1:250 000 GEOLOGICAL SERIES—EXPLANATORY NOTES

BARLEE

WESTERN AUSTRALIA

SHEET SH/50-8 INTERNATIONAL INDEX

WESTERN AUSTRALIA
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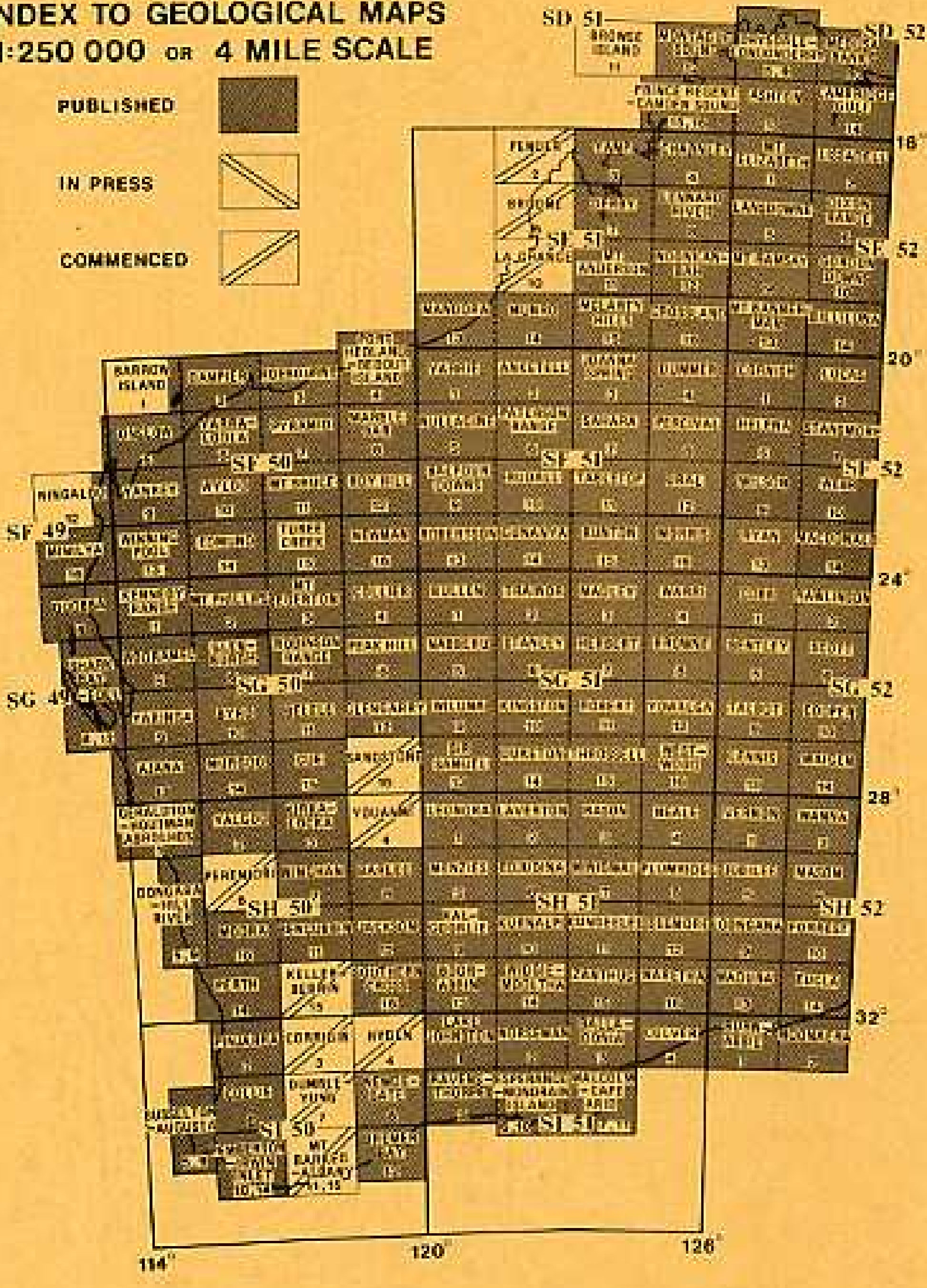

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

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BARLEE
WESTERN AUSTRALIA

SHEET SH/50-8 INTERNATIONAL INDEX

COMPILED BY I. W. WALKER AND D. F. BLIGHT

PERTH, WESTERN AUSTRALIA 1983

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DEPARTMENT OF MINES, WESTERN AUSTRALIA
Minister: The Hon. Peter Dowding, LL.B., M.L.C.
Director General of Mines: D. R. Kelly

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Explanatory Notes on the Barlee Geological Sheet

Compiled by I. W. Walker and D. F. Blight

INTRODUCTION

The BARLEE* 1:250 000 geological sheet, reference SH 50-8 of the International Series, is bounded by latitudes 29° and 30° south, and longitudes 118°30' and 120° east. It covers a sparsely populated area of pastoral leases and vacant crown land. Graded roads link the three homesteads (Diemals, Mount Elvire and Lake Barlee) on the map sheet with the towns of Bullfinch, Sandstone and Menzies. Station tracks are relatively few, however the activity of mining exploration companies in the late sixties and early seventies improved access to the central and southeastern parts of the sheet.

The climate is semi-arid: summers are hot and winters mild. The vegetation is heath on sand plain, woodland in valleys, and halophytes around salt lakes.

HISTORY OF GEOLOGICAL INVESTIGATIONS

The first description of the area seems to have been made by Giles (1889) during an east-west traverse across the southern part of what is now BARLEE. Giles passed by and named Pigeon Rocks. Early geological accounts of the area were made by Talbot (1912), Woodward (1912), and Blatchford and Honman (1917). Later work, principally concerned with gold mines in the area, was carried out by Matheson (1947). More recently students from the University of Western Australia have studied parts of the area in detail, and have written several honours theses (Porter, 1971; King, 1974; Walker, 1974), and an unpublished report (Anderson and others, 1976). The Bureau of Mineral Resources has published contoured aeromagnetic maps (1:126 720 scale), and a gravity survey covering the area.

PHYSIOGRAPHY AND CAINOZOIC GEOLOGY

Three physiographic units are defined on BARLEE (Fig. 1). The oldest, believed to be of Tertiary age, is a gently undulating, lateritic duricrust surface overlain by sandplain, which once completely covered the area, but which has since been substantially reduced by erosion. The elevation of this old erosion surface ranges from 480 to 530 m.

The drainage zones on the sheet are broad alluvial valleys feeding salt lakes, the largest of which is Lake Barlee. These salt lakes are surrounded by alluvial flats of saline gypsiferous clays, which are about 100 m below the present level of the old erosion surface.

Between the old erosion surface and the valley floors are breakaways and gently inclined areas of active sheet-wash erosion. It is in these areas that most rock is exposed.

*Sheet names are printed in full capitals to avoid confusion with like place names.

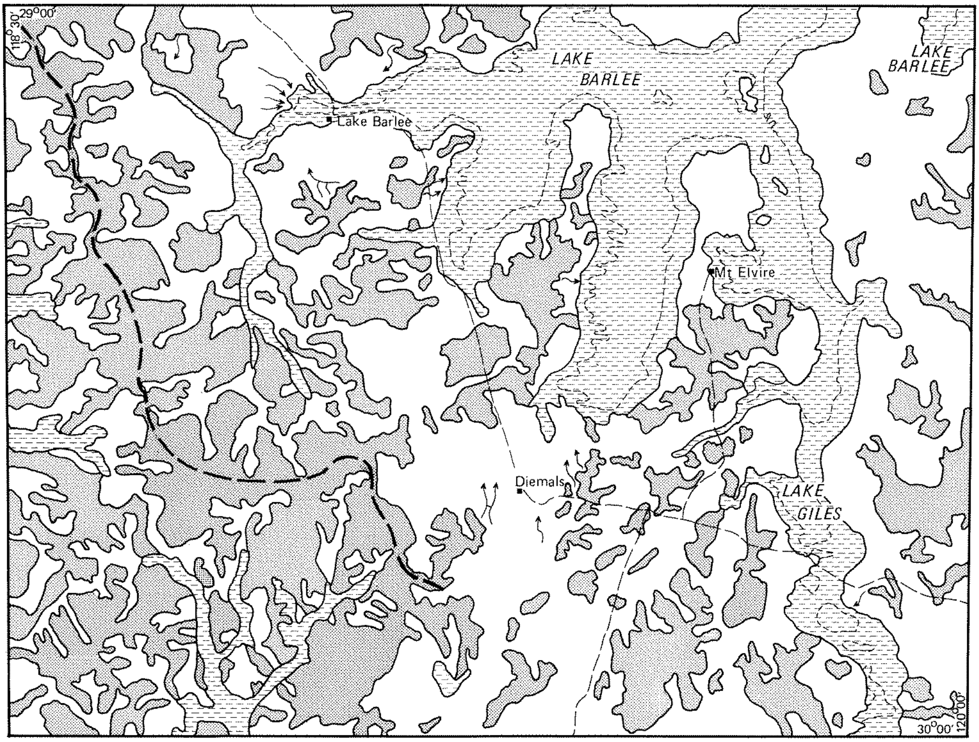

FIGURE 1

GSWA 18461

PHYSIOGRAPHY AND DRAINAGE

BARLEE SHEET SH 50–8

0 10 20 30km

REFERENCE

Remnant of once continuous blanket of laterite and sand plain developed on old peneplain

Areas of colluvium and sheetwash where laterite is mostly removed by erosion, exposing scattered bedrock

Drainage areas – alluvium, saline mud and aeolian (gypsiferous) dunes

Lake Margins

Main unsealed roads

Watercourse

Main drainage divide

In granitoid country, bold monoliths (e.g. Pigeon Rocks) or flat pavements occur, whereas in the greenstone country, elongate, subdued hills and rugged strike ridges are formed. Strike ridges of banded iron-formation provide the greatest relief and also form the highest points (e.g. Mount Elvire, 541 m).

