DEPARTMENT OF MINES
SOUTH AUSTRALIA

OUTLINE OF GEOLOGY OF WESTERN MUSGRAVE BLOCK SOUTH AUSTRALIA; PRE-AEROMAGNETIC SURVEY REPORT

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ABSTRACT

The proposed aeromagnetic survey by the Bureau of Mineral Resources in 1968 of theWestern Musgrave Block in South Australia covers MANN and portions of WOODROFFE, BIRKSGATE and LINDSAY 1:250,000 sheet areas.

Topographic features in the area vary between about 4000 feet and 1500 feet above sea level. Crystalline basement comprises granulites, gneisses, metaquartzites of the Musgrave-Mann Metamorphics and associated intrusive granites, mafic and ultramafic large intrusive bodies of the Giles Complex which are associated with major regional fault and shear structures trending across the northern part of the survey area. The margin of the basement in BIRKSGATE and LINDSAY areas is probably bounded by major faults or shears. The Officer Basin reaches its maximum development immediately south of the survey area. The basin sediments are Ordovician(?), Cambrian and Adelaidean. Adelaidean sandstones overlap with major unconformity the crystalline basement along the southern flank of the Officer Basin.

INTRODUCTION

This report was prepared at the request of the Bureau of Mineral Resources. Unpublished mapping by R.B. Major, J. Teluk and G. Krieg of the Geological Survey as well as published maps of the Survey were used. Aeromagnetic basement contours in the southern part of the area were obtained from an unpublished report for Exoil Pty. Ltd. on O.E.L. 28 by Adastra Hunting Pty. Ltd. The area of the proposed aeromagnetic survey is shown on Figure 1, It embraces the whole of MANN and the western two-thirds of the WOODROFFE, northwest of LINDSAY, the northern half of BIRKSGATE, 1:250,000 sheet areas. Generalised geological maps of the sheet areas of the 1:250,000 scale were prepared to accompany this report.

PREVIOUS WORK

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

Thediscovery of extensive nickel mineralisation in the vicinity of Mt. 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 and since 1960 S.A. Mines Dept. (Thomson & Miramms (1961), (Miller, P.G. 1966) have investigated the area. The MANN sheet was mapped in 1960 by the South Australian Geological Survey (Mirams, 1964). MANN and WOODROFFE have been published. BIRKSGATE and LINDSAY have been mapped, and mapping is in progress of EVERARD. Anaeromagnetic survey wascompleted in 1965 by Adastra Hunting in the Officer Basin from 129° to 134° East, in the area of O.E.L.28 for Exoil Pty. Ltd. This survey partly overlaps the area of the proposed survey. A Bureau of Mineral Resources aeromagnetic reconnaissance survey in 1954 covered part of the area (Quilty and Goodeve, 1958). MANN sheet area was flown by the Bureau of Mineral Resources on north-south lines at five miles spacing and at 500ft. above ground level in 1960. Part of MANN and WOODROFFE were also flown at 300ft. level in 1965 (Rowan, 1967).

TOPOGRAPHY

The Musgrave, Mann and Tomkinson Ranges form prominent E-W mountain chains rising to over 4,000 ft. above sea level in an area of gently sloping plains between 2,000 and 1,500ft. above sea level. Isolated hills occur in the centre of the plain area, the highest of these being Mt. Kintore 3,512ft. above sea level. In the southwestern part of the proposed survey area,the rounded tor-like Birksgate Ranges rise to a maximum of 2,530 ft. at Mt. 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

