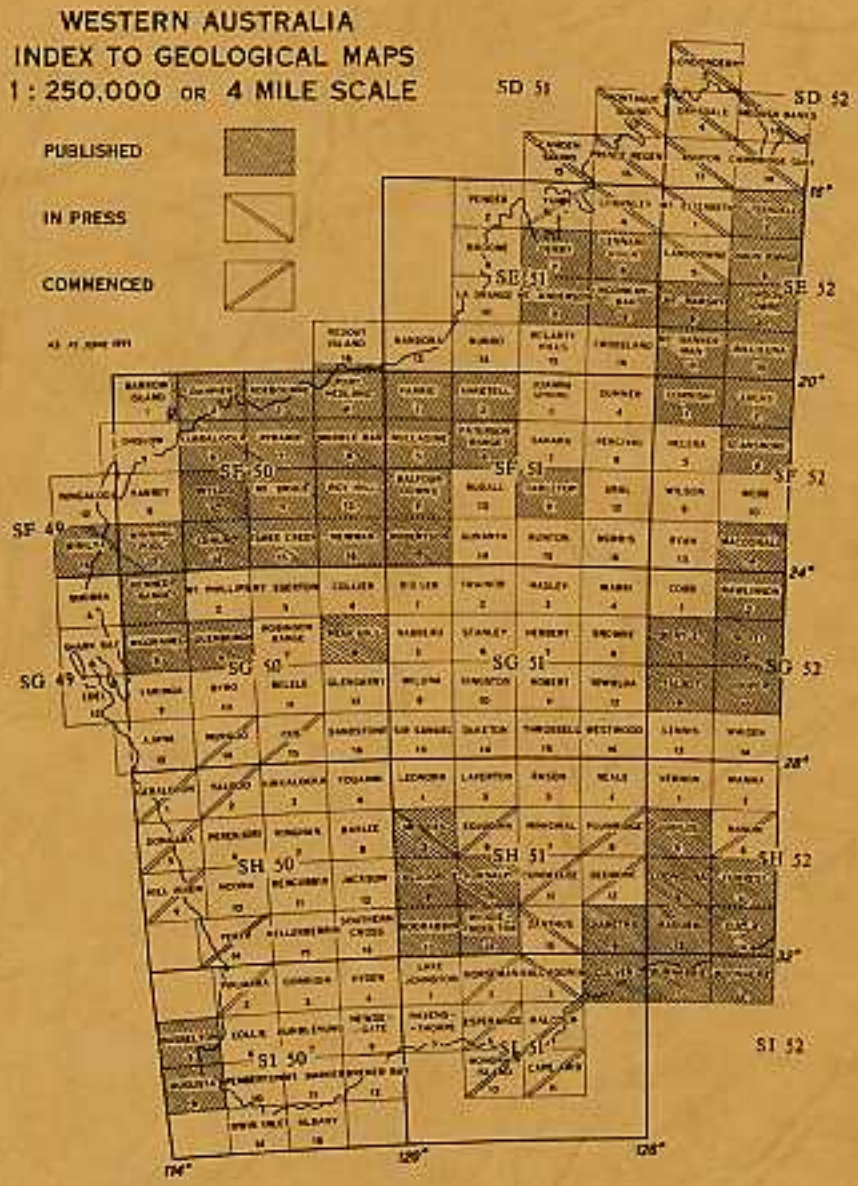
1:250:000 GEOLOGICAL SERIES—EXPLANATORY NOTES

MENZIES
WESTERN AUSTRALIA

SHEET SH/51-8 INTERNATIONAL INDEX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COMMONWEALTH OF AUSTRALIA

STATE OF WESTERN AUSTRALIA

1:250,000 GEOLOGICAL SERIES—EXPLANATORY NOTES

MENZIES

SHEET SH/51-5 INTERNATIONAL INDEX

Compiled by M. Kriewaldt

Geological Survey of Western Australia

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1970

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

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GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

DIRECTOR: J. H. LORD

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Explanatory Notes on the Menzies Geological Sheet

*Compiled by M. Kriewaldt**

INTRODUCTION

The Menzies 1:250,000 Sheet area (SH/51-5) lies between latitude 29°00'S and 30°00'S and longitude 120°00'E and 121°30'E and is named after the old mining town of Menzies which is about 80 miles north of Kalgoorlie. The town itself was named after L. R. Menzies, who, with A. S. McDonald, found gold there in 1894. The area adjoins the north boundary of the Kalgoorlie Sheet area and has many similarities with it in both topography and geology.