The Tertiary erosion surface is veneered by sand (*Ts*) which commonly contains scattered pisoliths. This grades downward into a laterite unit (*Tl*), which is composed of silcrete, friable pisolitic gravel, and indurated ferruginous and aluminous material derived from weathered bedrock. Laterite and sand are not strictly confined to the interfluves, as in places they pass under valley deposits, especially in the southwestern part of the sheet. This suggests that the modern drainage follows, at least in part, ancient drainage patterns.

Erosion of this Tertiary surface and the underlying rocks has produced the Quaternary units described in the reference of the map.

ARCHAEAN

EXPLANATION OF TERMINOLOGY

The oldest and most highly metamorphosed rocks are in the gneiss terrains, where two types of gneiss (*An*) occur. One is layered feldspar-quartz-biotite gneiss (*Anb*), and is here called banded gneiss. The second, which also shows layering, is derived from granitoid intruded into (*Anb*) prior to the gneiss-forming event. Deformation of the granitoid formed a quartzo-feldspathic orthogneiss (*Anl*).

A layered greenstone sequence overlies the gneiss. It consists of ultramafic volcanic rocks and their metamorphosed variants (*Au*), mafic intrusives (*Ad*), extrusives and metamorphic amphibolite (*Ab* and *Aab*), pelitic, psammitic and calcareous metasediments (*Al*), and metamorphosed iron-formation (*Ai*).

Younger pelitic and psammitic sediments (the Diemals Formation, *As*) unconformably overlie the greenstone sequence. Elsewhere, volcanic equivalents of the Marda Complex (*Af*) uncomformably overlie the greenstone sequence.

Greenschist and amphibolite-facies metamorphism affected most of the rocks on BARLEE. The term static metamorphism is used where the pre-metamorphic nature of the rock is still easily recognized despite recrystallization, but if the recrystallization was synchronous with deformation the metamorphism is described as dynamic. Consistent with practice in description of greenstones in the Eastern Goldfields, igneous and sedimentary nomenclature with the prefix *meta*, is used for rocks in the low-grade static domain (i.e. greenschist facies). Under low- and middle-amphibolite-facies metamorphism the original nature of the rocks can also be reasonably established or inferred. In accordance with a precedent set by Gee (1979a) on SOUTHERN CROSS, metamorphic rock terminology is used, but in the reference the units are grouped according to interpreted pre-metamorphic rock type.

GNEISS TERRAINS

The banded gneiss is a layered feldspar-quartz-biotite rock (*Anb*), which crops out 15 km southeast of Browns Soak, and trends to the north of the sheet. The most continuous development is a narrow, linear belt 18 km long, passing through Cronins Bore, and trending northeasterly. A smaller outcrop occurs as a tectonic sliver within greenstones northeast of Bandy Rock.

Discrete, finely laminated layers (ranging from centimetre to millimetre scale) of crystalloblastic plagioclase, microcline, and quartz, alternate with layers rich in lepidoblastic biotite with a preferred orientation. The layering is the earliest recognizable structure and is either coplanar with, or transected at a low angle by the gneissic fabric. Intimately associated with the gneiss are narrow slices of crystalloblastic micaceous quartzite and banded iron-formation. Lensoid bodies of granoblastic hornblende-plagioclase-clinopyoxene amphibolite, rarely with garnet, represent metamorphosed early mafic dykes in the sequence. A metamorphosed ultramafic dyke, now talc-tremolite schist, is preserved in banded gneiss 2 km south of Cronins Bore. A granoblastic diopside-plagioclase rock forms a mafic enclave in gneiss 9 km northeast of Bandy Rock. Granitoid dykes within the banded gneiss have been deformed and have a gneissic fabric. These early granitoids are similar to the orthogneiss described in the following paragraphs.

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These gneisses are similar to those described on PERTH (Wilde and Low, 1978), COLLIE (Wilde and Walker, 1979), ROBINSON RANGE (Elias and Williams, 1977) and BYRO (Williams and others, 1980), which consist predominantly of banded quartzo-feldspathic gneiss and orthogneiss, but which contain metamorphosed sedimentary enclaves and mafic intrusives with mineral assemblages indicating high grades of metamorphism.

Layered, lineated adamellite, granodiorite, and tonalite gneiss or 'augen' gneiss (*Anl*) border the eastern- and western-most greenstones on the sheet. The orthogneiss is best exposed at Mondie Rocks, and further outcrops occur at Fantasy Bore, Native Well, 15 km east of Elvire Rock, and 10 km north-northeast of Johnson Rocks. Deeply weathered material, thought to be layered orthogneiss, occurs in breakaways in the extreme northeast of the sheet.

The unit (*Anl*) is composed of alternating layers of medium-grained, crystalloblastic plagioclase-microcline-biotite-quartz and finer grained plagioclase-microcline-quartz. The mesocratic and leucocratic layers are continuous over considerable distances, and impart a distinctive striping to the outcrop. Layers range in width from about 10 mm to 200 mm, and are invariably overprinted by a gneissic fabric. This overprint is either coplanar with or at a low angle to the layering, and is responsible for flattening and attenuation of microcline 'augen' and quartz in the medium- to coarse-grained layers. The gneissic foliation is crenulated at some localities due to the presence of a second foliation at a low angle to the first. The second fabric has a similar orientation to zones of high strain which contain blastomylonite and are marginal to the contact with some greenstones.

The gneiss is often transgressed by narrow pegmatoid and aplite dykes which commonly have the appearance of being isoclinally folded. These dykes were injected synchronously with the development of the gneissic fabric, and owe their appearance to differential strain during the deformation.

This gneiss (*Anl*) is thought to be orthogneiss derived from igneous granitoids. Rocks similar to these are described as pretectonic and syntectonic granitoids by Gee (1979a) on SOUTHERN CROSS, and as banded gneiss by Archibald and others (1978) in the Menzies area. Similar gneisses, again juxtaposed with greenstones, crop out on JACKSON (Chin and Smith, 1981) and YOUANMI (Stewart and others, 1981). This gneiss lacks the metasedimentary enclaves of quartzite, banded iron-formation, and calc-silicate gneiss; and the compositional layering is on a more extensive scale than that in the banded gneiss (*Anb*).

Three km south-southeast of Yerramudder Hill, large rafts of banded gneiss (*Anb*) are either enveloped completely by the orthogneiss, or occur as attenuated, partly assimilated blocks within flow-folded orthogneiss.

Feldspar-quartz-biotite orthogneiss is the palaeosome in the migmatite (*Am*) cropping out 6 km north of Milky Soak. The palaeosome has many flow folds and diffuse patches of medium-grained adamellitic neosome permeate the fold hinges. Dykes of adamellite transgressing the outcrop are the more voluminous products of anatexis of the palaeosome.

LAYERED GREENSTONE SEQUENCE

Ultramafic and related rocks

Ultramafic peridotite (*Aup*), now serpentinized, occurs in elongate dykes or sills in the greenstone sequence. The most extensive of these, cropping out over strike lengths of many kilometres, are in the greenstones between Diemals and Broadbents, and east of Johnson Rocks. Constituent minerals include serpentine with subordinate amounts of talc, tremolite, carbonate and opaques. Serpentine pseudomorphs olivine, and relict cumulate textures are evident.

Metapyroxenite (*Aux*) occurs either as cumulate-textured layers within komatiitic metabasalt, or as sills within the greenstones. Tremolite, actinolite, or hornblende completely or partially pseudomorph original pyroxene. Some grains with fibrous cores could have been orthopyroxene. In the komatiitic metabasalt sequence, pyroxenite underlies the main spinifex-textured layers, and a decrease in size and concentration of cumulate pyroxene is obvious moving up towards the chilled flow top.

Komatiitic peridotite (*Aus*) crops out within the greenstone sequence 12.5 km southeast of Johnson Rocks, and in the Mount Manning Range. Coarse olivine, a product of rapid crystal growth, now pseudomorphed by fibrous tremolite, occurs as sets of thin, parallel, crystal plates texturally similar to the 'spinifex' textured rocks described by Williams (1970) from the Eastern Goldfields. The groundmass between the larger crystals has a dendritic texture and consists of fine-grained fibrous tremolite after skeletal olivine. Talc and opaques are accessory minerals.

Massive, komatiitic metabasalt (*Abu*), crops out over 20 km on the western limb of a large south-plunging antiform at Diemals (the Diemals antiform). Excellent preservation of primary volcanic textures occurs in the low-grade static metamorphic domain of the antiform. Acicular, ragged crystals of tremolite-actinolite or hornblende occur as pseudomorphs after original pyroxene, or as fine, prismatic grains within a fine-grained xenoblastic matrix composed of plagioclase, epidote, biotite and chlorite. Despite metamorphic recrystallization, the primary texture, consisting of parallel aggregates of pyroxene intersecting in a triangular pattern, is still evident.

