EXPLANATORY NOTES

GOVERNMENT OF WESTERN AUSTRALIA

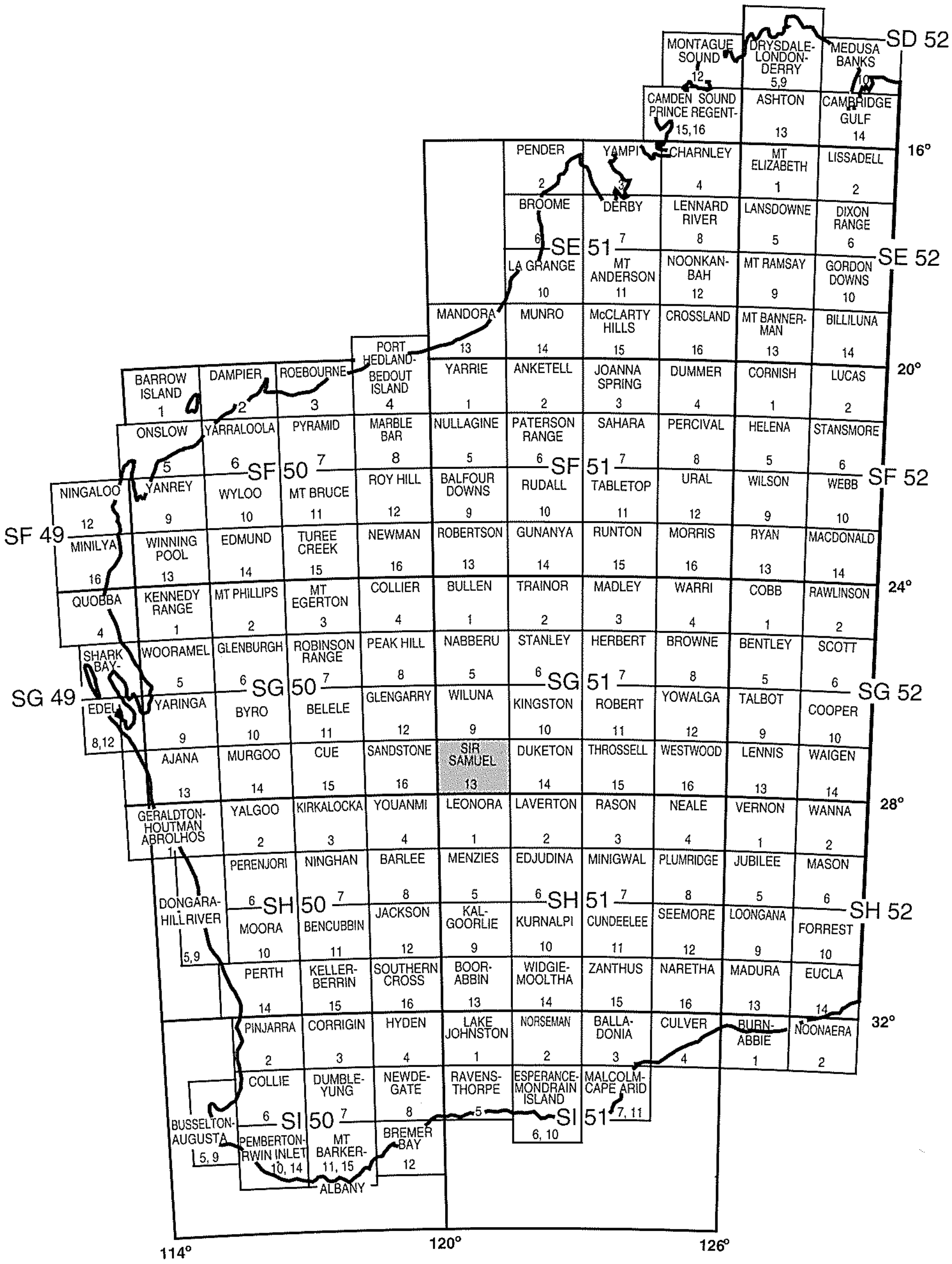
GEOLOGY OF THE DARLOT 1:100 000 SHEET

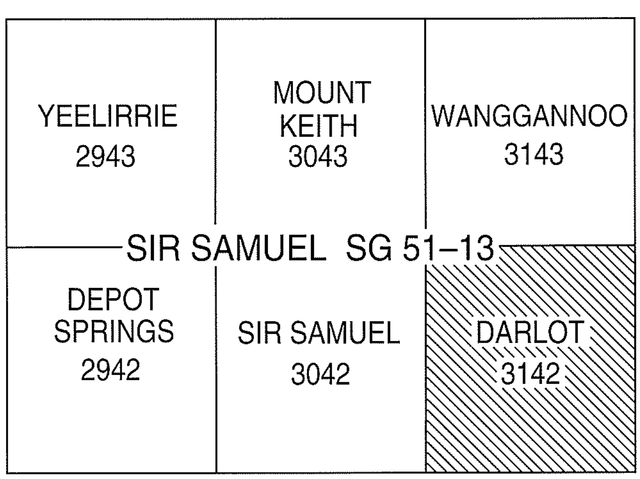
by J. M. Westaway and S. Wyche

1:100 000 GEOLOGICAL SERIES

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

DEPARTMENT OF MINERALS AND ENERGY





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GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

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Cover photograph:

View to the south across Lake Darlot towards Mount Von Mueller; basalt in foreground.

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by

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Abstract

The DARLOT 1:100 000 sheet lies in the southern part of the Yandal greenstone belt, a north-northwesterly trending, fault-bounded greenstone sequence that lies east of Leinster and Mount Keith in the northern part of the Eastern Goldfields Province. Much of the southern part of the Yandal greenstone belt is very poorly exposed with a deep weathering profile.

The rock assemblages are typical of granite–greenstones in the Eastern Goldfields Province. The greenstones are dominated by metabasalt and metamorphosed felsic volcanic and sedimentary rocks. They have been intruded by a variety of granitoid rock types. The two most widely observed structural elements are upright folding around north-northwesterly trending axes and north-northeasterly to north-northwesterly trending shearing. Late, small-scale, east-northeasterly trending faults have been recognized locally. Granite–greenstone contacts are characterized by strong deformation, relatively high grade metamorphism, and interleaving of granitoid and greenstone. Greenstones at the contacts are locally metamorphosed into the amphibolite facies. Those in the central part of the belt have typically attained a much lower grade of metamorphism, most commonly in the lower greenschist facies, and are generally much less deformed.

