1:250 000 GEOLOGICAL SERIES—EXPLANATORY NOTES

BENCUBBIN

WESTERN AUSTRALIA

SHEET SH/50-11 INTERNATIONAL INDEX

WESTERN AUSTRALIA
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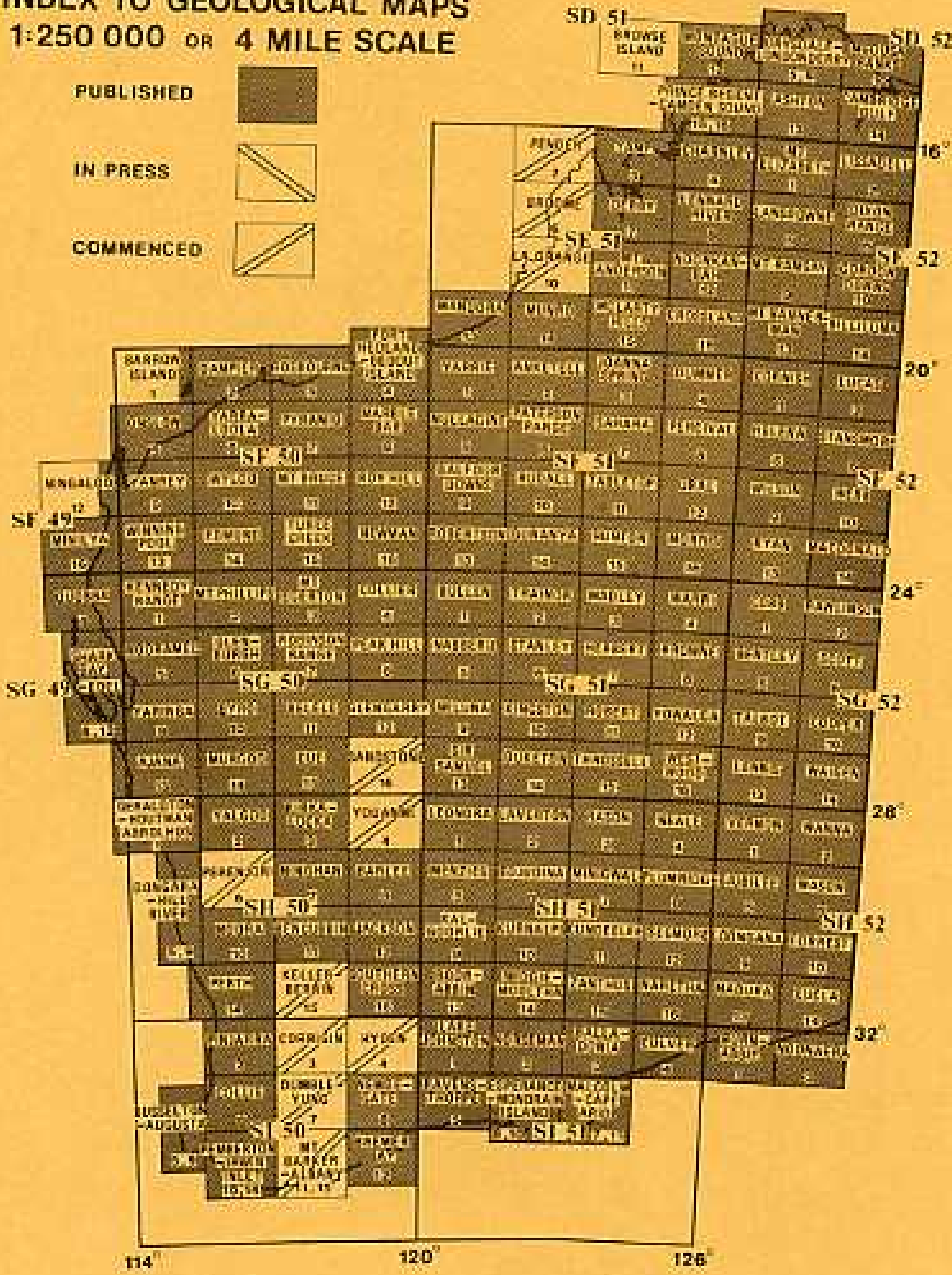

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

1:250 000 GEOLOGICAL SERIES—EXPLANATORY NOTES

BENCUBBIN
WESTERN AUSTRALIA

SHEET SH/50-11 INTERNATIONAL INDEX

COMPILED BY D. F. BLIGHT, R. J. CHIN, AND R. A. SMITH

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Explanatory Notes on the Bencubbin Geological Sheet

Compiled by D. F. Blight, R. J. Chin and R. A. Smith

INTRODUCTION

The BENCUBBIN* 1:250 000 Sheet, SH50-11 of the International Series, is bounded by latitudes 30°S and 31°S, and longitudes 117°E and 118°30'E. The sheet is named after Bencubbin, a small wheatbelt town 240 km northeast of Perth. Other towns, interconnected by a network of roads and railways, are Beacon, Cadoux, Kalannie, Koorda and Mukinbudin.

The climate is semi-arid with a high potential evapotranspiration. Precipitation, from winter rains and occasional summer storms, decreases from 330 mm/yr to 250 mm/yr, northeasterly across the sheet. Land use is dominated by cereal growing. The northern and northeastern margins remain uncleared and thick mulga scrub makes access difficult. The vegation in the area is described in detail by Beard (1980). The Lake Moore State Barrier Fence (vermin proof) crosses the northeast corner of the sheet.