Older Precambrian Musgrave Mann-Metamorphics and Granites

A large part of the crystalline basement is composed of a complex of metamorphic rocks referred to as the Musgrave-Mann Metamorphics. This complex comprises layered granulites, gneisses, meta-quartzites and occasional marbles. Traces of iron formation have been observed 10miles southwest of Mt. Caroline. The granulites pass gradationally into potassium felspar 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, these are of several types, firstly is the high temperature charnockitic variety (hypersthene adamellite) which is confined to the central high grade metamorphic belt and which contain xenoliths of the metamorphics. Flanking these and apparently intruding the metamorphics in the central part of the region are the lower temperature hornblende granites which are assigned to the amphibolite facies. These granites occur along the Northern Territory border north of the Mann Fault, to about latitude 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 referred to as the Giles Complex. This Complex is largely comprised of norites and gabbros with a smaller proportion of later pyroxenite, peridotite and other olivine-rich rocks. In the northwestern part of the survey area the Giles Complex rocks are flanked by areas of anorthosite, which are thought to have some genetic relationship with 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 crystal faults or shears (Thomson, 1966a, Rowan 1967). Mapping and geophysical evidence indicates that a chain of pipelike or steep trumpet shaped intrusive centres extends across the northern part of the survey area. Generally the attitudes of the Gilles Complex masses are steeply oriented, however, there are also some sheet-like development of Giles Complex intrusives such as in Michael Hills, Ewarara and Woodroffe Thrust areas. Generally the Giles Complex are not markedly magnetic, although locally intensely magnetic norite varieties occur on the margins of some intrusive centres.

Swarms of dominantly doleritic dykes occur throughout the region. The dominant dyke direction is northwesterly though some east-west and northeast dykes are alsoknown in the area. Major (1968), noted that the northwest dykes are olivine-bearing, but to date, no olivine has been noticed in the northeasterly or east-west trending dykes. It is believed that the dyke swarms are genetically related to the Giles Complex. The 1967 aeromagnetic survey indicated that marked negative magnetic anomalies are in places associated with east-west mafic dykes.

Sedimentary Rocks of the Officer Basin

(i) Upper Proterozoic (Adelaidean) and Cambrian -

The Adelaidean rocks are sandstones with very minor limestone and dolomite which rest non-conformably on the gneisses and granites of the Musgrave block. The Cambrian sequence consists of arkoses and micaceous sandstones.

The sediments have been gently folded with dips up to 20°, except in the Streich Hills, where they are 70°S.E. This may have been due to movements in the adjacent basement.

A normal fault may exist between the Patricia Hills and the Streich Hills. This probably trends E.S.E. towards the northern end of the seismic line, but between there and Coffin Hill, its position is quite indeterminable. It appears to continue southeast from Coffin Hill onto the Lindsay 1:250,000 sheet area. Here the crystalline basement is faulted and so its extension on the Birksgate area may bedetected fromtthe basement magnetics.

(ii) Post-Cambrian sediments & volcanics -

The southern half of Birksgate i.e. south of the proposed survey area includes the Ordovician Kulyong Volcanics and scattered outcrops of sandstones of ?Palaeozoic-?Mesozoic age. All these rocks are flat lying.

STRUCTURE

Planetary faults and shears of the Median Belt (Mann and Hinkley Faults etc.) , which are associated with major intrusions of the Giles Complex extend across the northern part of the survey area, north of 26° 30°South.

The boundary between the granulite facies and amphibolite facies extends in an arc from the northwest corner of LINDSAY to Mt. Tiekens, Mt. Harcus and southwesterly to Permano Hill. Giles Complex rocks have also been found at Mt. Agnes in the Blyth Range, a little west of the WA-SA border. A belt of Giles Complex rocks may

extend north-northwest from Mt. Agnes. It is possible that some of the effects of this belt may be observed in the aeromagnetic survey, near the western boundary of the MANN sheet.

The east-west features noted in the 1967 aeromagnetic survey may be reflected by the occasional east-west dolerite dykes such as occur in the northern part of LINDSAY and near Permano Hill on the BIRKSGATE. A further point of interest here is that the east-west trending southern boundary of the Musgrave Block farther west in Western Australia occurs at approximately 26°30° South. This is a possible extension of the trends observed in the previous survey in the graben occupied by the Moorilyanna Conglomerate on ALBERGA.

For the reasons outlined above it is concluded that the proposed survey be carried out on north-south flight lines.

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(additional to those given in 1967 pre-survey report R.B.64/120)

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BPT:RBM:SMA:OB
3.5.68

NORTHERN TERRITORY

AUSTRALIA

WESTERN

129°00' 130°00' 131°00' 132°00' 133°00' 134°00'

26°00'

27°00'

28°00'

MANN

WOODROFFE

ALBERGA

ABMINGA

BIRKSGATE

LINDSAY

EVERARD

WINTINNA

OFFICER

BASIN

Mt Davies

MANN FAULT

WOODROFFE THRUST

DAVENPORT FAULT

Mt Woodroffe FAULT

FERDINAND FAULT

Aylliffe Hill

Musgrave Park H.S.