A major structure, the Ockerburry Fault, trends north-northeast across DARLOT. West of the Ockerburry Fault is a poorly exposed succession of felsic volcanic, volcaniclastic and sedimentary rocks. This sequence appears to overlie a better exposed, east-younging sequence of predominantly mafic rocks adjacent to the greenstone contact on the sheet to the west, SIR SAMUEL. East of the Ockerburry Fault, the southern part of the area is dominated by the locally well-exposed Spring Well calc-alkaline volcanic complex. Remnants of a probable subaerial volcanic centre are exposed near Spring Well. There are numerous mafic intrusions throughout the sequence, many of which have internal differentiation or layering.

Permian sedimentary rocks, represented by a relict unit of glacigene conglomerate disconformably overlain by a unit of thin-bedded mudstone, are locally well exposed around Ockerburry Hill.

Gold mineralization at Darlot and Mount McClure is found in a variety of host rocks in north-northwesterly trending structures that may be related to the large-scale regional shearing.

KEYWORDS: Archaean, Eastern Goldfields, greenstone, Yandal, Spring Well, felsic volcanic, calc-alkaline, gold.

Introduction

The DARLOT* 1:100 000 sheet (SG51-13-3142) occupies the southeastern corner of the SIR SAMUEL 1:250 000 sheet and lies between latitudes 27°30' and 28°00'S, and longitudes 121°00' and 121°30'E. DARLOT lies in the northeastern part of the Eastern Goldfields Province of the Yilgarn Craton and covers the southern part of the Yandal greenstone belt (Griffin, 1990), an Archaean volcanosedimentary sequence that has been a target for intensive gold exploration in recent years (Fig. 1). There have been a number of significant discoveries including the deposit at Darlot within the sheet area and those at Mount McClure and Bronzewing just to the north. The eastern part of DARLOT is mostly underlain by granitoid rocks.

Field mapping, using 1:25 000-scale colour aerial photographs taken in March 1994 (Department of Lands Administration), was carried out between March and

* Capitalized names refer to standard 1:100 000 map sheets (unless another scale is specified).