PREVIOUS INVESTIGATION

In the latter part of the 19th Century numerous explorers, including the Gregory brothers (1846), Austin (1854), Forrest (1869) and Giles (1875), crossed BENCUBBIN utilizing granite rockholes in the normally waterless eastern part of the sheet (Feeken and others, 1970).

The dry salt lakes drew early comment from the Government Geologist (Woodward, 1897). More recently, gypsum deposits associated with these lakes were studied (de la Hunty and Low, 1958) and the palaeodrainages linking them were delineated by van de Graaff and others (1977). The existence of fluorite-bearing granites was pointed out by Wilson (1958); some adamellite and associated rocks were described by Leow (1958); and some Rb/Sr whole-rock isotopic ages of granites were published by Arriens (1971).

The Bureau of Mineral Resources conducted a reconnaissance gravity survey over BENCUBBIN (Fraser, 1974) in 1969, and an aeromagnetic survey (Wyatt, 1975) in 1972.

PHYSIOGRAPHY AND CAINOZOIC GEOLOGY

Topographic relief on BENCUBBIN is expressed by laterite breakaways and granite slopes and monoliths (e.g. Mount Marshall). Elevations range from 290 to 500 m above mean sea level. An undulating lateritic duricrust (*Tl*), overlain by yellow sand (*Ts*), which commonly contains scattered pisoliths, probably formed over a Mesozoic landscape some time during the early Tertiary. Later, arid-climate erosion of this duricrust and of underlying rocks has resulted in the infilling of the palaeodrainages with sheet wash, sand and clay (*Qz*); directional deposits of valley clay, silt, sand and gravel (*Qa*); lake deposits of clay, silt, sand and salt (*Ql*); and adjoining, partly

*Sheet names are printed in full capitals to avoid confusion with identical locality names.

eolian material (*Qg*). The present drainages, in part, follow broad Mesozoic valleys (van de Graaff and others, 1977), so that the northern half of the area drains northwest into the Moore palaeodrainage, and the remainder south into the Avon palaeodrainage. Very heavy rain is required for these drainage systems to actually flow into the present Moore and Avon rivers. North of Beacon a small, south-draining tributary of the Avon appears to have captured a west-draining tributary of the Moore (Fig. 1).

ARCHAEAN GEOLOGY

REGIONAL SETTING

BENCUBBIN lies within the Yilgarn Block—a stable Archaean area composed mainly of gneiss and granite with northerly trending, elongate "greenstone" belts. These belts consist of metamorphosed layered sequences of ultramafic, mafic and felsic volcanic rocks and some sedimentary material, small remnants of which are present on BENCUBBIN.

Post-kinematic granitoids cover most of BENCUBBIN. These intrude gneiss and greenstone, of which only small remnants are exposed. The age of the Archaean rocks is poorly known. Only a broad-scale study was undertaken by Arriens (1971), who sampled granite from Waddouring Hill and took three samples along a line from Cadoux to Bonnie Rock. Using his raw data and assuming an initial Sr^{87}/Sr^{86} ratio of 0.701 ($\lambda = 1.42 \times 10^{-11}$/year), model ages around 2.6 and 2.7 b.y. are obtained. No isotopic data are available for the gneiss and greenstones.

THE BENCUBBIN GREENSTONE BELT

Southwest of Bencubbin, there is one small, westerly dipping greenstone belt that crops out over a length of about 20 km. Additional small remnants (up to 0.5 km long) of greenstone, chiefly banded iron-formation or amphibolite, crop out 20 km east of Mukinbudin; 11 km northwest of Cadoux; and in association with gneiss 15 km southeast of Bencubbin.

Ultramafic schist (*Au*) crops out in the southwestern section of the Bencubbin greenstone belt. Exposed portions of this rock display a distinctive pitted (5 mm diameter) surface owing to the weathering of olivine porphyroblasts. These are set in a groundmass of aligned cummingtonite laths. Rare grains of spinel are also present.

Lustrous, fine- to medium-grained, foliated and lineated amphibolite (*Aa*) makes up the bulk of the Bencubbin greenstone belt. It consists of plagioclase, hornblende and minor sphene, and has a granoblastic to lepidoblastic, serite texture. Weak, discontinuous layering, presumably of metamorphic origin, is present. The rock is thought to represent metamorphosed basaltic flows, and at the northern end of the belt (4 km north of Mandiga) where dynamic metamorphism is less intense, pillow forms have been observed.

Layered gneissic rock (*Al*), possibly a metasediment, crops out along the southeastern margin of the Bencubbin greenstone belt. Two types can be recognized in the field. One is a leucocratic, fairly even-grained, medium-grained rock with small rounded tourmaline grains and diffuse layering. The other type has distinctive "eyes" of quartz set in a compositionally layered, melanocratic, schistose matrix.

