected by outboard scintillometer, were unresolvable.

Inboard scintillimeter. The radiometric 'highs' are shown in Plate 5. They have been smoothed to minimise distortions introduced by a combination of errors. These include: parallax error due to delay in instrument response resulting from the 10-second time constant; temperature affected instrumental drift; variations in instrument sensitivity; and positional error identical to that of the magnetic data. The main factors governing the radiometric count are rock radioactivity, variations in ground clearance, and thickness of soil cover.

Inspection of the radiometric data recorded at altitudes below 1500 ft a.g.l. shows that good correlation is apparent between the 'highs' and regions mapped as Elizabeth Creek Granite. The 'low' over Emu Creek in C1 demonstrates that this relationship is influenced by topography. The 'high' which enters the south-east corner of B3 supports the magnetic evidence for a shallow northerly extension of the Elizabeth Creek Granite beneath the Hodgkinson Formation. Radiometric 'highs' also appear to be associated with the Hales Siding Granite in B3 and the Atlanta Granite in A3 and A4. The few remaining radiometric 'highs' in the survey area are of unknown significance.

4. CONCLUSIONS AND RECOMMENDATIONS

In general, no close correlation is observed between geological and magnetic data. Some geological boundaries and regions of Atherton Basalt have been defined. An extension to an area of Elizabeth Creek Granite at shallow depth has been interpreted between Hales Siding and Bakerville. The inboard radiometric data are of assistance in delineating areas of Elizabeth Creek Granite.

The application of airborne magnetic and radiometric methods using a heavy aircraft in this region appears to be limited. It would only be appropriate to consider using these methods at an early stage of regional geological mapping. It is possible that to provide complementary data to detailed geological mapping, a detailed airborne magnetic and radiometric survey using a helicopter or a light aircraft would be required.

The rugged nature of the terrain precludes the use of a heavy aircraft to record geophysical data with the high degree of altitude and positional control demanded by such a survey.

5. REFERENCES

BEST, J.G. 1963 Atherton 1:250,000 map area. *Bur. Min. Resour. Aust. Geol. Map. No.* E55-5 with explanatory notes.

BLAKE, D.H. Geology of the Herberton/Mount Garnet Area, Herberton tinfield, North Queensland. *Bur. Min. Resour. Aust. Rec.* (in preparation).

Bureau of Mineral Resources 1955 Map showing radioactivity contours determined by airborne scintillograph survey, Herberton district, Queensland. *Bur. Min. Resour. Aust. Geophys. Map* No. G234-1.

Bureau of Mineral Resources	1959	Map showing total magnetic intensity measured by airborne magnetometer and radioactive anomalies detected by airborne scintillograph, Chillagoe-Mungana area, Queensland. <u>Bur. Min. Resour. Aust. Geophys. Map No</u>. G309-2.

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 be coincident with the apical axis of the body. This axis will generally be situated towards the negative part of the anomaly by an amount which is a function of the body's dip and strike angles.

Magnetic zones are based on dominant anomaly amplitude range. In this survey area there is no clearly dominant trend direction, and the presence or absence of trends bears little relation to rock type. Significance of the amplitude criterion should be assessed with the knowledge that amplitude is a function not only of magnetic susceptibility contrasts but also of width, depth, and strike of the 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.

APPENDIX 2

OPERATIONAL DETAILS

Staff

Party Leader	:	D.R. Waller
Geophysicist Class 1	:	B.S. Grewal
Senior Radio Technician	:	J. Swords
Pilots	:	Captain L. Giddens) First Officer) T.A.A. J. Lindsay)