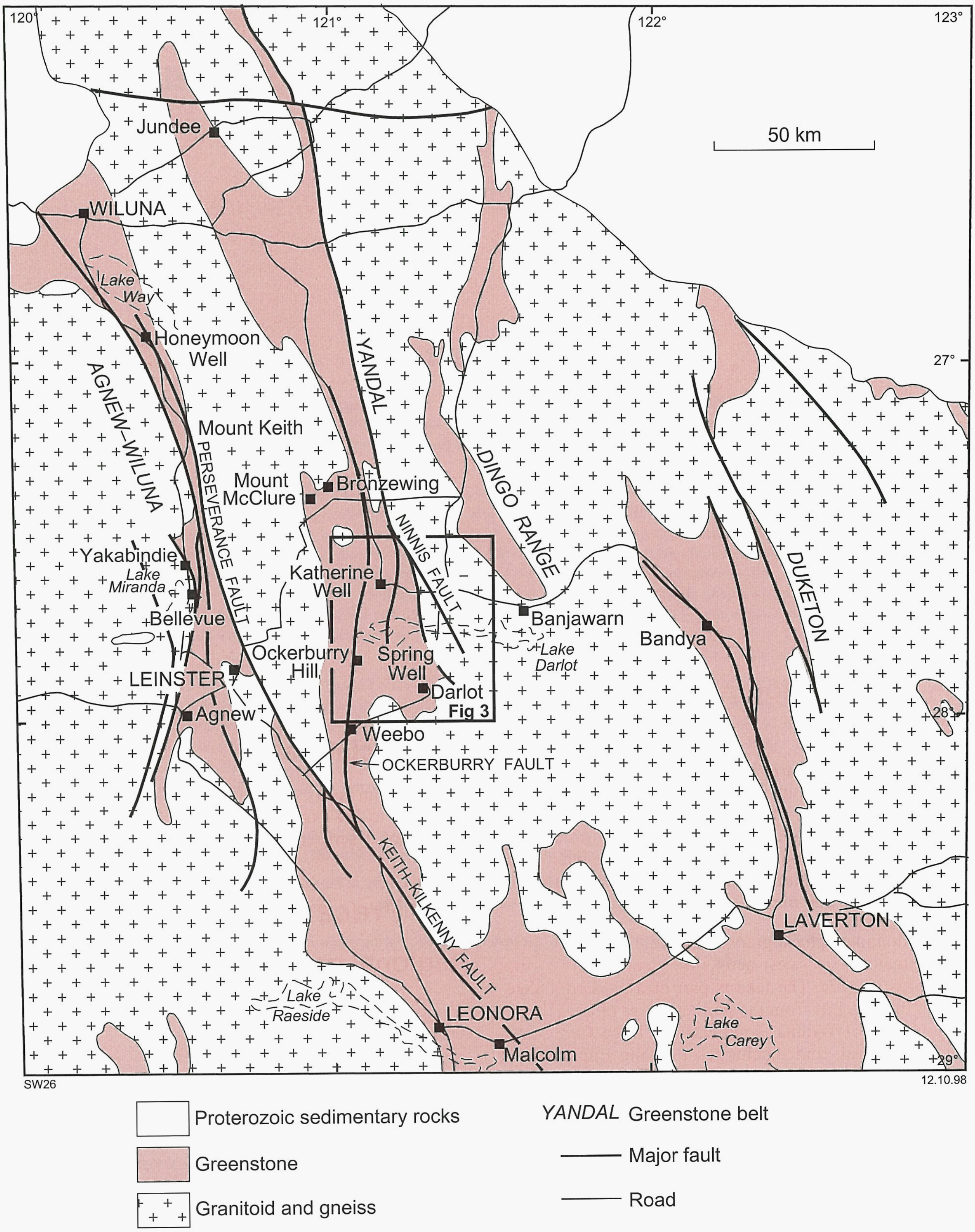

Figure 1. Regional setting of Darlot

November 1994. Mapping of greenstones generally required numerous traverses, whereas mapping in areas of granitoid rocks and Cainozoic cover relied more heavily on interpretation of aerial photographs and satellite images (LANDSAT Thematic Mapper). Much of the southern part of the Yandal greenstone belt is poorly exposed with a weathering profile to 100 m depth. Interpretation in areas of poor or no exposure utilized aeromagnetic data (400 m line spacing) for the SIR SAMUEL 1:250 000 sheet, acquired by the Australian Geological Survey Organisation as part of the National Geoscience Mapping Accord (Geological Survey of Western Australia, 1996).