Ernabella

Kenmore Park H.S.

Sundown H.S.

De Rose H.S.

Tieyon H.S.

Thin T-K cover

Approx limit of basement outcrops

T-K cover

MOORLYANNA GRABEN

Approx western margin of Great Artesian Basin Tertiary(?) & Mesozoic (K) cover

Granite Downs H.S.

Everard Park H.S.

Chambers Bluff

Mt Johns

Purndoo Claypan

Officer N°1

Southern boundary of hinge zone of aeromagnetic basement

Kulyong Volcanics

Wright Hill

Birksgate N°1

ORDOVICIAN — Sediments of Officer Basin; Basic volcanics of Kulyong area

ADELAIDEAN — Sediments – minor basalt flows in Chambers Bluff area. Probable Cambrian sediments are also present in western Birksgate sheet and Mt Johns area.

CARPENTARIAN — Moorilyanna Conglomerate and Levenger Arkose

UNDIFFERENTIATED PRECAMBRIAN BASEMENT ROCKS OF MUSGRAVE BLOCK — Dolerite dykes; Mafic and Ultramafic intrusives of Giles complex; Igneous and metamorphic rocks, includes Musgrave-Mann Metamorphics and metasediments of probable Carpentarian age

Foliation trend & dip of basement rocks (generalised)

Fault, mapped

Fault, extrapolated under young cover

Fault, inferred from geophysics and regional geology

Thrust or flat dipping major shear zone

MANN 1:250,000 map sheet areas

Area of 1967 aeromagnetic survey

⊕ Petroleum exploration bore

Area of proposed 1968 aeromagnetic survey

Compiled by B.P Thomson
Supervising Geologist, Regional Surveys
Geological Survey, Dept of Mines Sth. Aust.

To accompany report by B.P Thomson

DEPARTMENT OF MINES — SOUTH AUSTRALIA

MUSGRAVE BLOCK
REGIONAL GEOLOGICAL MAP

REGIONAL MAPPING SECTION		Drn. B.P.T.	SCALE: 1:1,000,000
		Tcd. R.H.	67-443 AB
Director of Mines		Ckd. L.V.W.	
		Exd.	DATE: 4-7-67 amended 8/6/68

130°30' 131°00' 131°30' 132°00'

26°00' 26°15' 26°30' 27°00'

HG

CG

Mt Woodward

Wintawata Hill

Kalywalanya

Julpartji

Mt Morris

Musgrave Park

WOODROFFE

DAVENPORT

THRUST

Lungley Gully

Mt Davenport

MANN

FAULT

Mt Caroline

Mt Woodroffe

Erlywanjawanja R.H.

Aylliffe Hill

Michelle Knob

McNamara Hill

outcrops

Mt Harriet

Mt Crombe

granite

Sparse

Bull Hill

Carbeena Hill

Eunyarrinna Hill

Anerinna Hill

Meinna Hill

Maryinna Hill

Bowden Hill

CARPENTARIAN

- Levenger Arkose
- Dolerite dykes
- Mafic & ultramafic intrusive rocks of Giles Complex including Woodroffe Norite

OLDER CARPENTARIAN & PRECAMBRIAN OF MUSGRAVE BLOCK CRYSTALLINE BASEMENT

- HG — Hornblende granite
- CG — Charnockitic granite (Hypersthene - Adamellite)
- Undifferentiated Musgrave - Mann Metamorphics and intrusive rocks

- Unconformity
- Foliation (Compositional layering of metamorphic & intrusive rocks)
- Foliation of granitic gneiss
- Fault with strike & dip
- Thrust or major shear zone with strike and dip
- Strike & dip of bedding
- Area of 1967 aeromagnetic survey
- Area of proposed 1968 aeromagnetic survey

Unpublished geological mapping by R.B. Major, J.E. Johnson, B. Leeson, R.C. Mirams Geological Survey, South Australia

Compiled and generalised by R.B. Major and B.P. Thomson Geological Survey S.A. April - May 1967

To accompany report by B.P. Thomson

DEPARTMENT OF MINES — SOUTH AUSTRALIA

WOODROFFE 1:250,000 SHEET GENERALISED GEOLOGICAL MAP

REGIONAL MAPPING SECTION		Drn. B.P.T.	SCALE: 1:250,000
		Tcd. R.H.	67-444 AB
		Ckd. L.V.W.	
Director of Mines		Exd.	DATE: 1-8-67 amended 8-5-68