Equipment

Aircraft	:	DC 3 VH-MIN
Magnetometers	:	MFS-5 saturable core flux-gate, tail boom installation coupled to "Speedomax" and digital recorders. MFD-4 saturable core fluxgate, ground installation for storm warning, coupled to Esterline-Angus recorder.
Scintillographs	:	Twin crystal MEL scintillation detector heads inboard and single phosphor detector head outboard (the latter suspended from a cable 200 feet below aircraft). Outputs coupled to De Var recorder.
Radio altimeter	:	STR30B, frequency modulated, output coupled to De Var recorder.
Air position indicator	:	track recorded by De Var recorder
Cameras	:	BMR 35-mm strip, and 70-mm Vinten Reconnaissance

Survey specifications

Nominal line spacing	:	½ mile
Line orientation	:	East-west
Tie system	:	Single and double lines, spaced 15 miles apart
Nominal altitude	:	1000 ft a.g.l.

Navigation control	:	Photo-mosaic
Record sensitivity		
MFS-5	:	50 gammas/inch
MFD-4	:	20 gammas/inch
Inboard scintillograph	:	50 c.p.s./inch
Outboard scintillograph	:	50 c.p.s./inch
Scintillometer time constants	:	Inboard 10 seconds Ooutboard 1 second

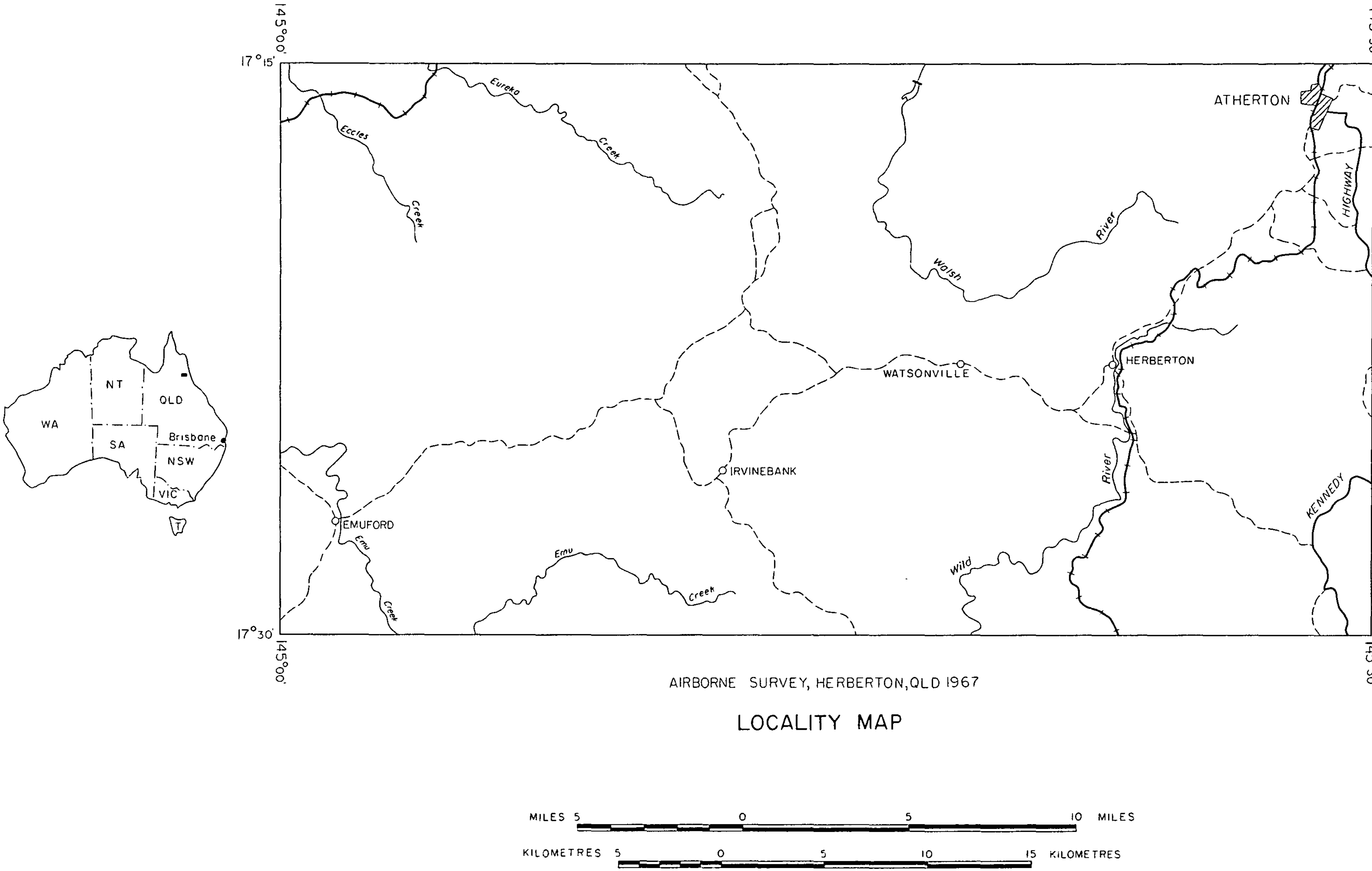
APPENDIX 3

SUSCEPTIBILITY MEASUREMENTS

In all, 55 rock specimens supplied by the Geological Branch of the Bureau of Mineral Resources were analysed. The results are summarised below:

Specimen	Susceptibility
Watsonville Granite	Very small
Slaughter Yard Creek Volcanics	Very small
Elizabeth Creek Granite	Very small
Kalunga Granodiorite	Very small
Featherbed Volcanics	Order of 2.00×10^{-5} CGS