Access

DARLOT contains parts of Melrose, Weebo, Yandal, and Nambi sheep stations and Melrose and Yandal Homesteads are situated within the sheet area (Fig. 2). These homesteads have airstrips suitable for light aircraft, and a larger (2 km) airstrip services the Darlot gold mine.

DARLOT lies about 350 km north of Kalgoorlie and can be reached from the Kalgoorlie – Meekatharra Highway (No. 91) via a formed, unsealed road that leaves the highway 35 km south of Leinster and traverses the sheet area linking homesteads and mine sites. Good access within the sheet is provided by station and exploration tracks.

Climate, physiography, and vegetation

The climate is semi-arid to arid. January is the hottest summer month, with an average maximum of 36°C and an average minimum of 18°C. Temperatures commonly exceed 40°C. Winters are cool to mild, with occasional frosts. The coldest month, July, has an average maximum of 21°C and minimum of 5°C. The average annual rainfall is about 200 mm.

The dominant physiographic feature, Lake Darlot, lies approximately east–west across the central part of the sheet area (Fig. 2). The lake is part of a palaeodrainage system that extends from the northern edge of the Yilgarn Craton west of Wiluna, southeast via Lake Carey and Lake Minigwal, and discharges into the Eucla Basin (Bunting et al., 1974). Away from the major lake system, drainage is characterized by ephemeral streams in poorly defined channels. Much of the area is covered by sand and sheetwash.

Relief is low with altitudes varying between 435 and 519 m Australian Height Datum (AHD). Areas underlain by greenstone form ridges of low hills or rocky outcrops up to about 50 m above the surrounding plains. Breakaways have formed in duricrust that has developed on weathered granitoid in the southeastern corner, and on deeply weathered parts of most of the other rock types. Granitoid rocks in the Mount MacDonald and Mount Blackburn areas form tors and domes.

Beard (1990) included DARLOT in the eastern part of the Murchison Region or Austin Botanical District of the Eremaean Province. The region is characterized by extensive mulga scrub. Mulga (*Acacia aneura*) is the dominant species throughout, but there are also other acacia species, local areas of eucalypts and a variety of shrubs, herbs and grasses. The natural vegetation is palatable to stock, and there is significant pastoral activity, mainly sheep grazing.

Previous investigations

The first edition of the SIR SAMUEL 1:250 000 geological sheet was published in 1977. The explanatory notes for this map sheet give details of earlier regional studies (Bunting and Williams, 1979). Jutson (1914, 1917) and Montgomery (1909, 1928) provide early descriptions of the gold mineralization at Darlot.

The Spring Well felsic volcanic complex has been documented by Giles (1980, 1982). These reports include mapping, petrography and geochemistry. Additional geochemical data from both greenstone and granitoid rocks is provided by Bunting and Williams (1979). Geochemical data obtained during the course of the current mapping project are contained in Wyche et al. (in prep.)

Unpublished maps and data produced as a result of mineral exploration are available through the WAMEX open-file system at the Geological Survey of Western Australia Library in Perth and at its Kalgoorlie Regional Office.

Nomenclature

All Archaean rocks described in these notes have been subjected to low- to medium-grade metamorphism, but for ease of description the prefix 'meta-' is omitted.

Precambrian geology

Regional geological setting

DARLOT is dominated by Archaean granite–greenstones that constitute the southern part of the Yandal greenstone belt, a north-northwesterly trending greenstone sequence that extends for about 200 km to the northwest and becomes the Lake Violet and Millrose greenstone belts on LAKE VIOLET and MILLROSE (Griffin, 1990). The relationship between the Yandal, Lake Violet and Millrose sequences is not well understood. The greenstones have been extensively intruded by granitoid rocks in the southern part of DARLOT and in the northern part of the adjacent WEEBO sheet (Oversby, 1995) to the south. Although greenstones in the northern part of WEEBO are poorly exposed, aeromagnetic data suggest that the belt extends south along its western side, possibly connecting with the southern extension of the Mount Keith–Perseverence or Mount Clifford greenstone belts (Griffin, 1990). The Yandal greenstone belt contains a number of