130°30' 131°00' 131°30' 132°00'

27°00' 27°15' 27°30' 27°45' 28°00'

Oonmooninna Hill 1969'

Gilby Hill

Moombunya Hill

Mingeemealinna Hill

Oompeinna Hill

Ampeinna Hill

Moolapinna Hill

Lindseys Pile

Mintiginna Hill

Cartomooninna Hill

Yeloginna Hill

Mt Illillinna

Umberdidinna Hill

Mt Bonybonninna

Turner Hill

Tarteecartagun Hill

Southern limit of crysalline basement, outcrop uncertain - some Adelaidean sub-outcrop possibly present under younger cover

Purndu Claypan

Wright Hill

1831'

1442'

+1900 +1100 +1700 +1600 +1500 +1400 +1300 +1200 +1800 +800 +400 +300 +900

1000

Trend of steep magnetic basement gradients

Concealed basement fault

Track to Emu

ORDOVICIAN

Chandler Sandstone etc.

ADELAIDEAN

Sandstone, shale, chert

Granite, gneissic in part

OLDER PRECAMBRIAN OF MUSGRAVE BLOCK

Undifferentiated metamorphics and intrusives

Dolerite dykes

Unconformity

Normal fault

Basement fault or hinge line inferred from aeromagnetic data

Area of 1967 aeromagnetic survey

Area of proposed 1968 aeromagnetic survey

+1300 / 1000 Magnetic basement in feet above sea level. Interpretation by Geophysical Associates International for Exoil Pty. Ltd.

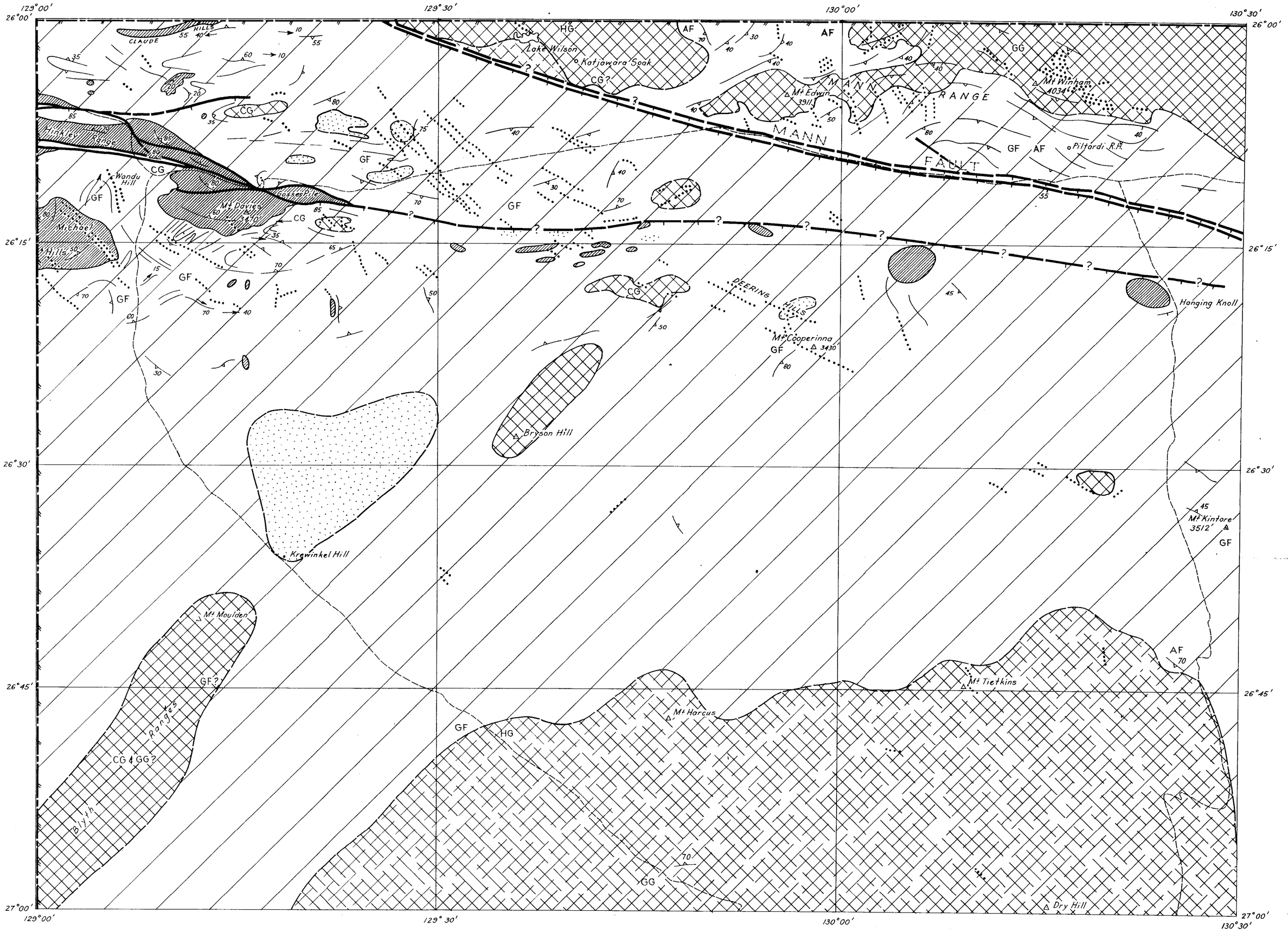
Unpublished Geological mapping by R.B. Major, J. Teluk, O. Krieg, J.E. Johnson, Geological Survey, South Aust.
Compiled and generalised by B.P. Thomson, R.B. Major and J. Teluk. Geological Survey-South Australia
S.A. Dept. of Mines April-May 1967