Glen Gordon Volcanics	Order of 1.50×10^{-5} CGS
Hodgkinson Formation	Very small

It is apparent, that of the samples collected, most have susceptibilities too small to measure. The Glen Gordon Volcanics and Featherbed Volcanics gave the highest susceptibilities; however, these are barely significant.



AIRBORNE SURVEY, HERBERTON, QLD 1967

LOCALITY MAP

PLATE 1

To accompany Record No. 1968/65

E55/B1-5

AUSTRALIA 1:63,360

HERBERTON
QUEENSLAND

GEOLOGICAL LEGEND

Era	Formation	Symbol	Lithology
CAINOZOIC		Czu / Czs	SOIL, ALLUVIAL SAND, SILT, GRAVEL
		Czl	LATERITE
	Atherton Basalt	Cza	OLIVINE BASALT FLOWS, OFTEN UNDERLAIN BY STANNIFEROUS GRAVELS
MIDDLE PERMIAN (?)	Hales Siding Granite	Pgs	LEUCOGRANITE, HORNBLENDE - BIOTITE GRANITE
		Pgc / Pgu / Pgv	GRANITE, GRANODIORITE
	Bakerville Granodiorite	Pgb	BIOTITE - HORNBLENDE GRANODIORITE
LOWER PERMIAN	Watsonville Granite	Pgw	PORPHYRITIC BIOTITE GRANITE
		Pd	DIORITE AND QUARTZ-DOLERITE
LOWER PERMIAN (?)	Walsh Bluff Volcanics	Pb	ACID LAVAS, TUFFS, PORPHYRIES
	Slaughter Yard Creek Volcanics	Pw / Pwa	
UPPER CARBONIFEROUS	Atlanta Granite	Cga	GRANITE
	Elizabeth Creek Granite	Cgz	LEUCOCRATIC GRANITE
	Kalunga Granodiorite	Cgk	GRANODIORITE
UPPER CARBONIFEROUS (?)	Featherbed Volcanics	Cf	PORPHYRITIC RHYOLITE, WELDED TUFF, BEDDED TUFF,
	Glen Gordon Volcanics	Cl / Cla	
MIDDLE CARBONIFEROUS	Silver Valley Conglomerate	Cus	CONGLOMERATE, SANDSTONE, TUFF, SILTSTONE
SILURIAN - DEVONIAN	Hodgkinson Formation	S-Dha	MASSIVE SANDSTONE
		S-Dh	GREYWACKE, SHALE, SILTSTONE
		S-Dhd	CHERT
		S-Dhc	CONGLOMERATE, LIMESTONE
		S-Dhe	PEBBLY MUDSTONE