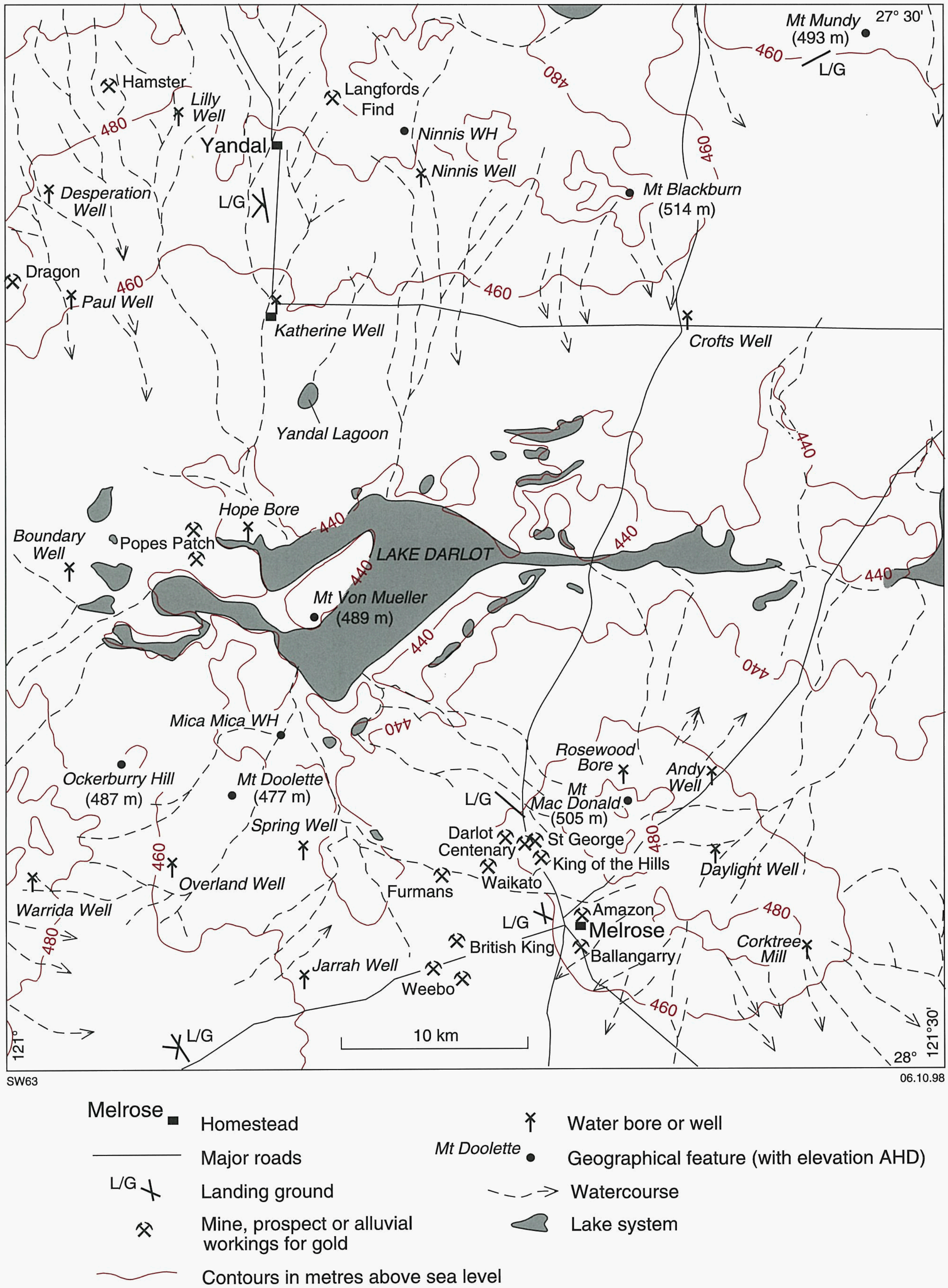

Figure 2. Darlot — **physiography and localities**

significant gold deposits including Bronzewing to the north, the Mount McClure deposits to the west and northwest of DARLOT on MOUNT KEITH and SIR SAMUEL, and the Darlot gold mine in the southeastern part of the sheet area.

The Yandal greenstone belt is fault-bounded, with the eastern and western contacts characterized by strong deformation, relatively high grade metamorphism, and interleaving of granitoid and greenstone. All greenstones are metamorphosed but primary igneous textures are commonly preserved. Those at the contacts are locally metamorphosed into the amphibolite facies whereas those in the central part of the belt have typically attained a lower grade of metamorphism, most commonly in the greenschist facies, and are generally less deformed. For ease of description, igneous rock names are used in these notes where protoliths can be identified.