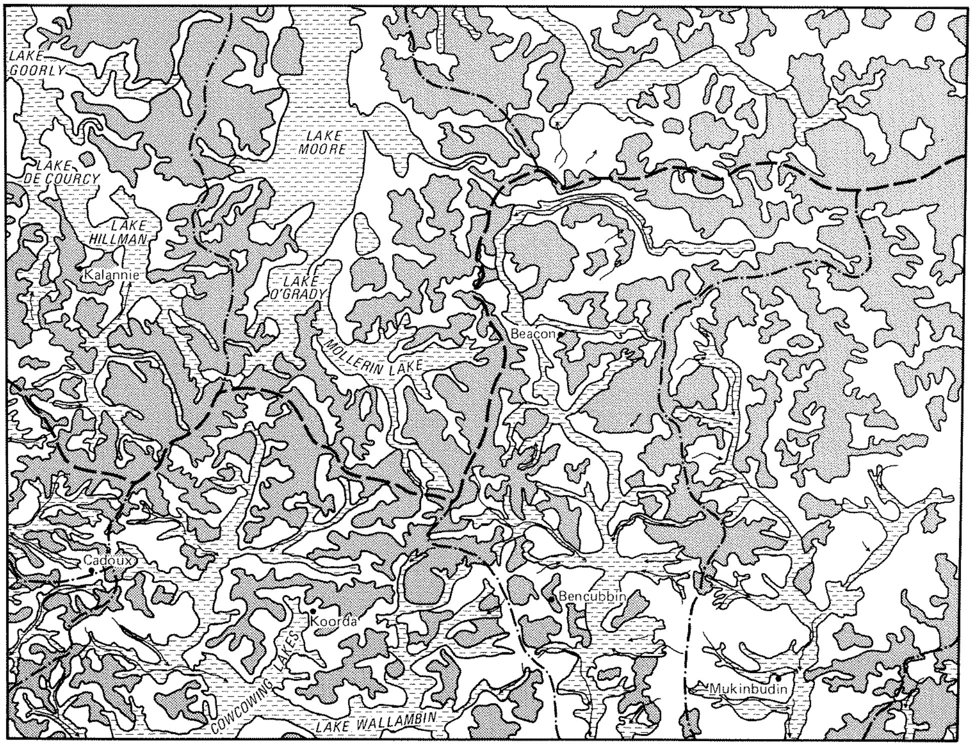

FIGURE 1

GSWA 18616

PHYSIOGRAPHY AND DRAINAGE

BENCUBBIN SHEET SH 50–11

0 10 20 30km

REFERENCE

- Tertiary laterite, remnant of old peneplain
- Sheetwash and bedrock exposed by erosion of peneplain
- Drainage areas – Alluvium, saline mud and aeolian (gypsiferous) dunes
- Main drainage divide separating Avon palaeodrainage system (south) and Moore palaeodrainage system (north)
- Minor drainage divide
- Watercourse

These quartz "eyes" are regarded as flattened quartz pebbles, although the possibility that they represent boudinaged quartz veins is not discounted. Mineral assemblages recognized in these rocks are:

(1) quartz + fibrolite + biotite + cordierite;
(2) quartz + hornblende + calcic plagioclase + epidote + opaques ± grunerite;
(3) biotite;
(4) quartz + fibrolite + sillimanite + biotite;
(5) quartz + fibrolite + sillimanite + andalusite + cordierite + biotite; and
(6) quartz + garnet + grunerite.

Field observations and mineral assemblages suggest that the parent rock was an arenaceous sediment, possibly with some chemical components.

Metamorphosed banded iron-formation (*Ai*) marks both the eastern and western margins of the Bencubbin greenstone belt. This rock forms discontinuous strike ridges and crops out as a medium-grained, sugary-textured, quartz-magnetite-hematite rock with strong compositional layering. At depth this rock is composed of varying proportions of quartz, grunerite, hornblende, magnetite and hematite. Those layers richer in hornblende presumably represent a more calcareous section of a silica-iron-oxide sediment.

GNEISS

Foliated biotite gneiss with adamellite, granodiorite and hornblende-diorite composition (*An*) crops out poorly 10 km south of Bencubbin, to the west and north of Kalannie (in a north-northeasterly trending belt), and 17 km east of Mukinbudin. At some localities this gneiss exhibits discontinuous layering which is best exposed south of Bencubbin on the eastern flank of the greenstone belt. Individual layers may extend for up to 5 m along strike and are up to 0.2 m thick. This layering is defined by grainsize and compositional variations of a medium-grained crystalloblastic quartz-plagioclase-microcline-biotite-hornblende gneiss. The layers are overprinted to varying degrees by a metamorphic fabric which is usually parallel or at a low angle to the layering. Commonly the gneiss is transgressed by later phases of non-foliated biotite adamellite and garnetiferous leuco-adamellite. The development of late-stage pegmatoid segregations within the gneiss is not uncommon.

This gneiss is thought to be orthogneiss derived by dynamic metamorphism of intrusive igneous granitoid, and is similar to those described as pre-kinematic and synkinematic granitoids by Gee (1979) on SOUTHERN CROSS. South of Bencubbin, adjacent to the greenstone belt, metamorphosed banded iron-formation layers which parallel the trend of the greenstone belt are completely surrounded by gneiss. This relationship suggests that the gneiss represents a granitoid which intruded the greenstone belt prior to, or during, the main metamorphism.

POST-TECTONIC GRANITOIDS

Over ninety per cent of the outcrop on BENCUBBIN is granite and adamellite which intruded after the formation of the gneiss described in the previous section. Although this group is characterized by irregular pluton shapes and spatial distributions, there tends to be a generalized sequence of intrusion. The oldest component is fine- and medium-grained adamellite and granite, in part strongly foliated. It is intruded firstly by homogeneous medium and coarse, even-grained granite and adamellite and subsequently by seriate adamellite. Mixtures of these granitoid types, commonly with remnants of older greenstone and gneissic rock, are also included in this older group.