Textural zoning occurs in the metabasalt 1.5 km west southwest of Diemals homestead, and has aided the determination of facing directions in the komatiitic pile. Skeletal coarse-grained pseudomorphs of pyroxene pass rapidly into zones where palimpsest crystals are orientated parallel to the contacts between the textural types, and then into layers where skeletal crystals are lacking and grains are equidimensional.

Interlayered with the spinifex-textured komatiitic metabasalt are rocks with variolitic textures. These are similar to komatiitic metabasalt described by Viljoen and Viljoen (1970), Ferguson and Currie (1972), and Nisbet and others (1977). On weathered surfaces the varioles protrude as light-coloured spheres. In zones of dynamic metamorphism, they are ellipsoids. Within the varioles, tremolite or actinolite either pseudomorph squat euhedral pyroxene, or occur as fibrous, acicular aggregates. The ground mass between the amphiboles consists of fine-grained crystalloblastic plagioclase. Marginal to the varioles are dark rims formed by reaction between this plagioclase and the mafic inter-variole groundmass.

Lineated tremolite-chlorite-talc schist (*Aub*) at Mount Elvire and the Yokradine Hills is dynamically metamorphosed komatiitic metabasalt. On the lake edge 4 km south of Mount Elvire enclaves of slightly deformed komatiitic metabasalts are preserved within intensely foliated schist. Constituent minerals are acicular or fibrous tremolite or actinolite, chlorite, talc, and accessory biotite, epidote and plagioclase. Aggregates of amphibole that recrystallized across the foliation have been crenulated during a subsequent deformation.

Soft, pale-green talc-chlorite-tremolite schist (*Aur*) is widespread. It is mostly a product of dynamic metamorphism of mafic and ultramafic volcanics and intrusives. However, where the schist occupies topographic depressions between ridges of banded iron-formation it may represent original ultramafic sediments. Pre-metamorphic textures are absent in these rocks, which are composed of fine-grained felted aggregates of talc, chlorite and acicular tremolite. As with the tremolite-talc-chlorite schist there has been post-foliation, pre-crenulation recrystallization of some amphibole. Interlayered with these schists in a synform north of Lake Giles (the Lake Giles synform) are narrow lenses of massive, crystalloblastic anthophyllite.

Mafic rocks

Fine- to medium-grained tholeiitic metabasalt (*Ab*) is best exposed in the core of the Diemals antiform. Low-grade static recrystallization has not destroyed the primary intergranular, porphyritic and amygdaloidal textures. Fine-grained acicular tremolite or actinolite either partly or completely pseudomorph pyroxene. Interstitial to the amphibole is crystalloblastic or relict plagioclase. Epidote is a ubiquitous secondary mineral, and in places the metabasalt contains amygdales of carbonate and epidote.

Finely laminated vitric tuff is interlayered with massive metabasalt in the core of the antiform. Current and graded bedding in this tuff suggest subaqueous deposition of the mafic sequence, although pillows in tholeiitic metabasalt were not observed.

Mafic lithic tuff, agglomerate, and flow-top breccia (*Abt*) occur within the tholeiitic sequence 9 km east-southeast of Diemals and 3.5 km northwest of Grass Flat Bore. Varying amounts of recrystallized vitric fragments are enclosed by a microcrystalline metabasaltic matrix of tremolite-actinolite, plagioclase and epidote.

Dynamically metamorphosed tholeiitic basalt is represented by lustrous, fine- to medium-grained, foliated and lineated amphibolite (*Aab*). It is the dominant mafic rock-type of the narrow, structurally attenuated, greenstones within granitoid at Clampton, Yokradine Hills, Die Hardy Range, Evanston, Mount Manning Range, Lake Giles, Mount Elvire, east of Elvire Rock, and north of Johnson Rocks. The change from massive metabasalt to foliated and lineated amphibolite is illustrated 10 km northeast of Diemals, in a zone of high strain between intrusive granitoid and the greenstone sequence.

The amphibolite has a nematoblastic texture with aligned hornblende (less commonly actinolite) and interstitial plagioclase (labradorite), quartz and biotite. Static recrystallization of acicular hornblende may occur across the foliation. Metamorphic clinopyroxene may also occur, and remobilized quartz often forms narrow, 'fish-net' veins. Almandine garnet has been detected by Porter (1971) in amphibolite from Lake Giles.

In a dynamic shear zone (recognized by the intrusion of massive, continuous quartz veins) at Mount Marmion on the east of the sheet, hornblende-plagioclase-microcline-biotite-quartz amphibolite is interlayered with a grunerite-cummingtonite-quartz rock. The origin of the amphibolite layers is unclear, but they have been interpreted as metamorphosed mafic volcanics rather than as para-amphibolites.

Medium- to coarse-grained, weakly foliated gabbro dykes and sills (*Ad*) intrude both the static and dynamic metamorphic variants of the greenstone sequence. The most extensive of these crop out on the western limb of the Diemals antiform, within the

Die Hardy Range, and in a layered intrusion east of Mount Elvire. Constituent minerals are plagioclase and hornblende (rarely actinolite), secondary epidote, quartz, biotite and chlorite. Less commonly the amphibole has a relict core of clinopyroxene. Texturally these rocks are blastophitic, with altered plagioclase interstitial to the interlocking amphibole. The layered intrusion east of Mount Elvire intrudes fine-grained metapelite; it strikes north-south for 4.4 km and has a maximum width of 1.6 km. It is compositionally layered with a basal pyroxenitic layer overlain in turn by mafic gabbro, gabbro, leucogabbro and granophyre (Walker, 1974).

Banded iron-formation

Multiple ridges (up to 25 m wide) of banded iron-formation (*Aiw*), separated by either mafic and ultramafic intrusives or fine-grained sediments, dominate the topography of the greenstone sequence. Near-continuous ridges extend the length of the greenstone belts, and provide markers for the bulk deformation of the sequence. In the static domain of the Diemals antiform, jaspilite is one of the highest stratigraphic members of the sequence. Refolding of the jaspilite lamination is common, and the presence of tight synforms and antiforms between jaspilite ridges indicates that the multiplicity of ridges is a structural repetition of perhaps the one layer.

Away from the closure of the antiform the banded iron-formation comprises laminae of hematite and/or magnetite alternating with laminae of iron silicates, quartz, and accessory biotite and carbonate. In the Johnstone Range east of Diemals, subsurface information within the static domain has been compiled by Gole (1979) from a 25 m diamond-drill hole through interlayered fine-grained iron-rich shale and iron-formation. The shale consists predominantly of stilpnomelane and ripidolite (Fe-Mg chlorite), while the principal minerals of the iron-formation are magnetite, grunerite, quartz, calcite, minnesotaite and stilpnomelane.

In the dynamic metamorphic domains the banded iron-formation consists of fissile, finely laminated hematite-magnetite-rich layers alternating with layers rich in quartz. Limonite and goethite replace hematite and magnetite in places, and iron-rich silicates have recrystallized with random orientation in the plane of the lamination.

Lineated, laminated chert (*Aic*) crops out 1.5 km south-southeast of Yeedie Hill. Pale siliceous layers up to 10 mm wide alternate with fine-grained, ferruginous layers. The lineation is defined by alignment of needles of metamorphic grunerite.

Pelitic and psammitic metasedimentary rocks

Unassigned, deeply weathered, fine-grained, crenulated ferruginous quartz-mica schist (*Al*) is poorly exposed south of the Die Hardy Range, 2 km east and southeast of the Clampton Mine, and in a wide northeast-trending unit within the greenstone sequence east of Diemals. The belt of schist southeast of Clampton lies in the western limb of a regional syncline that folds the Diemals Formation and the underlying greenstone sequence, and is stratigraphically equivalent to schist 10 km south of Diemals. Banded iron-formation interlayered with this schist helps distinguish it from stratigraphically different pelites in the Diemals Formation.

A distinctive purple- or maroon-weathering profile in breakaways characterizes this rock. Because of the deep weathering, it is not certain that all of its outcrops are pelitic metasediments. Fine-grained micaceous schist of similar appearance is derived from acid-volcanic, lithic-and-crystal tuff around the Youanmi Mine on YOUANMI (Stewart and others, 1981).

A stratiform massive pyrrhotite layer occurs within the schist approximately 4 km north-northeast of Clampton. The economic potential of this layer has been explored, but no significant base metal concentrations have yet been found.

Pelitic metasedimentary rock (*Alp*) crops out within the greenstone sequence, 6 km south-southeast of Elvire Rock on the edge of Lake Barlee, 6 km north of Lake Giles, 7.5 km east-southeast of Johnson Rocks, at Kims Bore and in the core of the Diemals antiform. In the Diemals antiform a thin dolomitic bed comprises part of the metasedimentary layer. The pelite is generally a fine-grained, finely laminated, crenulated, dark-grey (weathering purple) porphyroblastic quartz-sericite-graphite-andalusite schist. Sedimentary structures, including graded and rhythmic bedding, are recognizable at some localities.

The sedimentary succession 4 km east-southeast of Mount Elvire is atypical in that it lacks interbedded banded iron-formation, and the contact between the metasediment and underlying mafic volcanics is discordant.

Gossanous material crops out as narrow layers within the metasediments at Mount Elvire, and copper mineralization has been explored in phyllite 4 km south of Kims Bore.

Fine-grained chloritic schist (*Alc*) is interleaved with other fine-grained schists 1 km west of Broadbents. Similar material has been observed from drill holes, which suggests that the schist is more widespread than outcrop indicates.