The average elevation of the land is about 1,300 feet above sea level with local prominences represented by Ranford Peak, Mount Ida, Mount Melita, Mount Morley, and Mount Misery, and large depressions by Lake Ballard, Lake Marmion, and Lake Goongarrie.

Previous geological work on the area by the Geological Survey of Western Australia includes mapping at Comet Vale, Menzies, Kookynie, Mulwarrie, Mulline, and Mount Ida (Gibson, 1904, 1907; Jutson, 1921a, 1921b; Woodward, 1906). An aeromagnetic survey was also flown in 1964 by the Bureau of Mineral Resources (Young and Tipper, 1964).

The mapping described in these notes was commenced by M. Kriewaldt in April 1967 and completed in October 1967. R. C. Horwitz and I. R. Williams later re-interpreted the geology of the Kookynie, Desdemona, and Melita areas in October 1968, after further field work.

PRECAMBRIAN

ARCHAEAN

Precambrian rocks underlie the Menzies Sheet area. The succession is as follows (oldest to youngest):

1. Basalt, quartz-mica schist, slate, greywacke, and banded iron formation; all intruded by serpentinite, gabbro, pyroxenite, and other ultramafic rocks
2. Talc-chlorite schist, pyritic chert, conglomerate with chert cobbles, basalt, slate, siltstones, grits, and acidic volcanic rocks
3. Quartz porphyry, ultramafics, and abundant basic sills which intrude the rocks of (1) and (2)
4. Intrusive, granite.
5. Pegmatite, felsite.

* Geological Survey of Western Australia.

The layered sedimentary and volcanic rocks are metamorphosed. They are intruded by granite which is considered to be Archaean and probably about 2,600 million years old.

The bottom of the succession at Lake Goongarrie includes greywacke, shale, quartzite, and pyritic chert which interfinger to the north with basalt intercalated with shale, greywacke, and chert. Near King Dam and Springfield sediments of the succession are metamorphosed to quartz-fuchsite-andalusite schist. At the Goodenough Goldmine, east of Menzies, an outcrop of pyritic granulated chert has weathered to gossan. Between Lake Goongarrie and Menzies the succession is intruded by gabbro sills.

Serpentinite sills are present in the succession towards the west.

At Jeedamya, northeast from Menzies, metamorphosed basalt is overlain by rhyolite and tuff. This succession is intruded by quartz porphyry and the whole assemblage is intruded by numerous gabbro and dolerite sills. The same basalts are overlain by acid volcanic rocks and intruded by numerous gabbro and dolerite sills at Melita and Desdemona. Northwest of Desdemona, talc schists and chert, which are capped by conglomerate, are believed to be basal to the sequences described from Jeedamya, Desdemona, and Melita.

In the northwest of the Menzies Sheet area gabbro sills intrude banded iron formation, which is intercalated with metamorphosed basalt, underlain by micaceous quartzite and quartz-mica schist and overlain by a succession of metamorphosed basalts with ferruginous chert. East of Illaara homestead the banded iron formation sequence is overlain by metamorphosed basalt and ferruginous chert with a basal conglomerate. Further south the banded iron formation series is truncated by granite but reappears 16 miles southeast of Hospital Rocks, where it is intruded by serpentinite.

Centred on Riverina, metamorphosed basalts with intercalations of metamorphosed shale are intruded by sills of gabbro and serpentinite. These rocks extend through Snake Hill to Copperfield and Mount Ida townsite. Northeast of Fortyfive Mile Well they include a large folded ultramafic complex. At Mount Ida and Mount Bevan the basalts are underlain by banded iron formations.

The layered succession is intruded by granite which is usually a medium-grained biotite granite with little foliation and few phenocrysts. Granite is found at a higher level in the sequence at the south end of the country between Perrinvale and Illaara than at its northern end. It truncates the banded iron formation south of Mount Ida and is foliated parallel to its intrusive contact and to the foliation of the superjacent rocks north of Fountain Spring, south of Niagara, and between Copperfield and Mount Ida townsite.