Fine- and medium-grained granite and adamellite with even-grained allotriomorphic texture (*Age*) are distributed throughout BENCUBBIN. Although boundary relationships are rarely exposed, individual bodies may have different ages. Many small bodies and veins of this rock intrude most other granitoid bodies. However, some outcrops, such as those 8 km north-northeast of Bonnie Rock and 4 km south of Beacon, contain secondary muscovite and show more recrystallization than the enclosing adamellites, and are consequently considered to be older. A similar mass of fine-grained adamellite 13 km south-southwest of Kalannie contains zones of weak foliation and recrystallization. An unusual feature is the concentration of potassic feldspar in poorly defined leucocratic spots about 20 mm in diameter. Field relationships show that this body is intruded by the coarse-grained seriate adamellite (*Agv*).

Strongly foliated, fine-grained adamellite gneiss, which forms a northeasterly trending belt in the northwestern corner of BENCUBBIN, is derived by metamorphism and recrystallization of fine-grained equigranular adamellite (*Age*). Although the fine-grained adamellite body east of this gneiss is shown on the interpretative geology map (Fig. 2) as intruding the gneiss, poor exposure leaves open the possibility that this body is the parent rock for the formation of the gneiss.

Medium- and coarse-grained biotite granite and adamellite (*Agb*) predominantly occupies large bodies which intrude older gneiss and greenstone and is, in turn, disassociated by the intrusion of the younger seriate adamellite (*Agv*). However, even-grained textural variations of the younger adamellite have also been included in *Agb*. Most outcrop of the medium- to coarse-grained rock (*Agb*) is adamellite with up to 10% biotite, but there is continuous variation to granite. The texture is dominantly allotriomorphic granular, but some of the plagioclase (oligoclase) tends towards idiomorphism. This rock type is homogeneous and has no metamorphic foliation although rare trains of biotite and xenoliths outline a magmatic foliation. Secondary muscovite and chloritization of biotite are rare alteration effects.

Seriate, medium- and coarse-grained biotite granite and adamellite (*Agv*) forms a continuous "sea" which pervades the southwest Yilgarn Block (Gee and others, 1980), and represents over half the outcrop on BENCUBBIN. It encloses the gneiss, greenstone and other post-tectonic granitoids. Its composition is predominantly adamellite, but varies to granite, particularly where there are abundant potassic feldspar phenocrysts. The proportion of biotite rarely exceeds five per cent. Differences in the abundance and size of phenocrysts (up to 80 mm) are responsible for the variation in the seriate allotriomorphic texture, and true porphyritic textures may be present locally. The parallel alignment of tabular feldspar phenocrysts, measured as a primary foliation, is common, and in good quarry exposures, such as at Beringbooding Rock, a lineation formed by alignment of the longest crystal dimensions can be seen. This fabric suggests magmatic emplacement of the granitoid. Flow cells or discrete plutons are possibly outlined on the eastern side of BENCUBBIN by the circumferential orientation of feldspar foliation (Fig. 2). An intrusive relationship between two similar adamellites in this unit (*Agv*) has been observed on JACKSON (Chin and Smith, 1983), and although not found on BENCUBBIN the variation in textural types and orientation of primary foliation suggest that composite plutons form the continuous "sea".

A subordinate rock type which is a variant of the seriate adamellite (*Agv*) is fluorite-bearing granite and adamellite (*Agi*). It is characterized by violet fluorite in discrete crystals up to 1 mm across and aggregates up to 10 mm in diameter, by large rounded phenocrysts (up to 10 mm in diameter) of bluish-grey quartz, and by rounded phenocrysts of potassic feldspar. Biotite forms irregular clots up to 15 mm in diameter.

Syenite has been found as segregations in the fluorite-bearing adamellite 22 km northeast of Bencubbin. The syenite is coarse grained, allotriomorphic, and contains perthitic potassic feldspar, plagioclase and minor quartz, chlorite (after biotite), and secondary epidote.

Even-grained and seriate adamellite (*Agx*) containing abundant xenoliths of older gneiss and rare amphibolite is recognized at the margins of larger plutons of the post-tectonic granitoids. At De-Eranning Hill, xenoliths of layered gneiss (*An*), foliated adamellite and biotite-quartz schist in lensoid and sigmoidal shapes are enclosed in a variably textured, coarse-grained adamellite. Trains of biotite form nebulous layering which bows around the xenoliths and is considered to indicate magmatic flow. Abundant fine-grained adamellite and coarse-grained pegmatite intrude as the last phase.

Mixed granitoid (*Agm*) refers to the complex occurrence, on a scale of several metres, of younger phases intruding an older granitoid country rock. It is distinguished from the unit (*Agx*) by the lack of isolated and partially absorbed xenoliths. The mixed granitoid forms wide zones marginal to plutons of post-tectonic granitoids. In many areas, such as that 11 km west of Kokardine, older gneiss, foliated granitoids and a greenstone sequence are the early phases and these have been intruded by both even-grained and seriate adamellite. However, in other areas such as that 16 km southwest of Kalannie, the younger phase is simple seriate adamellite (*Agv*) in older fine-grained partially foliated adamellite. Pegmatite, commonly containing garnet, is concentrated at the margins of plutons, and constitutes a major component of the mixed granitoid in the form of small dykes and irregular patches.

A large quartz-microcline pegmatite (*P*) occurs 32 km north-northwest of Mukinbudin.

POST-GRANITE DYKES

Fine- and medium-grained dolerite infills fractures, joints and some fault planes, which trend predominantly east-northeast. They possibly correlate with the Widgiemooltha dyke suite dated at 2 420 $\pm$ 30 m.y. (Turek, 1966). Abundant xenoliths of granitoid country rock have been incorporated into a dyke 1 km north of Cadoux.