Porphyroblastic quartz-muscovite-andalusite psammitic schist (*Ala*) with a fawn-brown sheen is a distinctive layer within the metavolcanic sequence 1 km south of Mount Elvire. A narrow quartz-pebble conglomerate bed with a schistose quartz-muscovite matrix underlies this unit. A similar sequence crops out in the synform north of Lake Giles, where a deformed quartz-pebble conglomerate is a prominent basal unit to metamorphosed andalusite schist. Gossanous material after leached pyrite is evident in places.

The layered sequence at Lake Giles includes fine-grained, granoblastic diopside-plagioclase-quartz-biotite-microcline rocks (*Ald*) thought to be metamorphosed calcareous sediments. Calc-silicate rocks also crop out 9 km south of Milky Soak. There the rocks are layered, and nematoblastic hornblende and porphyroblastic garnet are accessory minerals.

Quartz-plagioclase porphyries

Quartz-plagioclase porphyries (*Afp*) intrude the greenstone sequence as narrow sills and dykes at many localities. They are dark grey to pale brown and contain large phenocrysts of corroded, partly recrystallized quartz and partly saussuritized albite in an aphanitic crystalloblastic mosaic of quartz, plagioclase, biotite, and muscovite. In zones of dynamic metamorphism these dykes have a tectonite fabric. At Deception Hill a large plug of porphyry intrudes phyllitic schist. The mineralogy, particularly the presence of albite, is identical to that of the smaller dykes and sills.

DIEMALS FORMATION

The term Diemals Formation is applied to folded and foliated clastic sediments which are weakly crenulated and which unconformably overlie the layered greenstone sequence. It is formally defined in Appendix II. The northernmost outcrop is 19 km west-northwest of Diemals Homestead, and it extends in a south-southeasterly direction for 35 km.

The lowermost recognizable unit is a fine-grained silty argillite (*Ass*) with interbedded, lensoid, oligomictic conglomerate (*Asc*). This conglomerate crops out 10 km south-southwest of Diemals, and dips to the southeast. Water-worn clasts up to 150 mm long of quartz-albite porphyry and jaspilite are similar to rocks at Deception Hill and in the Diemals antiform, and indicate a local derivation. These clasts are enveloped by a medium-grained, ferruginous, schistose quartz-sericite matrix.

A thick sequence of finely laminated, fawn to yellow-brown (purple-weathering) quartz-sericite silty argillite is exposed in breakaways northwest of the Yarbu Mine, and in the Eastern limb of the syncline 9 km west-northwest of Deception Hill. Sedimentary structures, including rhythmic and graded bedding, are common. Around the synclinal closure these sediments are juxtaposed with the fine-grained schist (*Al*) of the greenstone sequence. The contact is not exposed but is thought to be conformable. The presence of interlayered banded iron-formation, lack of sedimentary structures, and the presence of crenulation cleavage has been used to distinguish the greenstone-sequence schist from the younger Diemals Formation.

This silty argillite of the Diemals Formation is thought to be equivalent to rocks at the base of the Marda Complex on JACKSON (Hallberg and others, 1976; Chin and Smith, 1981).

Stratigraphically above the silty argillite is medium- to coarse-grained porphyroblastic quartz-muscovite-andalusite schist (*Asa*). Narrow intraformational pebble-conglomerate layers confirm the upward facing of the sequence. The schistosity is parallel to the axial planes of the tight, north-northeasterly plunging folds. An unconformity between the Diemals Formation and the underlying greenstone succession is exposed 5.5 km south of Kims Bore where quartz-muscovite-andalusite schist overlies metavolcanics and graphitic phyllite. Bedding in the overlying sediments dips at a moderate angle to the south, and contrasts with the steeply inclined attitude of the greenstones. Five kilometres northeast of Yarbu, in the limbs of the syncline, muscovite becomes less abundant, the schistosity less intense, and the rocks pass into feldspathic meta-arenite.

Interbedded with the quartz-muscovite-andalusite schist 5 km south and 5 km west of Kims Bore are lenticular beds of granoblastic quartzite (*Asq*). The quartzite beds west of Kims Bore are conformable with argillite similar to that described to the south. Clasts of fine-grained schist from the greenstone succession occur within intraformational conglomerate in the quartzite. Graded lamination provides facing evidence in these rocks, and current bedding and scour troughs are present but not abundant.

Stratigraphically high metasediments between Coolgardie and Kurrawang in the Eastern Goldfields (the Kurrawang Beds), described by Glikson (1971), appear to be remarkably similar to the Diemals Formation. In both the conglomeratic parts of the Kurrawang Beds and the Diemals Formation, clasts of quartz-albite porphyry and jaspilite are abundant. These porphyries have also been a source for meta-arenite in the Black Flag Beds (conformably underlying the Kurrawang Beds) and the fine- to medium-grained sediments (*Ass*) and (*Asa*) lower in the Diemals Formation.

The Diemals Formation is most likely a fluviatile deposit laid down in a quiet, low-energy environment above the volcano-sedimentary greenstone sequence. The presence of conglomerate, and medium- and coarse-grained sediments stratigraphically above fine-grained argillite attests to at least one episode of renewed erosion.

MARDA COMPLEX

South of the Yokradine Hills and Die Hardy Ranges are small, scattered outcrops of extrusive volcanic rocks intercalated with some pelite and arenite. These rocks are similar to those described from Marda on JACKSON by Hallberg and others (1976). This sequence on BARLEE overlies the layered greenstones of the Die Hardy Range and Yokradine Hills, and the sedimentary component is similar to that in the Diemals Formation. Deposition of these rocks and the Diemals Formation was probably contemporaneous, and felsic volcanism was confined to the Marda area, largely to the exclusion of clastic sedimentation.

Weakly deformed porphyritic and vesicular andesite (*Afz*) with trachytic texture crops out in the extreme south of the sheet. Euhedral saussuritized plagioclase phenocrysts occur in a fine-grained hyalopilitic groundmass of plagioclase, chlorite, sericite, carbonate, and quartz. Vesicles have been infilled by siderite or quartz. These amygdales are prominent on weathered surfaces, and their smooth, rounded appearance can be confused with that of a pebble conglomerate.

Acid volcanic rocks (*Aft*) thought to overlie the andesite are interleaved with poikiloblastic andalusite-muscovite quartzite, and crop out 9 km southeast of Pigeon Rocks. These rocks are agglomerate and crystal-and-lithic welded tuffs of rhyolitic to dacitic composition. Although the rocks have been deformed and finely recrystallized, most primary volcanic textures are still evident.

METAMORPHISM

The metamorphic grade of rocks of the banded gneiss terrains is the highest on the sheet. Diagnostic upper amphibolite (possibly granulite) assemblages, which have been detected within enclaves of mafic gneiss, are plagioclase-hornblende clinopyroxene-(garnet) 2.5 km northeast of Quartz Bore, and diopside-plagioclase northeast of Bandy Rock.

Low-grade static metamorphism within the greenstone sequence is evident in the Diemals antiform, and south of the Yokradine Hills. In komatiitic metabasalt the assemblage is actinolite (or hornblende)-plagioclase-epidote-biotite-chlorite. Actinolite, plagioclase and epidote occur in tholeiitic metabasalt. These assemblages are consistent with a transition from greenschist to low amphibolite-facies of regional metamorphism. Prehnite has been detected in the Diemals antiform (Anderson and others, 1976) and metamorphism could be as low as prehnite-pumpellyite facies in places. Low-temperature, low-pressure amphibolite-facies metamorphism is indicated by andalusite-muscovite-biotite within the volcano-sedimentary sequence south of the Yokradine Hills.

In the Diemals Formation the stable assemblage is andalusite-muscovite, which suggests low-pressure amphibolite facies.

Away from the Diemals antiform the layered greenstones were subject to dynamic metamorphism, but metamorphism also continued after deformation, allowing randomly orientated amphibole to crystallize.

In the ultramafic rocks the metamorphic assemblages are:

(a) tremolite/(Mg)actinolite-(Mg)hornblende-oligoclase/andesine-chlorite-biotite-epidote;

(b) talc-tremolite (with rare anthophyllite); and

(c) serpentine-tremolite-chlorite.

These assemblages are not diagnostic and can represent either greenschist-amphibolite transition or amphibolite facies. The stability field of tremolite or actinolite in these magnesium-rich rocks extends into the amphibolite facies since high MgO and low Al_2O_3 contents of the primary assemblage do not favour formation of hornblende (Cooper, 1972).

In metamorphosed tholeiite the typical assemblage is hornblende-oligoclase-biotite. Diopside may be present, and the association diopside-almandine garnet has been recorded from the Lake Giles synform (Porter, 1971). The absorption colour for Z in hornblende is generally pale green to blue green, and dark-green hornblende is rare. These assemblages are diagnostic of low amphibolite-facies. The presence of garnet and diopside further suggests that there were localized incursions into mid amphibolite-facies.

Assemblages in the pelite and arenite of the greenstone succession are:

(a) Andalusite-muscovite.

(b) Muscovite-chlorite-quartz.

At Lake Giles, sillimanite occurs within andalusite and muscovite (Porter, 1971). The association chlorite-quartz is unstable above 650°C (Miyashiro, 1973). The co-existence of andalusite and sillimanite is consistent with the mid amphibolite-facies, and with the high energy of activation required for the phase transformation of andalusite to sillimanite (Holdaway, 1971).

Assemblages in calc-silicate rocks include diopside-plagioclase-microcline-biotite at Lake Giles and clinopyroxene-plagioclase-garnet-epidote in the Mount Manning Range. These are consistent with mid amphibolite-facies. The deformed greenstones generally recrystallized under conditions of low amphibolite facies. However, locally higher temperatures resulted in discrete zones of mid amphibolite conditions. This contrasts with the static domain of the Diemals antiform where metamorphic conditions were transitional from upper greenschist to lower amphibolite facies.