At Morley Find and Jeedamya woolshed, the succession is intruded not only by granite but also by many pegmatites. Around Ularring Rock and north of Comet Vale the granite forms large embayments in the layered sequence.

North of Lake Ballard a large expanse of granite is exposed, with an intrusive eastern edge which may be seen between Jeedamya and Desdemona. The western

edge, from east of Mount Ida townsite to Snake Hill, is strongly foliated and intercalated with amphibolite. Gneissic and foliated granites with intercalations of amphibolite extend south from Snake Hill to 16 miles northeast of Mulwarrie. Northwest of Twin Hill to the north of Menzies, the granite is foliated.

At Alexander Hills, east of Menzies, there is a large roof pendant of metamorphosed basalt and gabbro.

Archaean-Proterozoic Dykes

The youngest of the Menzies Precambrian rocks, whose age may be either very late Archaean or early Proterozoic, form long basic dykes which generally cut across the trend of the country and are contemporaneous with a large number of similar dykes in other parts of the Eastern Goldfields. The positions of the dykes have been delineated by aeromagnetic anomalies which have been analyzed by Young and Tipper (1964).

It has been concluded that there are seven large dykes which cut across the Menzies Sheet area. Three of the dykes, which dip 80 degrees south, are about 1,000 feet wide and hidden by 50 to 100 feet of overburden. Two of these three have low anomalies which have been interpreted as being due to a remanent magnetization which is inclined 60 degrees south. The third dyke has a high anomaly produced by induced magnetization. The anomalies of the other four dykes are also considered to be due to induced magnetization.

Cross-cutting gabbro dykes which crop out northeast of Mount Ida townsite and west of Niagara (Tomich, 1955; Jutson, 1921a) are similar to gabbro dykes in the Kalgoorlie and Norseman areas. The latter have been assigned an age of about 2,400 million years (Turek, 1966).

Quartz dykes, which also cut across the general trend of the country, are exposed south of Donkey Well and Illaara South Boundary bore.

CAINOZOIC

Tertiary

During the Tertiary period the rocks of the Menzies area were weathered to depths of up to 200 feet or more below the land surface. Where the weathered material was exposed it became silicified and ferruginized to form extensive deposits of laterite. Detrital material from the laterite later became cemented in many places with sheets of calcareous material.

The southern part of the Menzies Sheet area has yellow sandy loams with limonitic nodules, some of which have been formed around the cocoons of weevils. Further north the same kind of nodules occur in a pale brown loam. Both types of soils are considered to have originated after the period of deep weathering had ended.

Pleistocene (or Tertiary)

The erosion of deeply weathered granite has resulted in the formation of deposits of angular quartz sand grains with a clay matrix. In places surface silicification is noticeable and forms the rock known as billy or silcrete. Such rocks can be

seen northeast of Mitchell Rocks, near Granite Creek, southwest of Olympic Bore, and elsewhere. Many other deposits of gravelly loam, detrital laterite, and colluvium in the Menzies Sheet area have been consolidated with a siliceous-calcareous matrix.

The headwaters of the old Ballard Drainage are filled with a valley fill, including windblown deposits, and contain diagenetic nodules of kankar.

Alluvial deposits of red gravelly loam in the Menzies Sheet area have become indurated to form hard pan. The deposits are in places cut by drainage channels; elsewhere they are covered by younger alluvium. Six miles northwest from Menzies hard pan containing gypsum crystals is exposed in an old dam.

Younger Pleistocene

The younger Pleistocene deposits of the Menzies Sheet area include:
Yellow sandy loam washed from older deposits
Washes of arkose from granites
Veneers of old pediment erosion surfaces
Alluvium and colluvium.

Recent (or Pleistocene)

Sheet deposits of saline sand and silt with kopai (impure gypsum) and irregular crumbly kankar concretions cover the greater part of the Lake Ballard, Lake Marmion, and Lake Goongarrie depressions. The age of the deposits may be Pleistocene or Recent.

Recent

Recent deposits which grade up into modern sediments include:
1. Silt and other alluvial deposits with diagenetic gypsum and often a thin crust of halite.
2. Silt and other alluvial and eolian deposits at the east and south sides of playas.
3. Veneers on pediments cut into weathered and fresh rocks on the west and north sides of playas.
4. Silt and other alluvial deposits in clay pans.