GEOLOGICAL BOUNDARY

SYNCLINE

FAULT (D, U INDICATE RELATIVE MOVEMENT DOWN UP)

50 STRIKE AND DIP OF FORMATION

TREND OF FORMATION

JOINT PATTERN

QUARTZ VEIN

DYKE; a - APLITE, b - BASALT

DYKE

BASED ON E55/B1-7
BASED ON E55/B0-11

Geology and Topography after HERBERTON, QLD 1:63,360 scale PRELIMINARY MAP REF. E55/A5/84 Bureau of Mineral Resources, Geology and Geophysics, Department of National Development.

INDEX OF ADJOINING SHEETS

MOSSMAN

MUNGANA	CHILLAGOE	DIMBULAH
F I SCHERTON	ALMADEN	HERBERTON
McDEVITT	MUNDERRA	MT GARNET
FOSSILBROOK	MT. BRIDGE	TIRRABELLA

ATHERTON

RED RIVER

INNISFAIL

EINASLEIGH

LOCATION DIAGRAM

AIRBORNE SURVEY, HERBERTON, QLD, 1967

RADIOMETRIC PROFILES AND GEOLOGY

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 KILOMETRES

GEOPHYSICAL LEGEND

PROFILES RECORDED AT AIRCRAFT GROUND CLEARANCE 500' TO 1000'

" " " " " " 1000' " 1500'

" " " " " " GREATER THAN 1500'

TOPOGRAPHICAL LEGEND

RIVER OR CREEK

RAILWAY WITH STATION OR SIDING

MAIN ROAD

SECONDARY ROAD OR TRACK

BUILT-UP AREA

NAMED PLACE

PROFILE SCALE

200 counts per sec.

100

0

EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A DC.3 AIRCRAFT AT AN AVERAGE ALTITUDE OF 1000 FEET ABOVE GROUND LEVEL ALONG LINES SPACED HALF A MILE APART. THE FLIGHT-LINES ARE IDEALISED AND SERVE AS BASELINES TO THE PROFILES. THEY APPROXIMATE THE ACTUAL FLIGHT PATH WITH A PROBABLE ERROR OF ± 1/4 MILE.

SELECTED PROFILES RECORDED AT AVERAGE INTERVAL OF 1 MILE ARE SHOWN ON THE MAP.