CONTACT METAMORPHIC ROCKS

Contact metamorphism in the greenstone sequence adjacent to intrusive granitoid has been discovered at two localities. An olivine-orthopyroxene-clinopyroxene-hornfels, with some hornblende, occurs in ultramafic rock 2.5 km north-northwest of Mountain Well. Walker (1974) considers that this assemblage belongs to the pyroxene-hornfels facies, and formed at high temperatures, with pressures up to 100 MPa. Two kilometres southwest of Mount Elvire the contact rock is of hornblende-hornfels grade, in metasediments containing the assemblage quartz-muscovite-andalusite.

Contact hornfels, developed in pelite adjacent to the layered intrusion at Mount Elvire and to the gabbro intrusion along the western limb of the Diemals antiform, has been overprinted by the regional metamorphism.

STRUCTURE

FIRST-GENERATION STRUCTURES

Compositional layering and gneissic foliation in the gneiss terrains record the earliest deformation recognizable in rocks on BARLEE. The gneissic foliation in the banded gneiss and orthogneiss is generally concordant with lithological trends in the greenstone sequence. However 3 km south-southwest of Mondie Rocks the gneissic foliation is at right angles to the foliation in the adjoining greenstones (Fig. 2). Evidence of non-contemporaneous generation of the fabrics in the gneiss and the greenstone sequence is also obtained from outcrop near White Cloud Bore on YOUANMI (Stewart and others, 1981). There the gneiss appears to have been overlain unconformably by banded iron-formation and quartzite. Fabrics indicative of high strain in the gneiss are not evident in the overlying rocks, which are part of the greenstone sequence.

Rootless, transposed isoclines within banded iron-formation are the earliest recognizable structures in the greenstone sequence. These structures cannot be linked with the pattern of regional deformation, and their origin is unclear.

SECOND-GENERATION STRUCTURES

Second-generation structures have not been observed in the gneiss on BARLEE. On YOUANMI near Noondie Well, tight angular folds with near-vertical axial-surfaces affect the gneissic fabric. A weak axial-surface foliation in these folds is coplanar with the foliation in the nearby greenstones. This second deformation appears to be the first to affect both the layered-gneiss and greenstone sequences.

In the greenstones the first identifiable regional deformation was synchronous with regional metamorphism, and produced both the foliation and tight, moderately to steeply plunging isoclinal folds with steep axial-surfaces. This event transformed what appears to have been a simple stratigraphy into a complex repetition of various rock types. Isoclines have been clearly identified in all greenstone belts. Within the banded iron-formation, tight, angular, non-cylindrical folds, with a lineation parallel to the fold axes and amplitudes up to 1 m, are parasitic to the isoclines. Zones of extremely high-strain strike-slip faults, particularly along fold limbs, further modified the stratigraphy (e.g. the angular discordance between phyllite and metavolcanics east of Mount Elvire). An axial-plane foliation was developed in the isoclines, and is the most common fabric in the greenstone sequence. The regional strain patterns during this deformation appear to have been quite heterogeneous. Extreme attenuation of the greenstone sequence took place in the more dynamic zones e.g. Evanston and Mount Elvire. In zones of less intense strain (e.g. near Diemals), the rocks, although isoclinally folded, did not develop the intense penetrative foliation.

THIRD-GENERATION STRUCTURES

Third-generation structures are related to the present arcuate configuration of the greenstone belt, and were generated synchronously with the emplacement of the large domal granitoids. The regional folds are doubly plunging, rounded to angular synforms and antiforms with half wavelengths of 1-10 km. Specific examples include the Yokradine Hills, Die Hardy Range, Mount Manning Range and Lake Giles synforms, the Diemals antiform, and the plunging, inclined syncline in the Diemals Formation.

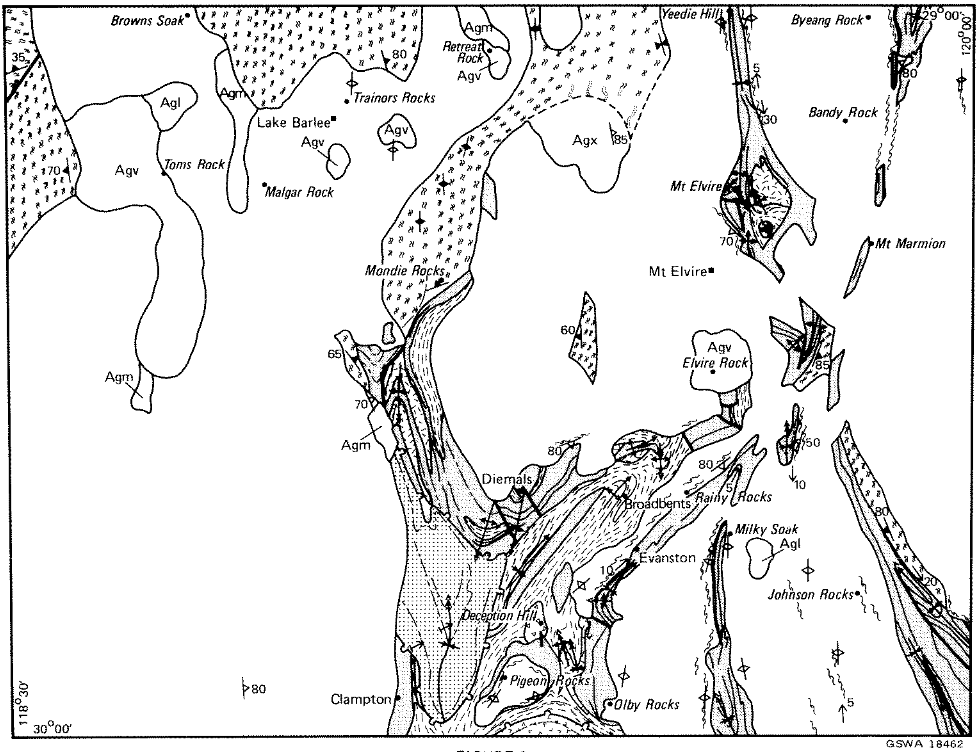

FIGURE 2

STRUCTURAL SKETCH MAP

BARLEE SH 50–8

0 10 20 30km

REFERENCE

Agl	Porphyritic Adamellite
Agv	Variably porphyritic to seriate adamellite
	Even-grained adamellite
Agm	Mixed granitoid
Agx	Heterogeneous granitoid
	Marda Complex
	Diemals Formation
	Quartz – albite porphyry
	Meta-gabbro; with some layering
	Pelite metasediments
	Banded iron-formation
	Mafic - ultramafic metavolcanics
	Granitoid gneiss; including orthogneiss

Foliation; vertical, inclined, dip unknown
Solid symbol-metamorphic, open symbol-igneous

Plunge and direction of lineation

Trend of lithological layering

Facing direction

Second-generation fold; antiform; synform

Third-generation fold; antiform; synform

Fourth-generation structure; protoclastic fabric and mylonite in granitoid

Geological boundary

Unconformity

Fault

In the nose of the south-plunging Diemals antiform 10 km southwest of Diemals, the third deformation has refolded tight, angular, second-generation folds. A penetrative crenulation cleavage, which is axial-planar to the third-generation folds, is superimposed on a weak second-generation cleavage. Elsewhere in mafic and pelitic schist, the regionally pervasive second-generation cleavage is clearly folded or crenulated by third-generation structures. The most marked development of third-generation foliation is in the Diemals Formation.

FOURTH-GENERATION STRUCTURES

The zones of high strain in the earlier deformations continued to act as loci of high strain during the final stages of granitoid emplacement. The fabrics in the granitoids are interpreted as fourth-generation structures, and are described in the section on granitoids. However, not all the deformation was confined to the granitoids. Near Mondie Rocks blastomylonite has developed near the contact between layered orthogneiss and the greenstone sequence. Further north this relatively late deformation produced crenulation in an orthogneiss 7 km east of Retreat Rock.

STRATIGRAPHIC SEQUENCE IN THE GREENSTONES

The succession in the Diemals antiform provides the best indication of the stratigraphic sequence on BARLEE. At the base is a volcanic pile of komatiitic basalt up to 1.1 km thick. Volcanics of tholeiitic affinity conformably overlie the komatiites and attain a thickness of 2.2 km in the core of the antiform. Pelitic sediments with banded iron-formation occupy the stratigraphically highest level; however the thickness of these sediments has been severely modified by folding, and the maximum possible thickness is 3 km. The Diemals Formation unconformably overlying the greenstone sequence attains a maximum thickness of 5.0 km.

Without the Diemals antiform as a guide, stratigraphic interpretation in the more deformed greenstone belts would be impossible. In these belts two principal lithostratigraphic associations can be identified. The first and by far the dominant is the mafic-ultramafic volcanic unit and chemogenic banded iron-formation. The second is a pelitic metasedimentary unit with felsic volcanic and iron-formation components. Both these associations are similar to those in the Diemals antiform, and they may represent a stratigraphic succession.

GRANITOIDS

Granitoids are subdivided into specific textural types. They are homogeneous, near-contemporaneous magmatic variants of major granitoids intruding and distending the layered greenstone sequence. Areas of heterogeneity do exist and are an integral part of the granitoid complex. These have been identified and given appropriate symbols (e.g. *Agm, Agx*). Often discrete zones have a penetrative foliation or lineation developed synchronously with granitoid emplacement. These zones are identified by an overprint as described in the symbol description of the map. Emplacement of the granitoids is later than the culmination of the regional tectono-thermal event and they are distinct from the layered orthogneiss previously described.