The age and type of Cainozoic units is shown in Table 1.

TABLE 1. AGE AND TYPE OF CAINOZOIC UNITS

Age	*Type*	*Map symbol*
Recent	Alluvial and eolian deposits	Qr
Recent (or Pleistocene)	Eolian and alluvial deposits	Qa
Pleistocene	Mostly alluvial deposits, some eolian	Qp
Pleistocene	Alluvial and eolian deposits, and soils	Qq
Pleistocene	Hardened weathered rocks, alluvial deposits, and soils	Qt
Pleistocene (or Tertiary)	Alluvial deposits	Qu
Tertiary	Deeply weathered rocks and laterite	To, Tl

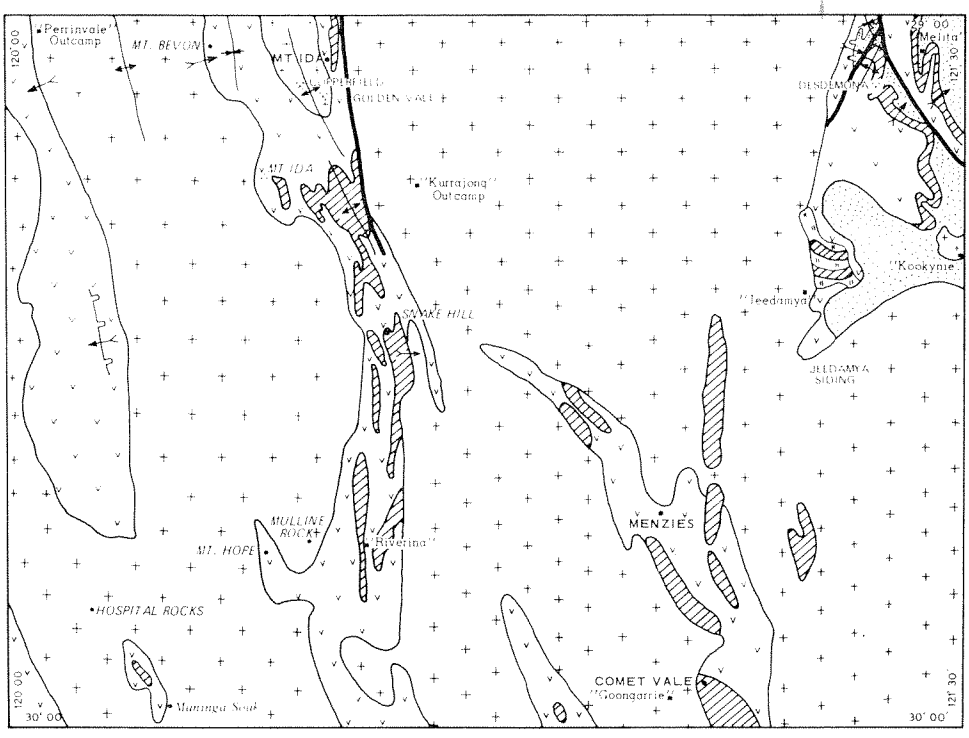

FIGURE 1

STRUCTURAL SKETCH MAP

MENZIES SHEET SH 51-5

SCALE OF MILES

10 0 10 20 30

REFERENCE

ARCHAEAN

- Granite
- Basic and ultramafic intrusive complexes
- Intrusive porphyry and micro granite
- Acid volcanic rocks and clastic rocks
- Basic lavas and sediments

- Facing of sequence
- Unconformity, hiatus
- Anticline axis
- Syncline axis
- Fault

STRUCTURE

A structural interpretation of the Sheet area is shown in Figure 1. The important features are:

1. A west-facing limb from Perrinvale which extends 50 miles to the south-southeast

2. An east-facing limb at Mount Bevan with a north-plunging left-hand drag at the south

3. A deduced anticline between the two limbs

4. A south-plunging anticline between Copperfield and Mount Ida townsite

5. An interpreted south-plunging anticline to the west of Kurrajong old homestead

6. An interpreted fault between the structures to the west of Kurrajong homestead and the intercalated amphibolite and gneissic granite to the east