To accompany report by B.P. Thomson

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LINDSAY 1:250,000 SHEET GENERALISED GEOLOGICAL MAP

REGIONAL MAPPING SECTION		Drn. B.P.T.	SCALE: 1:250,000
		Tcd. R.H.	67-447 AB
		Ckd. L.V.W.	
Director of Mines		Exd.	DATE: 8-5-68



CARPENTARIAN & OLDER PRECAMBRIAN

- Basic Dykes, generally doleritic.
- Mafic & Ultramafic intrusive rocks of the Giles Complex.
- HG — Hornblende granite.
- CG — Charnockitic granite. (Hypersthene Adamellite.)
- GG — Granitic gneisses & intrusive granite.
- Anorthosite
- Undifferentiated Musgrave-Mann methamorphics & intrusive rocks. AF = Amphibolite Facies. GF = Granulite Facies.

- Foliation (compositional layering) of metamorphic & intrusive rocks.
- Fault or major shear Stike and dip.
- Area of proposed Aeromagnetic survey.

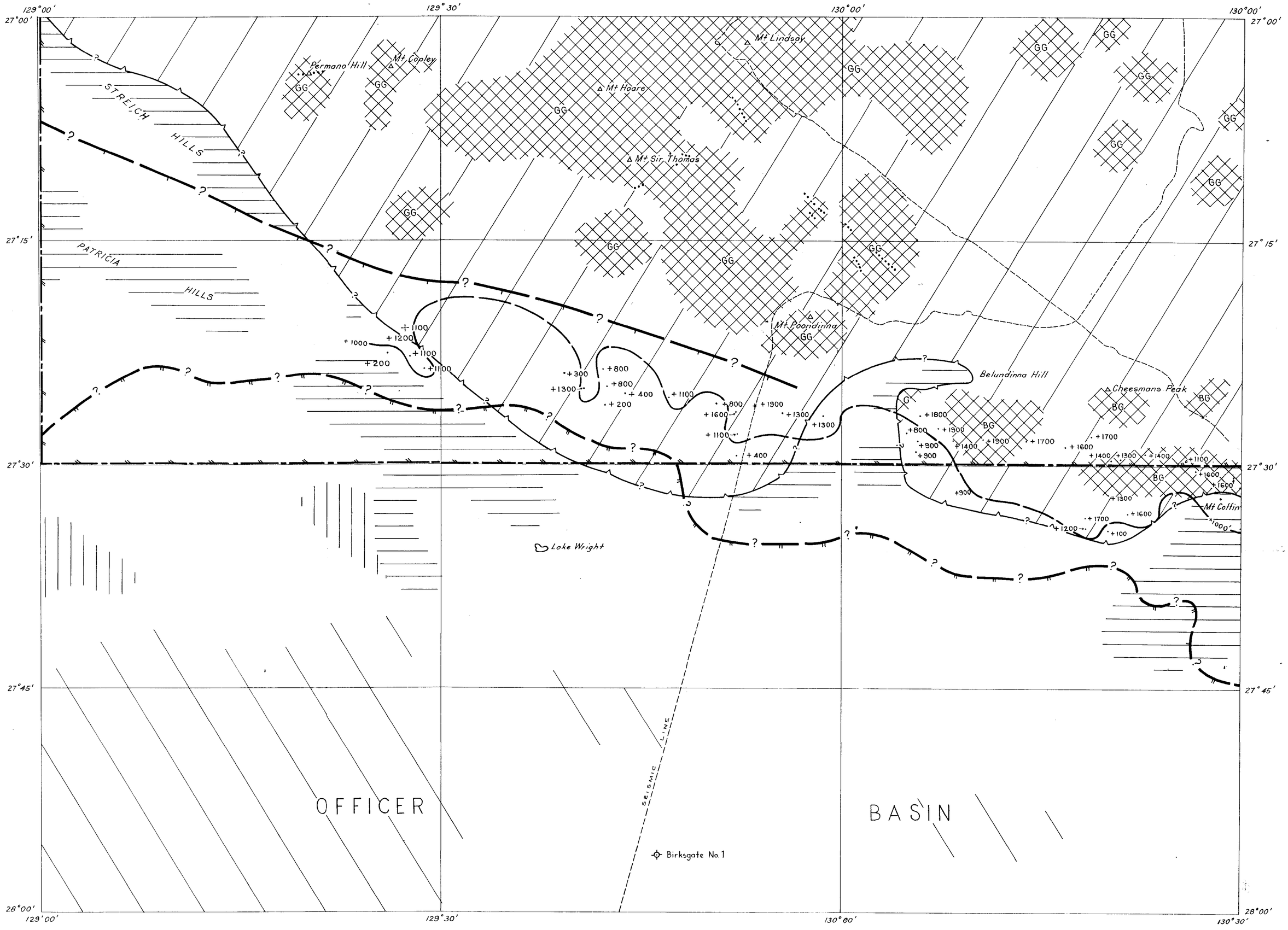
Generalised from published Mann 1:250,000 sheet
by B.P. Thomson
Geological Survey of South Australia, April '68

To accompany report by B.P. Thomson & R.B. Major.

DEPARTMENT OF MINES — SOUTH AUSTRALIA

MANN 1:250,000 GENERALISED GEOLOGICAL MAP

REGIONAL MAPPING SECTION		Drn. B.P.T.	SCALE: 1:250,000