METAMORPHISM AND STRUCTURE

Metamorphic mineral assemblages in the metasedimentary and amphibolite units define fairly closely the grade of metamorphism reached during the earliest recognizable deformation event. This event probably generated the penetrative fabric in the gneiss and greenstone. The apparent equilibrium assemblages—quartz + fibrolite + sillimanite + andalusite + biotite + cordierite, and hornblende + plagioclase—place these rocks in mid to upper amphibolite facies, corresponding to a temperature of about 600-650°C and a load pressure of about 300-450 MPa (Winkler, 1976).

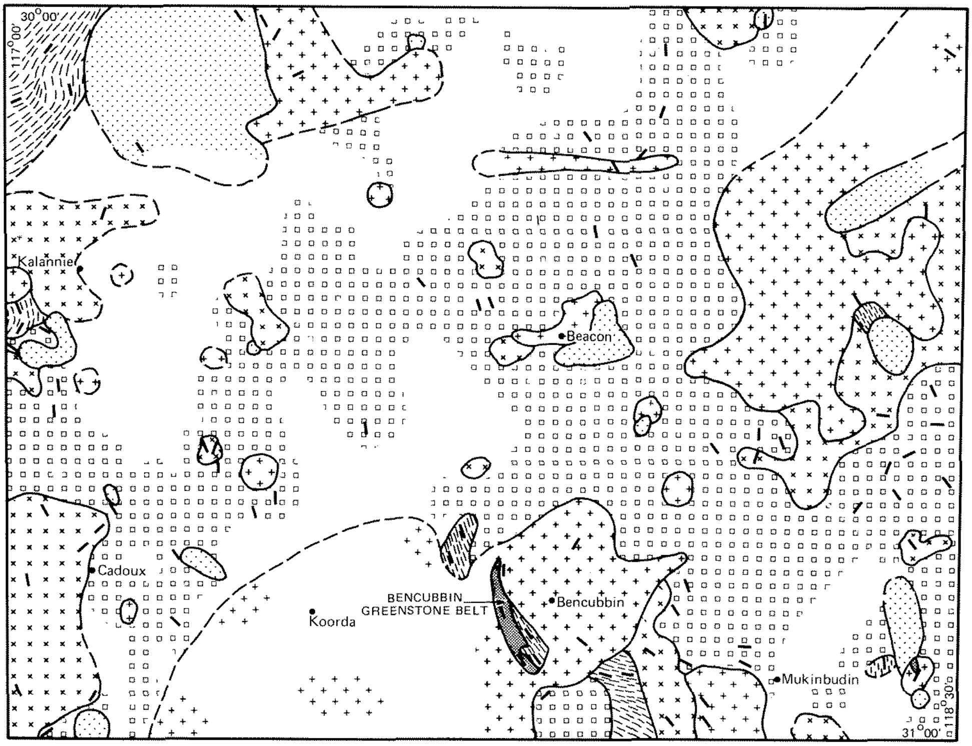

FIGURE 2 GSWA 18617

GEOLOGICAL INTERPRETATION

BENCUBBIN SHEET SH 50–11

0 10 20 30km

REFERENCE

- Fine – and medium – grained equigranular biotite adamellite
- Variably porphyritic to seriate biotite adamellite
- Medium – and coarse – grained equigranular biotite adamellite
- Mixed granitoid rocks
- Greenstones
- Orthogneiss
- Areas of no exposure
- Observed structural trend

Banded iron-formation is the only unit within the Bencubbin greenstone belt which exhibits abundant mesoscopic-scale structures. This factor, coupled with poor outcrop, precludes structural analysis of the Bencubbin greenstone belt (Fig. 2). However, two fold generations have been recognized. The earlier folds are typically tight, asymmetric and steeply plunging, chiefly to the north. The deformation event responsible for this folding probably generated the pervasive penetrative fabric exhibited by the other lithologies in the Bencubbin greenstone belt and by the granitoid gneiss, but the existence of an ealier deformation has not been discounted. A later deformation has overprinted these earlier folds, producing more open folds with shallow northerly plunges.

No major faults were recognized on BENCUBBIN, but there are numerous east-northeasterly trending dolerite dykes which delineate fractures and possible faults. The same is true of the many quartz veins which trend either easterly or north-easterly.

On June 2nd, 1979 an earthquake (the Cadoux Earthquake) of magnitude 6.2 on the Richter Scale occurred. Its epicentre was approximately 7 km south-southeast of Cadoux. The shaking and direct movements associated with this earthquake damaged many structures over a wide area. The earthquake produced surface faulting and tension gashes in a north-trending belt 14 km long which passed just east of Cadoux. An account of the earthquake, its effects and probable cause are given by Daetwyler and others (Lewis and others, 1981).

ECONOMIC GEOLOGY

METALLIC MINERALS

The prospects for economic base-metal mineralization on BENCUBBIN are poor. Approximately 19 km south of Bonnie Rock, zinc mineralization occurs entirely within granitoids in an easterly trending zone about 350 m long. Feldspathic manganiferous rocks contain lenses of magnetic franklinite up to 6 m long (Stevenson, 1973).

The Bencubbin greenstone belt has been extensively prospected. Despite the discovery of massive and disseminated pyrite and some pyrrhotite in zones 15 m thick over a distance of 3.3 km, no economic base-metal concentrations have been located.