7. A west-facing limb from Goongarrie to Menzies

8. A southeast-facing limb along the Twelve Mile Hills

9. An east-facing limb along the line of mineralization of the Cock Robin mine (from a large right-hand south-plunging drag)

10. A generally east-facing sequence in the northeast corner of the Sheet area between the areas of Jeedamya, Kookynie, Desdemona, and Melita

11. An interpreted north-northeast-striking fault 3 miles west of Desdemona

12. An interpreted north-northwest-striking fault 4 miles east of Desdemona

13. Traces of a limb through Mount Hope and northwest from Mulline rocks. The limb has been interpreted as part of the limb from Mount Bevan to Mount Ida to the north and of the Callion limb to the south in the Kalgoorlie Sheet area

14. Outcrops between Hospital Rock and Maninga Soak. These are thought to be part of the south extension of the limb from Perrinvale

15. The existence of a syncline between the east-facing Coorara-Yerilgee limb of the Kalgoorlie Sheet and west-dipping rocks in the southwest corner of the Menzies Sheet area

16. An east-facing limb through Riverina and Mulline. A fault has been interpreted between this limb and intercalated amphibolites and gneissic granites to the east.

ECONOMIC GEOLOGY

Gold

Over 2¼ million ounces of gold and about 50,000 ounces of silver have been produced from mines in the Menzies Sheet area from some 3¼ million tons of ore.

At the Altona and Cosmopolitan mines at Kookynie the gold occurs in quartz veins in granite. Gold, with galena, has been mined in quartz reefs at the Paramount Mine at Morley Find, east of Menzies. Mines at Riverina, Mulline, Ularring, and Mulwarrie were worked for gold-bearing quartz veins with sulphides. Six different types of gold mineralization have been recognized at Mount Ida (Tomich, 1955). At Mount Ida quartz reefs near the granite are cupriferous (Gibson, 1907).

Other Minerals

The analyses for lead, zinc, silver, nickel and copper of some ferruginous materials collected in the area are given in Table 2.

TABLE 2. ANALYSES OF FERRUGINOUS MATERIALS

No.	*Location*	*Parts per million* *Pb*	*Zn*	*Cu*	*Ni*	*Co*	*Silver dwt/ton*
17290	North-northwest from Four Corners bore (Kurrajong Station)	—	440	460	500	200	n.d.
17294	2.4 miles south of Illaara South Boundary bore 7	120	1200	160	670	330	n.d.
17295	North of Blue Well (Riverina Station)	—	210	560	120	40	n.d.
17296	North of Red Bore (Riverina Station)	—	120	190	40	40	n.d.
17297	As 17296	—	70	150	40	40	n.d.
17276	Deep bore (Yunndaga Station)	70	120	690	140	60	n.d.
17261	1½ miles east of Mulline	130	950	230	100	70	n.d.
24101	Goodenough gossan, northeast of Menzies	110	70	420	60	80	2.4
24102	Spion Kop gossan (Yunndaga Station)	110	110	100	1300	200	0.1
24103	East of Moriarty Well (Yunndaga Station)	50	230	150	260	60	2.2
24104	Morapoi Station, east of homestead, south of road	110	170	80	390	210	0.1
24106	Melita Station (west of homestead on Menzies-Leonora road)	50	100	70	80	40	0.1

Battery sands collected from the Menzies Sheet area have been analyzed by King (1966). Some of the results are given in Table 3.

TABLE 3. ANALYSES OF BATTERY SANDS

Comet Vale (Sand Queen and Gladsome)
Pb, 0.15 per cent; Zn, 0.15 per cent; Cu, 0.07 per cent; V, 0.06 per cent (unusually high).

Yunndaga (Menzies Consolidated)
Cr, 0.1 per cent; Ba, 0.15 per cent; Sr, 0.1 per cent.

Menzies (Lady Shenton)
Pb, 0.15 per cent.

Menzies (First Hill)
Li, 600 ppm (highest in district).

Mulline
Pb, 0.2 per cent; Zn, 0.15 per cent; Mn, 0.15 per cent.

Kookynie (Cosmopolitan)
Wo, 0.3 per cent; some copper stains.

Malachite and azurite were reported by Feldtmann (1915) in the dump of the Day Dream Mine at Mulline. He also reported the existence of a copper-bearing quartz reef about 2 miles east of Mulline.