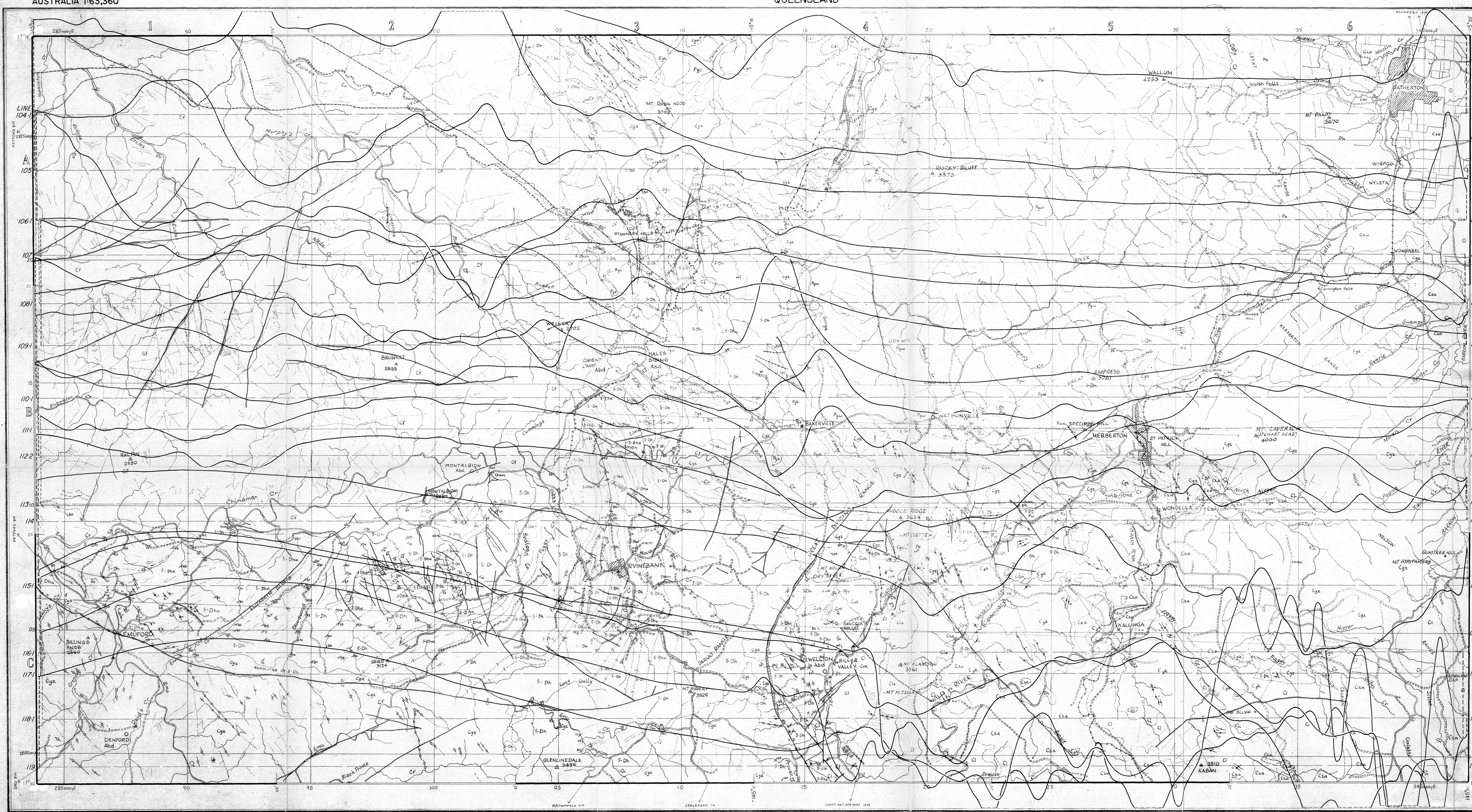
To accompany Record No.1968/65

E55/B1-12

AUSTRALIA 1:63,360

HERBERTON
QUEENSLAND

PLATE 3



GEOLOGICAL LEGEND

Era	Formation	Symbol	Description
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GEOLOGICAL BOUNDARY

SYNCLINE

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STRIKE AND DIP OF FORMATION

TREND OF FORMATION

JOINT PATTERN

QUARTZ VEIN

DYKE; a – APLITE, b – BASALT

DYKE

BASED ON E55/BI-10
BASED ON E55/BO-11

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ATHERTON

RED RIVER

INNISFAIL

EINASLEIGH

LOCATION DIAGRAM

AIRBORNE SURVEY HERBERTON QLD, 1967

TOTAL MAGNETIC INTENSITY PROFILES AND GEOLOGY

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 KILOMETRES

APPROX. PROFILE SCALE

100 gammas
50
25
0

TOPOGRAPHICAL LEGEND

RIVER OR CREEK

RAILWAY WITH STATION OR SIDING

MAIN ROAD

SECONDARY ROAD OR TRACK

BUILT-UP AREA

NAMED PLACE

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SELECTED PROFILES RECORDED AT AVERAGE INTERVAL OF ONE MILE ARE SHOWN ON THE MAP.