Exploration for Yeelirrie-type uranium deposits (Butt and others, 1977) has been undertaken near Lakes Moore and Harvey. No significant mineralization has been reported.

NON-METALLIC MINERALS

Numerous occurrences of gypsum, as kopi, gypsum sand, and minor crystals, are found on BENCUBBIN. The first Western Australian deposit mined was at Cowcowing Lakes near Koorda. The deposit was worked from 1921 to 1929 (de la Hunty and Low, 1958). Other small deposits were mined at Dukin in 1924, Lake McDermott in 1947, and Lake Hillman in 1977. Salt for domestic and industrial use was harvested from Cowcowing Lakes (Simpson, 1952). Alunite occurs at Lake Wallambin (Simpson, 1948).

About 20 km north of Gabbin, kaolin forms *in-situ* zones extending down to 45 m in deeply weathered granites. It contains forty per cent quartz, and has a good colour and a suitable viscosity for paper coating. However, the area lacks adequate supplies of good-quality water necessary for processing, and transport from this remote site would disadvantage marketing. Another occurrence of kaolin is in a clay pan 15 km north of Wialki (Simpson, 1952).

Pure quartz is quarried and crushed 6 km west-northwest of Mukinbudin by Snowstone Pty Ltd. The deposit, located in a north-northeasterly trending vertical fracture in homogeneous seriate adamellite, outcrops over a strike length of 750 m and has a minimum width of 20 m. It had proven reserves of 250 000 tonnes (Carter, 1976). Between 1970 and 1979, 35 882 tonnes were mined, of which almost one third was exported, chiefly to Japan. It has been used for making decorative cladding and in the manufacture of silicon metal, ferro-alloys, refractories, ceramics and quartz glassware. A pegmatite 32 km north-northwest of Mukinbudin has been prospected by the same company for both quartz and feldspar.

GEMSTONES

Gem-quality smokey quartz, citrine and quartz crystals have been reported from the property of Mr F. Ayres, 17 km northwest of Beacon. They are found in soil formed over quartz-infilled easterly trending fractures which parallel dolerite dykes in the area.

METEORITES

A 9.75 kg meteorite (an intermediate olivine-hypersthene chondrite of Baroli type) was found near Lake Brown in 1919 (Prior, 1929), close to the boundary between JACKSON and SOUTHERN CROSS. Two enstatite-olivine stony-iron meteorites of mixed type (with chondrite enclaves) were found at Mandiga near Bencubbin (McCall, 1972). The first, found in 1930, weighed 54.2 kg, the second, found in 1959, weighed 64.6 kg.

WATER RESOURCES

Pipelines from Mundaring Weir in the Darling Range east of Perth serve all the towns. Runoff from granite hills has been reticulated to several farming districts, including Bonnie Rock, but most farms draw from dams or bores. Owing to unreliable rainfall, there has been considerable groundwater prospecting although prospects are generally poor.

During 1969-70, the Geological Survey of Western Australia was involved in drilling near Mollerin Lake, Lake O'Grady and Lake Harvey as part of a drought relief programme. Supplies above 4.5 m^3/d of less than 11 000 mg/L TDS were sought. Of 166 bores, 156 were unsuccessful (Lord, 1970) and encountered either shallow bedrock, high salinities, or insufficient supplies (Davidson, 1977). There were 66 unsuccessful bores out of 77 drilled at Kalannie in 1958-59 (Berliat, 1960). Prospects for successful water boring are also poor near Gabbin (de la Hunty, 1955).

APPENDIX

LOCATIONS MENTIONED IN TEXT

	Latitude	*Longitude*
Beacon	30°26′20″	117°51′20″
Bencubbin	30°48′10″	117°51′15″
Beringbooding Rock	30°33′30″	118°29′30″
Bonnie Rock	30°32′00″	118°21′45″
Cadoux	30°46′15″	117°08′00″
Cowcowing Lakes	31°00′00″	117°15′00″
De-Eranning Hill	30°43′30″	118°25′25″
Dukin	30°56′20″	117°25′40″
Gabbin	30°48′00″	117°41′00″
Kalannie	30°21′45″	117°06′45″
Kokardine	30°41′50″	117°08′50″
Koorda	30°49′30″	117°28′45″
Lake Harvey	30°18′20″	117°33′20″
Lake Hillman	30°18′40″	117°10′50″
Lake McDermott	30°48′50″	117°55′39″
Lake Moore	30°12′00″	117°30′00″
Lake O'Grady	30°23′40″	117°25′45″
Lake Wallambin	31°00′00″	117°32′00″
Mandiga	30°47′50″	117°45′45″
Mollerin Lake	30°39′00″	117°34′25″
Mount Marshall	30°50′20″	117°54′10″
Mukinbudin	30°54′40″	118°12′00″
Waddouring Hill	30°56′40″	117°51′00″
Wialki	30°28′30″	118°06′45″