A sample of black sand from the west shore of Lake Goongarrie contained 37 per cent quartz and feldspar, 30 per cent magnetite and maghemite, and 33 per cent goethite and hematite.

Halite stained with goethite occurs as a thin crust in a small salt pan southwest of Comet Vale.

A few parcels of prase have been collected from deposits southeast of Jowett Well, east of Menzies.

Iron ore from Mount Mason assayed over 96 per cent Fe_2O_3 (Talbot, 1912).

Prospecting Recommendations

Areas recommended for prospecting for base metal sulphides and gold in the Menzies Sheet area are as follows:

Gold: Around Menzies, Mulline, Morley, Kookynie, and Metzke. (Particular areas for gold prospecting were also recommended by Tomich (1955) near Copperfield. Young and Tipper (1964) recommended prospecting for gold on cross-fold axes located by aeromagnetometer work, and in particular suggested the intersection of two aeromagnetic anomalies to the southeast of Days Rock at latitude 29°33′S, longitude 120°11′E.)

Nickel: The ultramafic rocks between Comet Vale and Goongarrie; at Twelve Mile Hills; between Snake Hill and Kurrajong, and in the area northwest and west of Desdemona, between a fault and the granite.

Copper, lead, zinc and silver: Immediately to the west of Riverina Gold Mine; near the Emerald Gold Mine; 2 miles east of Mulline Battery; around the anticline from Copperfield to Mount Ida townsite; around the Melita-Desdemona Structure at the contact between the rhyolite and the overlying shale; northeast of Jeedamya at the contact of rhyolite and shale; in the pyritic shale to the east of Moriarty Well; in shales on a line from Perrinvale to Metzke Find and southwards.

Lithium: Near the Riverina Gold Mine, northeast of Riverina, and near Melville Well.

Underground Water

The average annual rainfall of the Menzies Sheet area is about 10 inches and much of this falls in cyclonic storms during the summer months. There are over 200 bores and wells within the region which are used for stock purposes. The watering points have generally been sunk into the higher ground away from salt lake areas where underground water is invariably saline. Underground water collected from a pit sunk 1 foot into the playa floor of Lake Ballard for example, was found to contain 189,000 parts per million of total dissolved solids by evaporation.

The nitrate content of underground water analyzed from the Menzies Sheet area ranges up to 300 parts per million and has a bimodal distribution with peaks at 10 parts per million and 110 parts per million.

The Cosmopolitan mine at Kookynie, the Lubra Queen mine west of Kookynie, and the Riverina South mine at Riverina are recorded as having large inflows of underground water.

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AUSTRALIA 1 : 250,000 GEOLOGICAL SERIES

MENZIES

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SHEET SH 51 - 5

SYMBOLS

Geological boundary
Fault
- Accurate
- Concealed

Top of unit
- Top of bed
- Graded bedding
- Facing of lava flow

Bedding
- Measured
- Unmeasured
- Vertical

Cleavage
- Unmeasured
- Vertical

Foliation
- Measured
- Unmeasured
- Vertical

Lineation
- Direction and plunge
- Foliation with plunge
- Lineation on bedding

Banding
- Platy flow, inclined
- Platy flow, vertical

Folding
- Anticline
- Dragfold
- Plunge of fold axis

Specimen locality — × 17276

Goldfield boundary
Goldfield district boundary
Road
Track
National route marker — 91
Railway, 3′ 6″
Tramway formation, abandoned
Telegraph line
Town — Menzies
Siding — Melita
Homestead — Riverina
Locality — Mindanda
Horizontal control, major, minor
Bench mark, height accurate — XM 113 1432′
Airfield
Landing ground
Shed
Yard

Sand dune
Breakaway

Watercourse, intermittent
Well — W
Bore — B
Tank (earth) — T
Dam (earth) — D
Windpump
Pipeline
Soak — Sk
Gnamma hole — GH
Rockhole — RH
Position doubtful — (PD)
Abandoned — (Abd)

Mining centre (Gold unless otherwise shown) — COMET VALE
Mine (Gold unless otherwise shown) — Desdemona
Prospect (Gold unless otherwise shown) — Redleap
Battery
Battery (abandoned)
Mineral occurrence
- Copper — Cu
- Iron — Fe
- Lithium — Li