Medium-grained biotite adamellite (*Agb*), with either allotriomorphic-granular or partly recrystallized textures, is the dominant granitoid. Typical of this type are the regional, elliptical domes that distend and embay the arcuate greenstone belts. Smaller domes intrude, dilate, and disrupt the greenstone sequence. Large enclaves of nebulitic or schlieric banded material occur in adamellite 30 km west-northwest of Flat Granite Rocks, and 4 km west of the Clampton Mine. Recrystallization has all but destroyed a relict gneissic structure in these enclaves. Elsewhere (e.g. Malgar Rock), the occurrence of quartz-feldspar-biotite orthogneiss as angular xenoliths within this granitoid suggests that its generation involved anatexis of gneiss under suitable water pressures.

The homogeneous adamellite commonly has a weak protoclastic fabric defined by attenuation and flattening of quartz grains, a fabric which is much less intense than that in the foliated and/or lineated variant (*Agb* with overprint) identified on the map.

The intense protoclastic fabrics (fourth-generation fabrics referred to in the structural section) in zones of high strain at the contacts with the greenstone sequence are best developed along the margins of the Mount Elvire-Yeedie Hill greenstone belt, and east of Byeang Rock. The deformation produced zones of cataclastic feldspar-quartz-biotite gneiss marginal to the granitoid diapirs, and where strain was more intense, mylonite has been produced (e.g. Mountain Bore, and east of Byeang Rock).

Granitoids emplaced into the greenstone sequence are strongly lineated and/or foliated, and the fabric is subparallel to the contact with the greenstone sequence. Such relationships occur at Pigeon Rock and Johnson Rocks. A strong, shallowly plunging mineral lineation parallel to the contact can be seen southwest of Evanston, and at Rainy Rocks.

The unit symbolized as *Agv* is a variably porphyritic or seriate adamellite to granite. It is common in the northwest of the sheet, e.g. Toms Rock, and also occurs at Retreat Rock and Elvire Rock. It has an allotriomorphic-granular texture with conspicuous microcline megacrysts that show a complete range in size from the intergranular matrix to large tabular crystals. Orientation of these is generally variable, however at Retreat Rock a probable flow-alignment occurs.

Porphyritic granite (*Agl*) with copious megacrysts of tabular microcline crops out 7.5 km north of Toms Rock and 7 km east-southeast of Milky Soak.

Mixtures of two or more granitoids, e.g., *Abg* and *Agv*, commonly net-veined by late magmatic fractionates, are called mixed granitoid (*Agm*). The best examples occur 12.5 km southeast of Brown's Soak, and north of Retreat Rock.

A heterogeneous granitoid crops out near Top Soak Bore. It is a mixture of even-grained adamellite and assimilated or partly assimilated gneiss. Textures in these rocks are either allotriomorphic or partly recrystallized, and outcrops show prominent schlieric layering and diffuse, nebulitic structures.

AGES OF THE GNEISSES AND GRANITOIDS

Anderson and others (1976) reported Rb/Sr whole-rock ages for the banded gneiss at Mondie Rocks. They obtained a value of 2765 $\pm$ 63 m.y. with an initial ratio of 0.7009. The raw data have been re-interpreted (H. Chapman pers. comm., 1979) to an age of 2 695 $\pm$ 15 m.y. with an initial ratio of 0.7021. These ages probably reflect the metamorphism undergone by both the gneiss and the greenstones.

Various intrusive granitoids from BARLEE give Rb/Sr whole-rock ages ranging from 2 726 $\pm$ 185 m.y. (Johnson Rocks) to 2 467 $\pm$ 36 m.y. (15 km west of Kims Bore) with initial ratios ranging from 0.695 $\pm$ 0.013 to 0.719 $\pm$ 0.012 (H. Chapman, pers. comm., 1979).

SYNTHESIS

The geological evolution of BARLEE is summarized below.

1. A gneiss complex with metamorphic fabrics not evident in the overlying greenstone sequence is thought to be the most ancient association. It is inferred that the gneiss complex is the metamorphosed and partly remelted equivalent of

the basement upon which the greenstone sequence accumulated. Contrasts in metamorphism, deformation, and rock type are evidence of early events in gneiss terrains which did not occur in greenstone terrains, as discussed by Groves and others (1978), Archibald and others (1978) and Gee (1979b).

2. The deformation and metamorphism of the gneiss complex was followed by a mantle-tapping event that allowed mafic-ultramafic volcanic piles to accumulate. Archibald and others (1978) suggested a model involving a 'mantle plume', which initially led to the extrusion of mafic and ultramafic material through tensional fissures in a sialic crust. The greenstone sequence and the underlying gneiss was then folded into tight isoclines. This deformation was inhomogeneous, high strain being confined to discrete zones within the greenstones. Greenschist- and amphibolite-facies assemblages developed during the deformation, and domal granitoid diapirs, generated by partial melting of the gneiss complex, began to rise. Quartz-albite porphyries intruding the greenstones could represent an early melt derived from this anatexis.
3. Erosion followed this deformation, prior to deposition of the Diemals Formation. During this time volcanism of restricted extent produced the calc-alkaline equivalents of the Marda Complex. Subsequent diapiric activity of the granitoid generated open synforms and antiforms. The thermal conditions maintained during most of this activity declined from a peak of low amphibolite-facies regional metamorphism, although there were isolated zones of mid amphibolite-facies.
4. Final deformation and metamorphism occurred during later stages of crystallization and emplacement of the granitoids. Locally high temperature (pyroxene hornfels) occurred along the contacts of the granitoids with the greenstones. More commonly the contacts were zones of high strain, generating strong protoclastic fabrics and mylonite.

ECONOMIC GEOLOGY

GOLD

Gold is by far the most important mineral recovered on BARLEE. 1 486 kg of gold was produced from several localities (see production figures in Table 1) at an average grade of about 19 g per tonne. Over 80% of this production came from the Evanston group of claims, where the majority of the gold occurs in quartz-carbonate veins in ultramafic schist. Sulphides are encountered at depth. Further geological details of the Evanston claims and the other mines on BARLEE can be found in Matheson (1947). Most underground mining occurred prior to 1950, however, more recently the spiralling gold-price has made re-treatment of some tailings dumps an attractive proposition. The tailings dump at Evanston has been successfully re-treated in the past few years but production figures are not available.

OTHER MINERALS

Silver.

Thirty kilograms of silver were recovered from Evanston as a by-product of gold production from tailings during the period 1957-60.

Nickel.

Intense exploration for nickel was carried out over ultramafic rocks during the period 1969-72. However no significant mineralization was reported.

TABLE 1. SUMMARY OF REPORTED GOLD PRODUCTION FROM THE BARLEE SHEET

Group	*Name of Company or Lease*		*Ore treated (tonnes)*	*Gold produced (kilograms)*	*Production years*
Evanston	Blue Peter		1 308.7	9.891	1937-39
	Evanston		48 897.7	803.972	1938-44
	Evanston North		1 624.4	33.590	1938-42
	Evanston East		34.5	.423	1938
	Goldies		203.2	1.342	1938
	Harbour Lights		342.4	2.500	1938
	Four B's		12.2	.244	1939
	Everett		304.8	4.432	1938-39
	Sundry Claims		430.3	3.444	1938-40
	Evanston Gold NL		12 598.2	172.006	1946-51
	Various Groups treating tailings dump			130.953	1957-60
				7.799	1976
				49.126	1977-78
		Total	65 756.4	1 218.722	
Bullseye			785.4	3.890	1938-40
Clampton	Clamps Central		1 252.3	19.664	1939-40
	Mount Jackson		7 340.0	200.855	1933-38
	Mount Jackson South		23.4	.364	1936
		Total	8 615.7	220.883	
Yarbu	Yarbu		10.2	.511	1912
	Effies Reward		.2	.115	1911
	Bronzewing		45.2	1.867	1912
		Total	55.6	2.493	
Diemals Find	Lake Barlee		33.5	.449	1937-38
	Bullshead		103.6	.490	1936
	Trier		1.5	.189	1909
	Sundry Claims		104.1	3.935	1913
		Total	242.7	5.063	
Broadbents Find			117.5	2.442	1939-40
Die Hardy (Olby Rocks)	Die Hardy		371.5	10.695	1933-40
	Mount King		133.1	3.669	1932-33
	Mount King Enterprise		507.0	6.286	1933-39
	Mount Jimbo		1 265.0	12.204	1936-37
		Total	2 276.6	32.854	
		Overall total	77 849.9	1 486.347	

Copper

Small, rich shows of secondary copper (azurite and malachite) occur in a thin, longitudinally striking, black-shale horizon about 14 km west of Diemals. This unit has been extensively prospected but no economic mineralization has been reported.

Pyrrhotite

Further south, near Clampton, exploration drilling has outlined a massive pyrrhotite body of black graphitic shale within tholeiitic metabasalt. A gossanous cap within the metasediments (*Alp*) near Mount Elvire probably defines a similar type of mineralization. Some encouraging base-metal values were encountered (e.g. Zn 950 ppm), and the area is worth further prospecting.

Uranium

Minor occurrences of sedimentary uranium mineralization have been located in the saline and gypsiferous clay deposits and calcrete associated with Lake Barlee in the northeast of the sheet.