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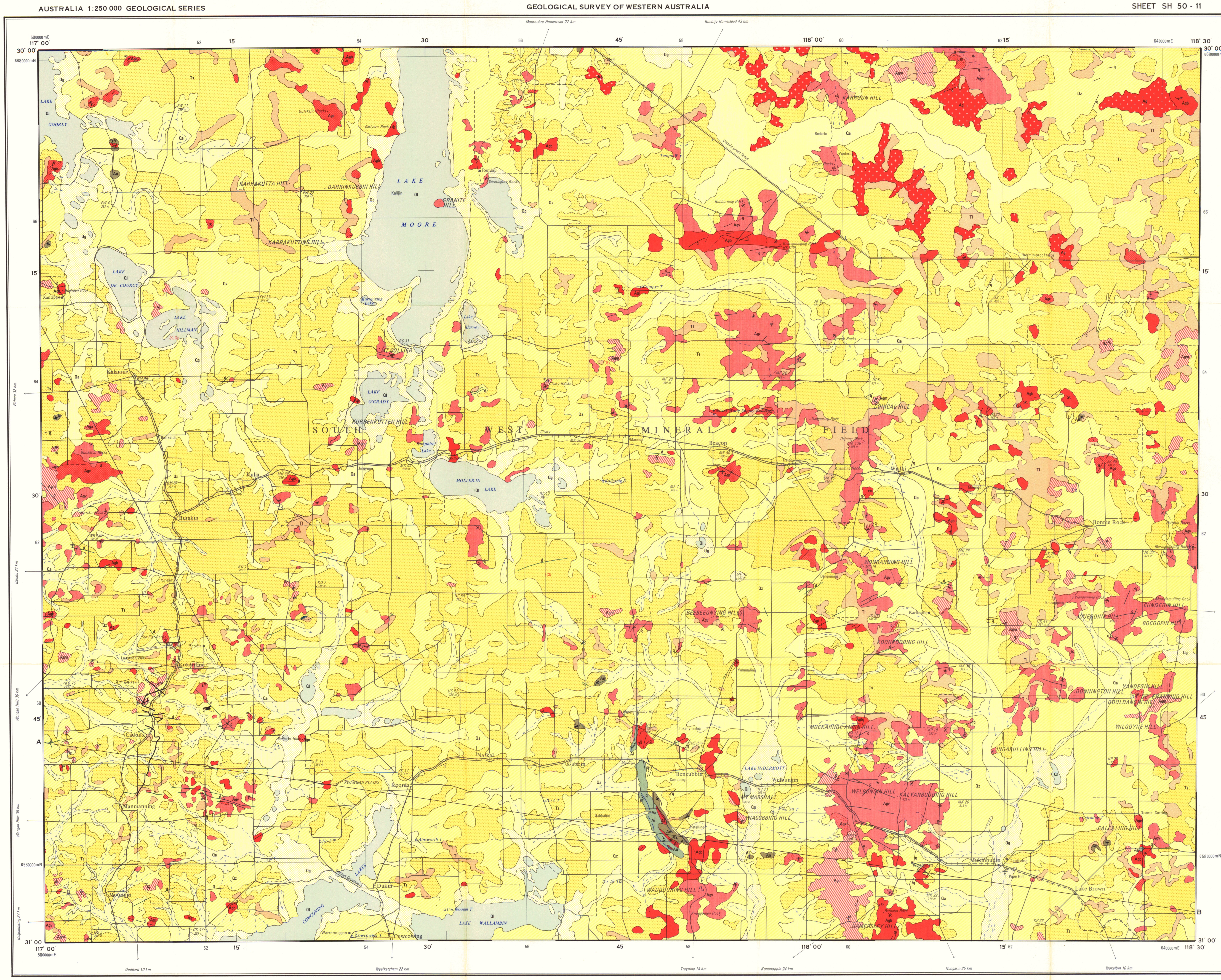
BENCUBBIN

AUSTRALIA 1:250 000 GEOLOGICAL SERIES

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SHEET SH 50 - 11



Compiled and published by the Geological Survey of Western Australia. Cartography by the Geological Mapping Section, Department of Mines. Topographic base from compilations by the National Mapping, Canberra. A.C.T.

Copies of this map may be obtained from the Geological Survey of Western Australia, 66 Adelaide Tce., Perth.

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Geology by D.F. Blight, R.J. Chin, R.A. Smith, J.A. Bunting and M. Elias. 1979

REFERENCE

CAINOZOIC

QUATERNARY

Ql | Qg | Qa | Qz

- Ql Lacustrine deposits – clay, silt and sand in salt lakes
- Qg Mixed Lacustrine, alluvial and eolian deposits – clay, silt and sand in small lakes and dunes adjacent to main salinas
- Qa Alluvium – clay, silt, sand and gravel, valley fill
- Qz Mixed sheetwash deposit, colluvium and alluvium – red-brown sandy and clayey loam on valley slopes

TERTIARY

Ts | Tl

- Ts Sand, yellow-white – commonly contains limonite nodules. Remnant of Tertiary sandplain
- Tl Laterite and silcrete – grades upward into Ts and downward into weathered bedrock

PROTEROZOIC OR ARCHAEAN

- d Dolerite dyke
- q Quartz vein
- p Pegmatite

ARCHAEAN

Ag | Age | Agi | Agv | Agb | Agm | Agx

- Ag Granitoid, unassigned
- Age Biotite adamellite and granite; medium and fine-grained, equigranular, allotriomorphic
- Agi Adamellite; seriate textured, characterized by rounded blue-grey quartz phenocrysts, biotite clots and abundant fluorite
- Agv Variable textured adamellite; medium and coarse-grained, commonly seriate, microcline phenocrysts up to 60 mm
- Agb Biotite adamellite and granite; medium and coarse-grained, equigranular, allotriomorphic
- Agm Mixed granite rocks not separable on map scale; includes pervasive pegmatite
- Agx Heterogeneous facies of granitoid plutons; has prominent schlieric layering; contains many gneissic and foliated granitoid xenoliths at various stages of assimilation