REFERENCE

CAINOZOIC — QUATERNARY — RECENT

Qra Silt and other alluvial deposits in playas
Qrb Silt and other alluvial and eolian deposits adjacent to playas
Qrp Silt and other alluvial deposits in claypans
Qrc Soil veneers on weathered and fresh rock

Qas Silt to sand—buff sheet deposits with crumbly irregular kankar concretions; white and yellow sand
Qak Kopi; gypsum and clay in dunes (lunettes) and sheets

Qpy Clay to sand colluvial veneer on erosion surfaces
Qpa Clay to pebble colluvium
Qpv Clay to pebble alluvium
Qpm Silt to sand—quartz and feldspar from granite
Qps Silt to sand—yellow to buff alluvium and colluvium

PLEISTOCENE

Qqa Silt to sand alluvium and colluvium
Qqc Soil veneers on weathered and fresh rock, some with sheet kankar
Qqf Ironstone gravel with sheet kankar
Qqq Gravel with sheet kankar (cemented colluvium)
Qqs Loam with regular kankar nodules
Qqz Clay to pebble colluvium and alluvium with hardpan

Qtb Jasper, some chrysoprase; grey billy
Qtc Canga (limonite—cemented ironstone colluvium)
Qtl Limonite—cemented ironstone gravel
Qtn Ironstone nodules in brown loam
Qtg Ironstone nodule gravel
Qts Loam to sand, yellow to buff

Qu Gritty sandstone with clay matrix

TERTIARY

Tl Massive laterite
To Deeply weathered rock

PROTEROZOIC OR ARCHAEAN

Pd Gabbro, dolerite
Pq Quartz

ARCHAEAN

Ap Pegmatite
Aq Quartz
Ay Porphyritic felsite

Ag Granite—light-coloured, equigranular
Agn Intercalated gneissic granite
Agg Gneissic granite

A4Λ Altered gabbro and dolerite

A3s Slate, cleaved greywacke and conglomerate
A3v Altered basalt, some with pillows
A3x Felsite, rhyolite
A3Δ Felsite and rhyolite breccia
A3p Intrusive quartz porphyry

A2Λ Altered gabbro and dolerite
A2r Serpentinite
A2t Matted acicular amphibole rock
A2h Chevron-patterned amphibole-chlorite rock

A2s Slate, cleaved greywacke and conglomerate
A2f Ferruginous quartzite
A2c Pyritic chert
A2o Conglomerate with chert cobbles
A2v Altered basalt, some with pillows
A2x Felsite, rhyolite

A2m Knotted andalusite schist
A2n Quartz-fuchsite schist, quartz—fuchsite—andalusite schist
A2k Altered basalt ('sparkling' hornfels)
A2l Talc—chlorite schist

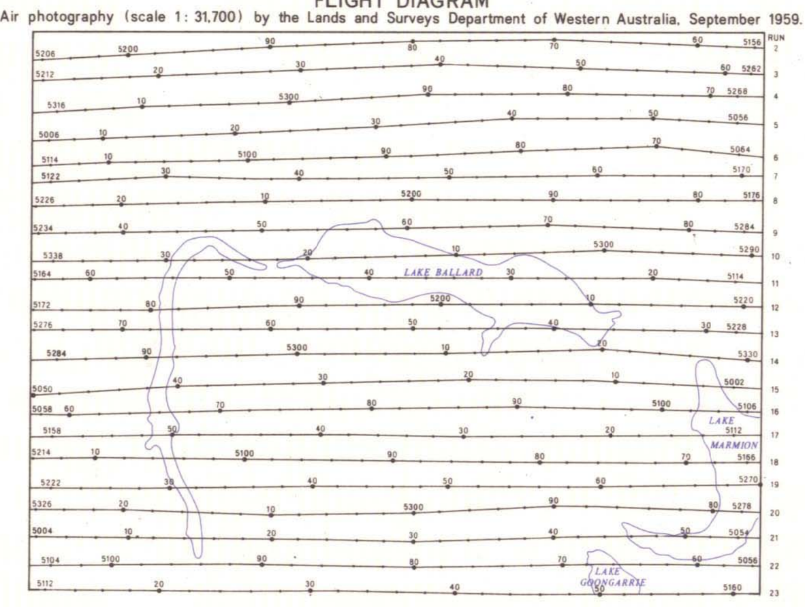
A1Λ Altered gabbro and dolerite
A1r Serpentinite

A1b Banded iron formation
A1s Slate, cleaved greywacke and conglomerate
A1v Altered basalt, some with pillows
A1d Quartzite

A1a Quartz—mica schist
A1k Altered basalt ('sparkling' hornfels)

FLIGHT DIAGRAM

Air photography (scale 1: 31,700) by the Lands and Surveys Department of Western Australia, September 1959.