Iron oxides

Anomalous concentrations of iron oxides resulting from tectonic thickening of banded iron-formation (e.g. Mount Manning) have been prospected in the past but were found to be uneconomic.

WATER SUPPLIES

Annual rainfall at Diemals in the period 1970-79 ranged from 141 to 462 mm, averaging about 250 mm. After rains, water may be collected from various gnamma holes, principally in the granite areas e.g. Johnson Rocks. Because of the low rainfall and high evaporation, water for pastoral areas is provided by bores and wells. The quality and quantity of these supplies varies with the aquifer. The best supply is from the black shale 14 km west of Diemals (e.g. Copper Mill). This water has a salinity around 800 mg/L TDS, and a supply in excess of 20 000 L/day. However most wells are much more saline with concentrations from 2 000 to 6 000 mg/L TDS, and supplies as low as 2 500 L/day.

APPENDIX 1

Localities mentioned in text.

Place Name	*Latitude (S)*	*Longitude (E)*
Bandy Rock	29°09′05″	119°48′35″
Broadbents	29°40′00″	119°28′30″
Browns Soak	29°00′30″	118°46′55″
Byeang Rock	29°01′05″	119°50′10″
Clampton Mine	29°57′00″	119°06′35″
Copper Mill	29°36′00″	119°10′00″
Cronins Bore	29°14′55″	119°09′45″
Deception Hill	29°50′30″	119°20′35″
Die Hardy Range	29°56′25″	119°19′30″
Diemals Homestead	29°40′05″	119°17′55″
Elvire Rock	29°30′00″	119°36′45″
Evanston	29°44′45″	119°29′10″
Fantasy Bore	29°04′00″	119°03′55″
Flat Granite Rocks	29°38′30″	119°00′40″
Grass Flat Bore	29°30′15″	119°07′20″
Johnstone Range	29°40′30″	119°20′50″
Johnson Rocks	29°48′25″	119°49′20″
Kims Bore	29°38′45″	119°09′35″
Lake Giles	29°41′00″	119°44′30″
Malgar Rock	29°14′35″	118°54′00″
Milky Soak	29°43′45″	119°36′15″
Mountain Well	29°18′08″	119°39′45″
Mondie Rocks	29°22′50″	119°10′10″
Mount Elvire	29°15′30″	119°37′50″
Mount Elvire homestead	29°21′50″	119°40′40″
Mount Marmion	29°19′45″	119°50′00″
Native Well	29°02′30″	119°32′15″
Pigeon Rocks	29°55′15″	119°16′00″
Quartz Bore	29°16′45″	119°08′45″
Rainy Rocks	29°40′05″	119°33′15″
Retreat Rock	29°03′45″	119°15′00″
Toms Rock	29°13′58″	118°45′25″
Top Soak Bore	29°12′05″	119°26′25″
Yarbu Mine	29°52′35″	119°09′10″
Yeedie Hill	29°00′52″	119°38′50″
Yerramudder Hill	29°04′30″	119°05′30″

APPENDIX II

Definition of a New Stratigraphic Name

DIEMALS FORMATION

The formation is named after the Diemals homestead (lat. 37°39′S, long. 119°18′E) on the BARLEE 1:250 000 sheet (SH 50-8). It is poorly exposed in a roughly longitudinal belt 35 km long and up to 14 km wide, from 5 km west of Pigeon Rocks to 20 km west-northwest of Diemals. The type area is located about 17 km south-southwest of Diemals.

The lowermost unit of the formation is a silty argillite with interbedded, lensoid oligomictic conglomerate, containing rounded clasts up to 15 cm long of quartz-albite porphyry and jaspilite. Overlying this argillite is a metamorphosed coarse-grained argillaceous quartz arenite with narrow intraformational pebble-conglomerate layers. Interbedded with the meta-arenite are lenticular beds of quartzite. The formation has been metamorphosed to low amphibolite-facies.

The Diemals Formation attains a maximum thickness of 5 km (measured from air photos). It unconformably overlies metavolcanics and graphitic phyllite of a greenstone belt and is intruded by biotite adamellite. The age of the formation is not well known, but Rb/Sr whole-rock isochrons give the age of the intruding biotite adamellite as around 2.6 to 2.7 b.y., and the greenstones are considered to have developed at about this time, namely 2.7 b.y. (Gee, 1979b).

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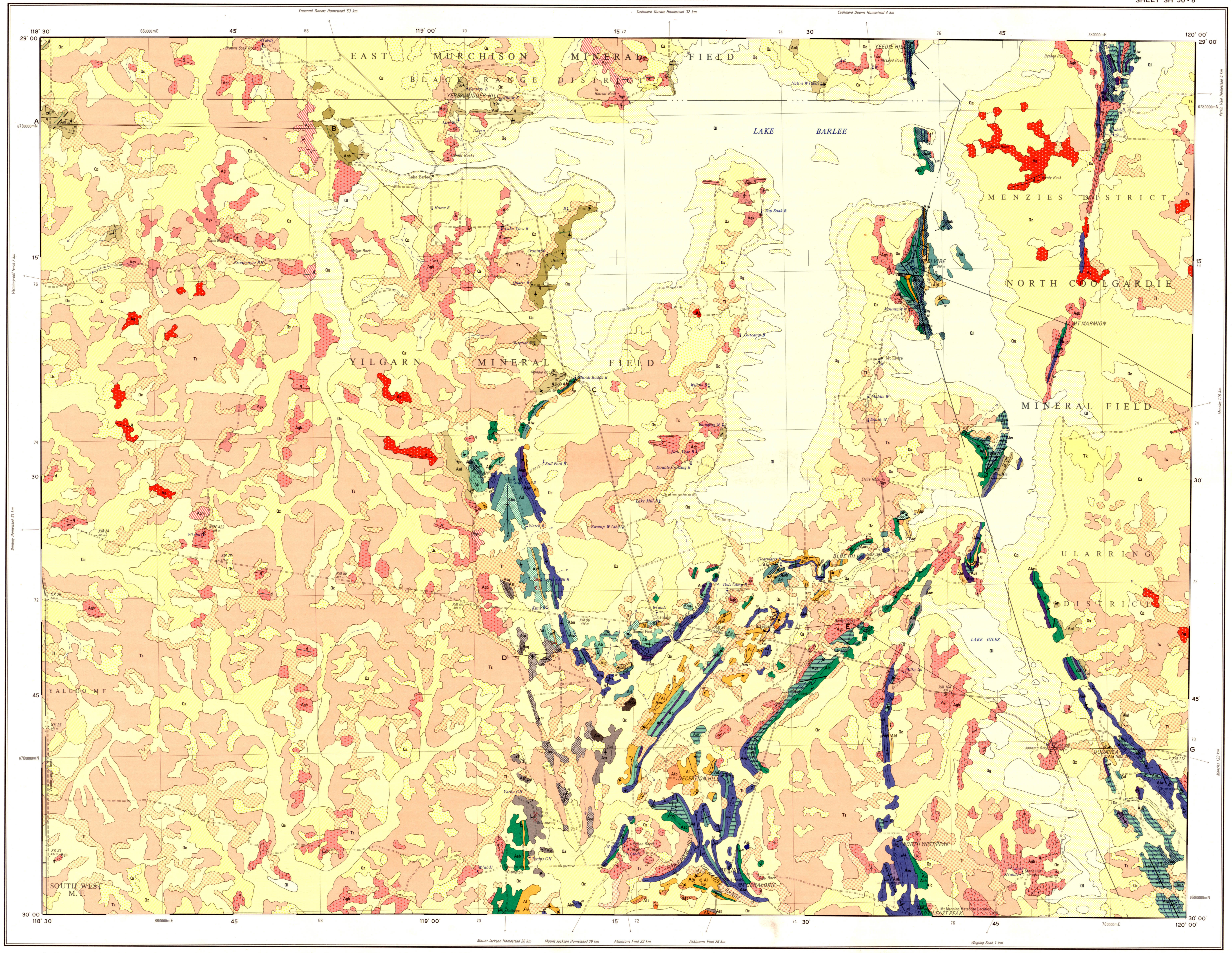
AUSTRALIA 1:250 000 GEOLOGICAL SERIES

BARLEE

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SHEET SH 50-8



SYMBOLS

REFERENCE

CAINOZOIC — QUATERNARY

Ql	Qg	Qa	Qz	Qs	Qc

- Ql — Alluvium—clay, silt and sand; mainly saline playa lake surface
- Qg — Mixed alluvium and eolian clay, silt and sand – lake, claypan and dune country adjacent to main playas
- Qa — Sandy loam – alluvial wash
- Qz — Mixed colluvium and alluvium – red-brown loam, sheetwash deposits; grades to Qs and Qc
- Qs — Eolian sand in dunes – red-brown
- Qc — Colluvium – quartz and rock fragments in loam adjacent to outcrop

TERTIARY

Tk	Ts	Tl

- Tk — Calcrete – sheet carbonate with minor chalcedony, in paleodrainage lines
- Ts — Sandplain – yellow to white; scattered limonite nodules; remnant of extensive Tertiary sandplain
- Tl — Laterite – limonite nodules in cemented matrix; grades upward into Ts and downward into bedrock

PROTEROZOIC

- d — Dolerite dyke – some metamorphosed
- q — Quartz vein

ARCHAEAN

- Acp — Olivine-orthopyroxene-clinopyroxene-hornblende contact hornfels. Pyroxene hornfels facies
- Aca — Quartz-andalusite-muscovite contact hornfels. Hornblende hornfels facies