An Layered and foliated biotite adamellite, granodiorite and tonalite orthogneiss

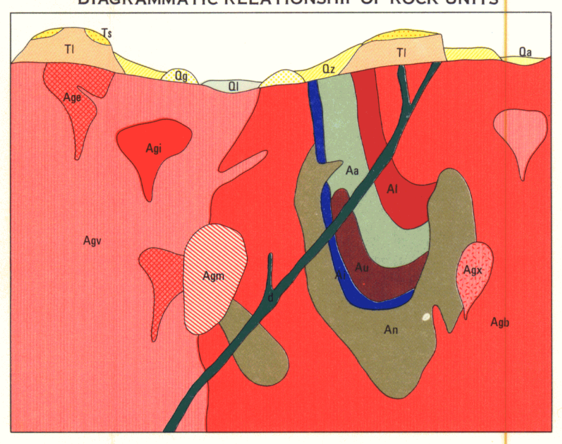
Ai | Al | Aa | Au

- Ai Metamorphosed iron-formation; laminated quartz-magnetite - hematite - grunerite - hornblende rock
- Al Gneissic rock; represents metamorphosed pelitic and psammitic sediment with some chemical component
- Aa Amphibolite; fine and medium-grained; contains plagioclase and actinolite/hornblende
- Au Ultramafic schist; contains olivine porphyroblasts set in a finer grained matrix of cummingtonite laths

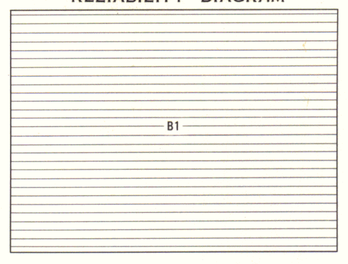
SYMBOLS

- Geological boundary
- Fault, scarp, recent (Cadoux)
- Foliation, igneous
  - inclined (70)
  - vertical
  - undetermined
- Foliation, metamorphic
  - inclined (70)
  - vertical
  - undetermined
- Metamorphic foliation in granite
- Formed road
- Track
- Railway 3'6"
- Railway, abandoned
- Townsite, gazetted (pop less than 1,000) — Wialki
- Homestead — Ygoola
- Locality — Bunketch
- Landing ground
- Horizontal control, major — HK 136 498 m
- Bench mark, height accurate — MC 19 470 m
- Watercourse, intermittent
- Well — W
- Dam — D
- Tank — T
- Quarry or open pit mine
- Mineral occurrence
  - Gemstone — Gs
  - Gypsum — Gp
  - Kaolin — Ck
  - Quartz aggregate — Qa
  - Zinc — Zn

DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



RELIABILITY DIAGRAM



B1 Numerous traverses with air photo interpretation

HON. P. M'C. DOWDING, M.L.C.
MINISTER FOR MINES
A.F. TRENDALL, DIRECTOR, GEOLOGICAL SURVEY

SCALE 1:250 000

5 0 5 10 15 20 25 30 Kilometres

TRANSVERSE MERCATOR PROJECTION
ZONE 50 AUSTRALIAN MAP GRID

INDEX TO ADJOINING SHEETS

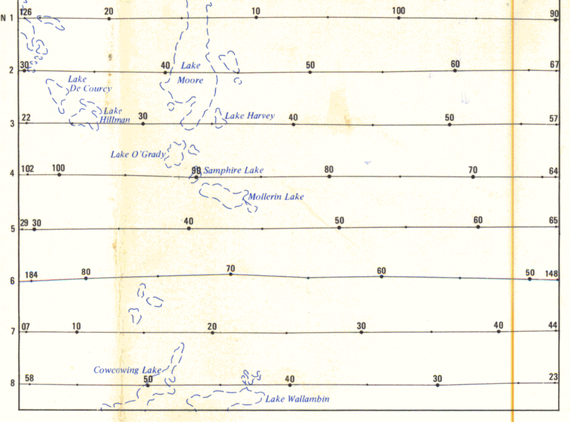
PERENJORI SH 50 - 6	NINGHAN SH 50 - 7	BARLEE SH 50 - 8
MOORA SH 50 - 10	BENCUBBIN SH 50 - 11	JACKSON SH 50 - 12
PERTH SH 50 - 14	KELLERBERRIN SH 50 - 15	SOUTHERN CROSS SH 50 - 16

DECLINATION DIAGRAM

The lines indicate magnetic declination, 1980 + 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' westerly

FLIGHT DIAGRAM

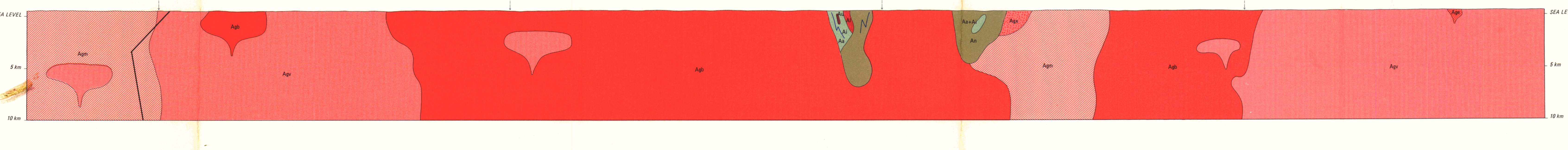
Air photography (1: 80 000) by National Mapping, Canberra, May 1968



DIAGRAMMATIC SECTION

NATURAL SCALE

SECTION A-B



BENCUBBIN
SHEET SH 50 - 11

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