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Published by Bureau of Mineral Resources, Geology and Geophysics, Department of National Development, Canberra, A.C.T.

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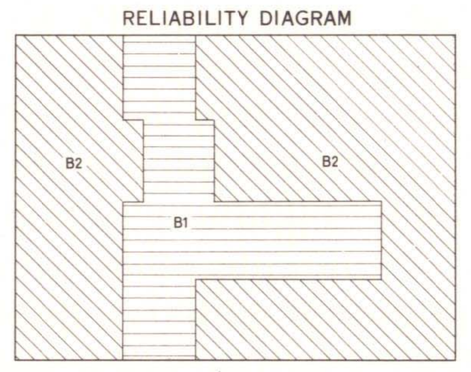
RELIABILITY DIAGRAM



B1 Numerous traverses with air photo interpretation
B2 Air photo interpretation with a few traverses

HON. D.G. MAY, M.L.A.
MINISTER FOR MINES
J. H. LORD, DIRECTOR, GEOLOGICAL SURVEY

SCALE 1 : 250,000

TRANSVERSE MERCATOR PROJECTION
ZONE 2 AUSTRALIA SERIES

Geology by M. Kriewaldt 1967
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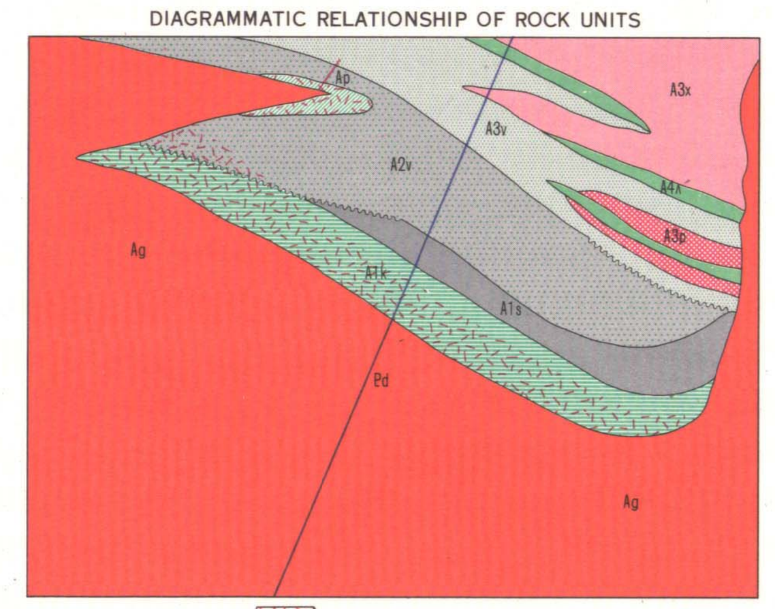
DECLINATION DIAGRAM

The lines indicate magnetic declination, 1965.
+ means declination is east and correction must be added to compass bearing to give true bearing.
– means declination is west and correction must be subtracted from compass bearing to give true bearing.

Annual change is +1′ easterly

DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS

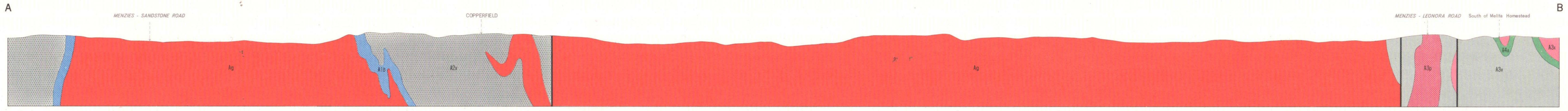


Contact metamorphism
Disconformity or unconformity

DIAGRAMMATIC SECTION

NATURAL SCALE
Topography is exaggerated

SECTION A - B



MENZIES
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