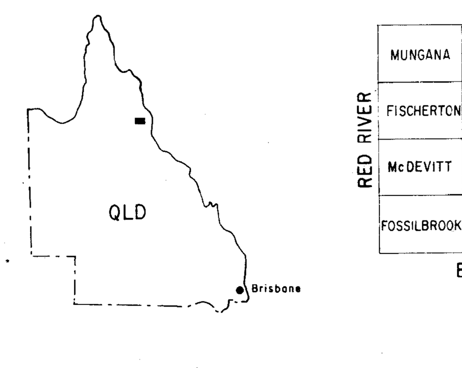
THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 10 GAMMAS PER MILE.

To accompany Record No. 1968/65

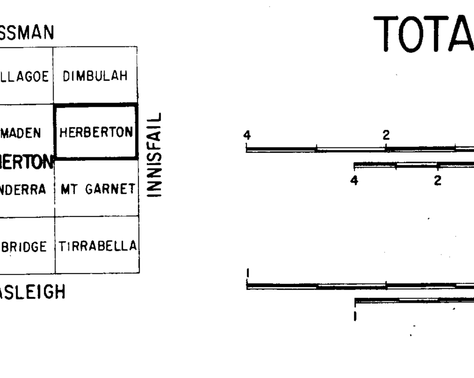
E55/BI-11

HERBERTON
QUEENSLAND

LOCATION DIAGRAM

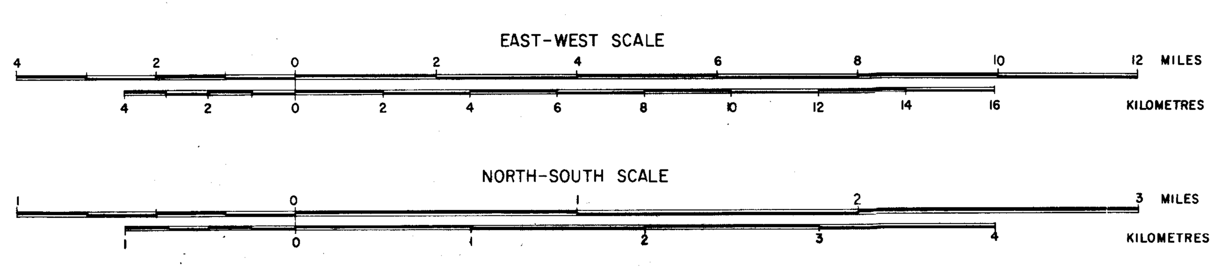


INDEX TO ADJOINING SHEETS

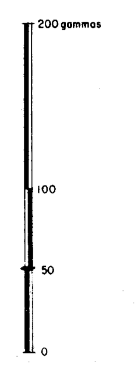


AIRBORNE SURVEY, HERBERTON QLD, 1967

TOTAL MAGNETIC INTENSITY PROFILES



APPROX. PROFILE SCALE



EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A DC.3 AIRCRAFT AT AN ALTITUDE OF 1000 FEET ABOVE GROUND LEVEL ALONG LINES NOMINALLY SPACED HALF MILE APART. THE SELECTED FLIGHT-LINES SHOWN ARE IDEALISED AND SERVE AS BASELINES TO THE PROFILES THEY APPROXIMATE THE ACTUAL FLIGHT PATH WITH A PROBABLE ERROR OF ± 1/4 MILE.

WHERE FLIGHT-LINES CROSSED, ONE OF THE LINES HAS BEEN OMITTED FROM THIS SHEET.

THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 10 GAMMAS PER MILE.

AUSTRALIA 1:63,360

HERBERTON
QUEENSLAND

PLATE 5

BASED ON E55/BI-9
BASED ON E55/BO-11

Geology and Topography after HERBERTON, QLD 1:63,360 scale PRELIMINARY MAP REF. E55/A5/84 Bureau of Mineral Resources, Geology and Geophysics, Department of National Development.