		Tcd. E.B.T.	68-395 Ad
		Ckd. L.V.W.	
Director of Mines		Exd.	DATE: 20·5·68



MESOZOIC — Sandstones & siltstone.

ORDOVICIAN — Kulyong Volcanics.

ADELAIDEAN & CAMBRIAN — Sandstone, siltstone arkose.

OLDER PRECAMBRIAN OF MUSGRAVE BLOCK

- BG — Biotite Granite
- Dolerite dykes
- GG — Granitic gneisses
- Undifferentiated gneisses & granites covered by thin sand veneer.

Unconformity

Normal fault

Basement fault or hinge line inferred from aeromagnetic data.

+1200 / 1000 — Magnetic basement in feet above sea level. Interpetation by Geophysical Associates International for Exoil Pty. Ltd.

Area of proposed Aeromagnetic Survey.

Unpublished mapping by R.B. Major, J.A. Teluk and J.E. Johnson, Geological Survey of South Australia.

Compiled and generalized by B.P. Thomson, R.B. Major and J.A. Teluk, Geological Survey of South Australia.

S.A. Dept. of Mines April-May 1968

To accompany report by B.P. Thomson and R.B. Major

DEPARTMENT OF MINES — SOUTH AUSTRALIA

BIRKSGATE 1:250,000 SHEET GENERALISED GEOLOGICAL MAP

REGIONAL MAPPING SECTION		Drn. R.B.M.	SCALE: 1:250,000
		Tcd. E.B.T.	68-396 Ad
Director of Mines		Ckd. L.V.W.	
		Exd.	DATE: 21·5·68