Ag	Agb	Agv	Agl	Agm	Agx

- Ag — Granitoid, unassigned
- Agb — Biotite adamellite – even-grained allotriomorphic; with biotite in books
- Agv — Variably textured, medium to coarse-grained adamellite; commonly seriate with continuous gradation in grain size of microcline phenocrysts
- Agl — Medium to coarse-grained porphyritic adamellite to granite
- Agm — Mixed granitic rock not separable on map scale – includes pervasive pegmatite component
- Agx — Heterogeneous facies of granitoid pluton; complex mixing of anatectically derived granitoid, and assimilated gneissic rock; prominent schlieric banding

Aft	Afz

MARDA COMPLEX

- Aft — Metamorphosed volcanic rock – includes agglomerate, and crystal and lithic tuffs of rhyolite and dacite composition
- Afz — Metamorphosed andesite – porphyritic and vesicular

Asq	Asa	Ass	Asc

DIEMALS FORMATION

- Asq — Quartzite
- Asa — Metamorphosed arenaceous rock – includes quartz-muscovite-andalusite schist
- Ass — Metamorphosed argillaceous rock – includes fine-grained quartz-sericite-andalusite schist
- Asc — Metamorphosed conglomerate – generally oligomictic

- Afp — Quartz-albite porphyry – sills, dykes and irregular bodies
- Ad — Metamorphosed gabbroic sills, dykes and irregular bodies; contains actinolite rimmed by hornblende, and calcic plagioclase. Transitional greenschist to low amphibolite facies

Al	Alp	Alc	Ala	Ald

- Al — Unassigned quartz-mica schist—deep weathered; metasediment with probable acid volcanic component
- Alp — Pelitic metasediment – fine-grained quartz-sericite-graphite-andalusite schist
- Alc — Chlorite schist – fine-grained
- Ala — Psammitic quartz-muscovite-andalusite schist
- Ald — Calc-silicate rock – contains diopside, quartz, biotite, microcline, epidote and rarely garnet

Aiw	Aic

- Aiw — Iron-formation—laminated Fe-amphibole rock with magnetite, hematite and/or quartz; includes jaspilite
- Aic — Banded chert

Ab	Abt	Aab

- Ab — Metabasalt – tholeiitic, narrow interlayered tuff bands. Greenschist to low amphibolite facies
- Abt — Metamorphosed mafic tuff – coarse lithic fragments
- Aab — Amphibolite – fine to medium-grained; contains hornblende, plagioclase, quartz and biotite; dynamically metamorphosed tholeiitic basalt. Low amphibolite facies

Abu	Aub

- Abu — Metamorphosed komatiitic basalt – spinifex and variolitic textures. Greenschist to low amphibolite facies
- Aub — Tremolite-chlorite-talc schist – lineated and/or crenulated; dynamically metamorphosed komatiitic basalt. Low amphibolite facies

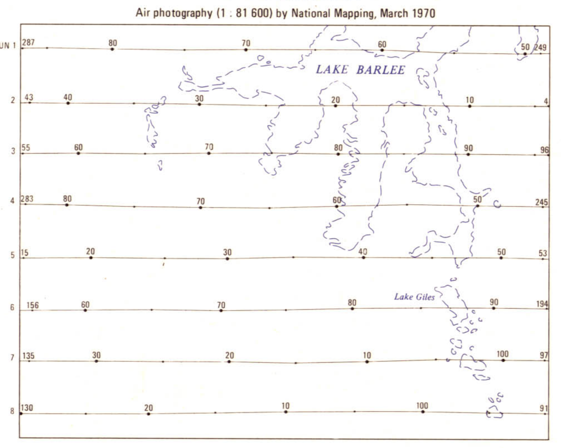
Aup	Aux	Aus	Aur

- Aup — Serpentinite – palimpest olivine textures recognizable
- Aux — Metapyroxenite – cumulate layers within komatiitic flows, or as separate pyroxenite intrusions; large actinolite (or hornblende) pseudomorphs after primary pyroxene; contains relict cumulate textures
- Aus — Metamorphosed komatiitic peridotite – spinifex texture; skeletal olivine pseudomorphed by serpentine and fibrous tremolite
- Aur — Talc-chlorite-tremolite schist – medium to coarse-grained crystalloblastic; dynamically metamorphosed ultramafic volcanics or sediments; often crenulated and/or lineated

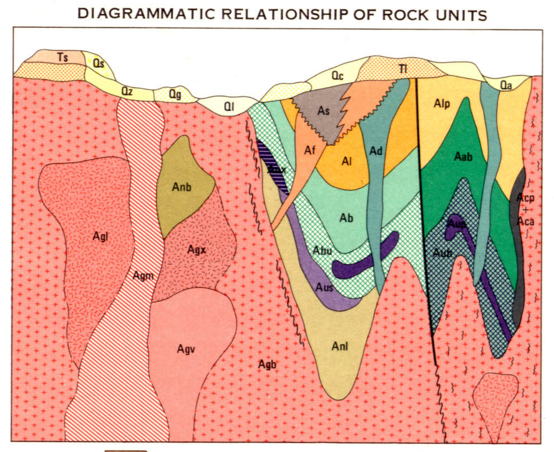
Am	Anl	Anb

- Am — Migmatite with adamellite neosome and quartz-feldspar-biotite orthogneiss palaeosome
- Anl — Layered and lineated, adamellite, granodiorite or tonalite orthogneiss and augen gneiss
- Anb — Banded gneiss – layered quartz-feldspar-biotite gneiss with enclaves of high-grade metamorphosed sediments and dykes; some orthogneiss component

FLIGHT DIAGRAM

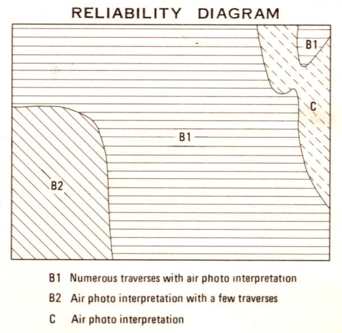


DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



Af MARDA COMPLEX — Unconformity
As DIEMALS FORMATION — Facies change

RELIABILITY DIAGRAM



SCALE 1:250 000

TRANSVERSE MERCATOR PROJECTION

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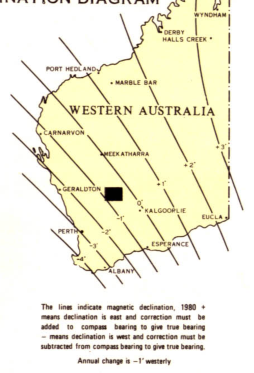
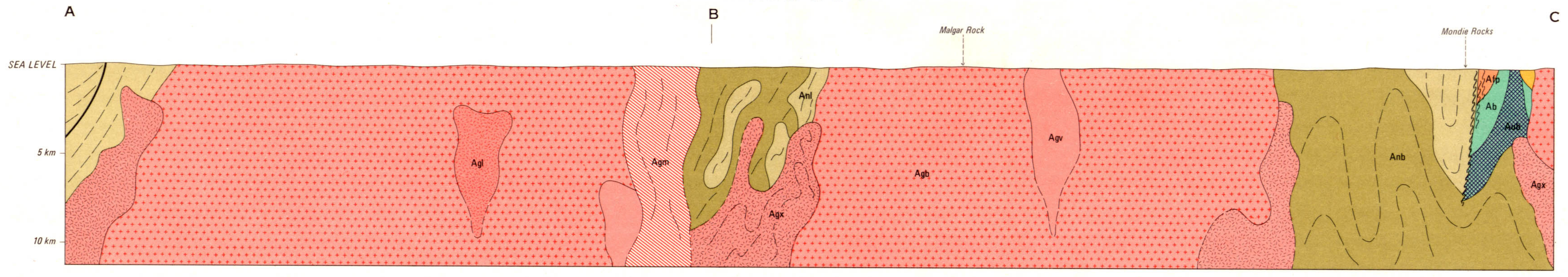
DECLINATION DIAGRAM



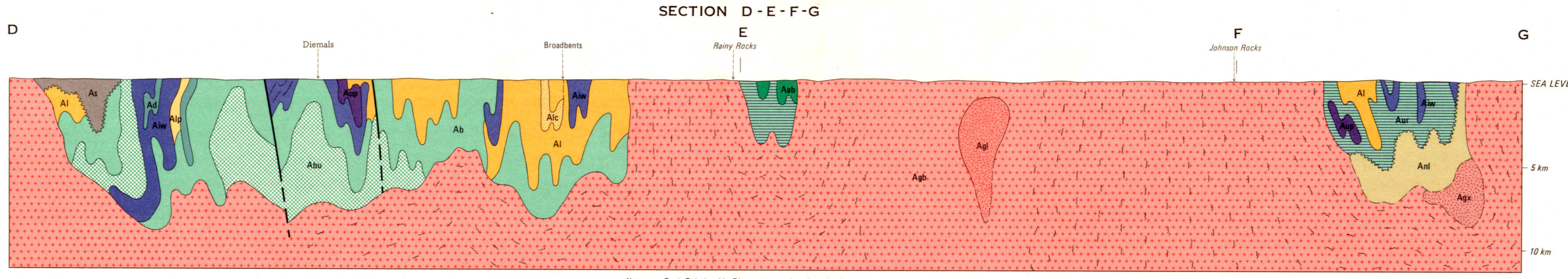
DIAGRAMMATIC SECTIONS

NATURAL SCALE

SECTION A-B-C



SECTION D-E-F-G



BARLEE

SHEET SH 50-8

FIRST EDITION 1983