GEOLOGICAL LEGEND

Age	Formation	Symbol	Lithology
CAINOZOIC		Czu / Czs	SOIL, ALLUVIAL SAND, SILT, GRAVEL
		Czl	LATERITE
	Atherton Basalt	Cza	OLIVINE BASALT FLOWS, OFTEN UNDERLAIN BY STANNIFEROUS GRAVELS
MIDDLE PERMIAN (?)	Hales Siding Granite	Pgs	LEUCOGRANITE, HORNBLENDE-BIOTITE GRANITE
		Pgc / Pgu / Pgv	GRANITE, GRANODIORITE
	Bakerville Granodiorite	Pgb	BIOTITE-HORNBLENDE GRANODIORITE
LOWER PERMIAN	Watsonville Granite	Pgw	PORPHYRITIC BIOTITE GRANITE
		Pd	DIORITE AND QUARTZ-DOLERITE
LOWER PERMIAN (?)	Walsh Bluff Volcanics	Pb	ACID LAVAS, TUFFS, PORPHYRIES
	Slaughter Yard Creek Volcanics	Pw / Pwa	
UPPER CARBONIFEROUS	Atlanta Granite	Cga	GRANITE
	Elizabeth Creek Granite	Cgz	LEUCOCRATIC GRANITE
	Kalunga Granodiorite	Cgk	GRANODIORITE
UPPER (?) CARBONIFEROUS	Featherbed Volcanics	Cf	PORPHYRITIC RHYOLITE, WELDED TUFF, BEDDED TUFF,
	Glen Gordon Volcanics	Cl / Cla	
MIDDLE CARBONIFEROUS	Silver Valley Conglomerate	Cus	CONGLOMERATE, SANDSTONE, TUFF, SILTSTONE
SILURIAN - DEVONIAN	Hodgkinson Formation	S-Dha	MASSIVE SANDSTONE
		S-Dh	GREYWACKE, SHALE, SILTSTONE
		S-Dhd	CHERT
		S-Dhc	CONGLOMERATE, LIMESTONE
		S-Dhe	PEBBLY MUDSTONE

- GEOLOGICAL BOUNDARY
- SYNCLINE
- FAULT (D, U INDICATE RELATIVE MOVEMENT DOWN UP)
- STRIKE AND DIP OF FORMATION (50)
- TREND OF FORMATION
- JOINT PATTERN
- QUARTZ VEIN
- DYKE; a - APLITE, b - BASALT
- DYKE

INDEX OF ADJOINING SHEETS

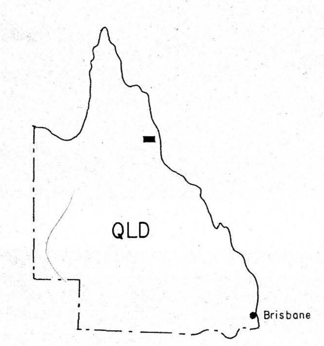
MOSSMAN

MUNGANA	CHILLAGOE	DIMBULAH
FISCHERTON	ALMADEN	HERBERTON
McDEVITT	MUNDERRA	MT GARNET
FOSSILBROOK	MT BRIDGE	TIRRABELLA

RED RIVER — ATHERTON — INNISFAIL

EINASLEIGH

LOCATION DIAGRAM



AIRBORNE SURVEY HERBERTON QLD, 1967

GEOPHYSICAL INTERPRETATION AND GEOLOGY

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 KILOMETRES

GEOPHYSICAL LEGEND

- POSITIVE MAGNETIC TREND
- NEGATIVE MAGNETIC TREND
- MAGNETIC ZONE
- INTERPRETED DYKE
- RADIOMETRIC HIGH

TOPOGRAPHICAL LEGEND

- RIVER OR CREEK
- RAILWAY WITH STATION OR SIDING
- MAIN ROAD
- SECONDARY ROAD OR TRACK
- BUILT-UP AREA
- NAMED PLACE

To accompany Record No. 1968/65

E55/B1-13