There is no recognized stratigraphy for the Yandal greenstone belt but the associations of rock types within the belt differ in detail from those described in greenstone belts to the east and west (Langford and Farrell, in prep.; Liu et al., in prep.). Figure 3 is an interpretative map showing the distribution of major rock types and structures on DARLOT. This map is based on the outcrop geology and interpretation of aeromagnetic data (Fig. 4).

Archaean rock types

Metamorphosed ultramafic rocks (*Au, Auc, Auk, Aur, Aup, Aut*)

There are three main areas of ultramafic outcrop. The best exposed is represented by a string of exposures along the western margin of the sheet, predominantly of serpentinized peridotite, with lesser amounts of tremolite–chlorite schist and associated high-Mg basalt (*Abm*). There is another north-trending ultramafic body between Lilly Well and the Yandal airstrip, immediately east of the interpreted position of the Ockerburry Fault. This body is mostly overlain by siliceous caprock (*Czu*), but drillholes have demonstrated the presence of talc–carbonate rock and talc–chlorite(–tremolite) schist along strike. Several small ultramafic bodies in the vicinity of the Yandal Homestead are known from drillholes, small areas of caprock, and rare, deeply weathered outcrops.

Undivided ultramafic rock (*Au*) represents deeply weathered material in outcrop and drillholes that is thought to have been originally ultramafic in composition.

Serpentinized peridotite (*Aup*) is well exposed 2.5 km northwest of Desperation Well (AMG 033484)* in a ridge, up to 200 m wide, of blocky outcrop. Mid-brown to green blocks average 20 cm in diameter but can be up to 50 cm. Serpentinized peridotite has a relict olivine orthocumulate to mesocumulate texture with grains averaging 0.5 mm but up to 1.5 mm in diameter. These grains, now totally converted to radiating serpentine, commonly have fractures infilled with magnetite. The intercumulus material consists of serpentine, talc, and carbonate. On the eastern side of the outcrop, there is a small amount of high-Mg basalt interleaved with the peridotite. A small body of peridotite 2 km west-southwest of Desperation Well (AMG 033459) is more strongly altered to talc and carbonate. Peridotite 3.5 km southwest of Paul Well (AMG 044385) consists of massive serpentine with subordinate magnetite and fine-grained tremolite.

Tremolite–chlorite(–talc) schist (*Aur*) also occurs mainly in the central and northwestern parts of the sheet area, and is generally poorly exposed. The tremolite commonly exists as fine (<1 mm) needles, up to more than 5 mm long, with varying amounts of chlorite. The schist may contain subordinate talc and minor magnetite and carbonate. This rock forms a strongly foliated, broken outcrop of blue-green blocks 2 km west-southwest of Desperation Well (AMG 034460), and there is a thin unit of pale-green tremolite–chlorite schist within a sequence of strongly foliated mafic rocks in the hills to the west of Paul Well, adjacent to the sheet boundary. This latter unit extends north and is exposed in the Dragon openpit. Tremolite–chlorite schist is also known in drillholes west of Paul Well, and east of the Yandal Homestead. In drill chips from northeast of the Yandal Homestead, a later generation of tremolite cuts across the dominant foliation.

Metakomatiite (*Auk*) is known only in exploration drillholes in the central western part of the sheet area. The rock is characterized by relict olivine spinifex texture in which platy olivine crystals have been replaced by tremolite, and the glassy interstitial material by very fine grained tremolite and chlorite with subordinate, very fine grained magnetite.

Talc–carbonate rock (*Auc*) was encountered in a number of exploration drillholes immediately east of the mapped Ockerburry Fault. However, there is a relatively wide (approximately 1 km) zone of shearing associated with the fault and the talc–carbonate rock probably lies within this broader shear zone. It is fine grained and pale green, has a greasy lustre, and contains brown porous iron oxide-rich spots up to 2 mm in diameter, formed after an iron carbonate mineral.

Talc–chlorite(–tremolite) rock (*Aut*) is also found in drillholes in a setting similar to those described for talc–carbonate rock above. It is similar to talc–carbonate rock in that it is fine grained and pale green with a greasy feel, but without the spots after carbonate. This rock type is typically strongly foliated.

Metamorphosed fine-grained mafic rocks (*Ab, Aba, Abc, Abe, Abi, Abm, Abp, Abv*)

Undivided mafic rocks (*Ab*) include all fine-grained rocks which are thought to have a mafic association but where

* Australian Map Grid (AMG) standard six-figure reference system is used in which the first group of three figures (eastings) and the second group (northings) together uniquely define position on this sheet to within 100 m.

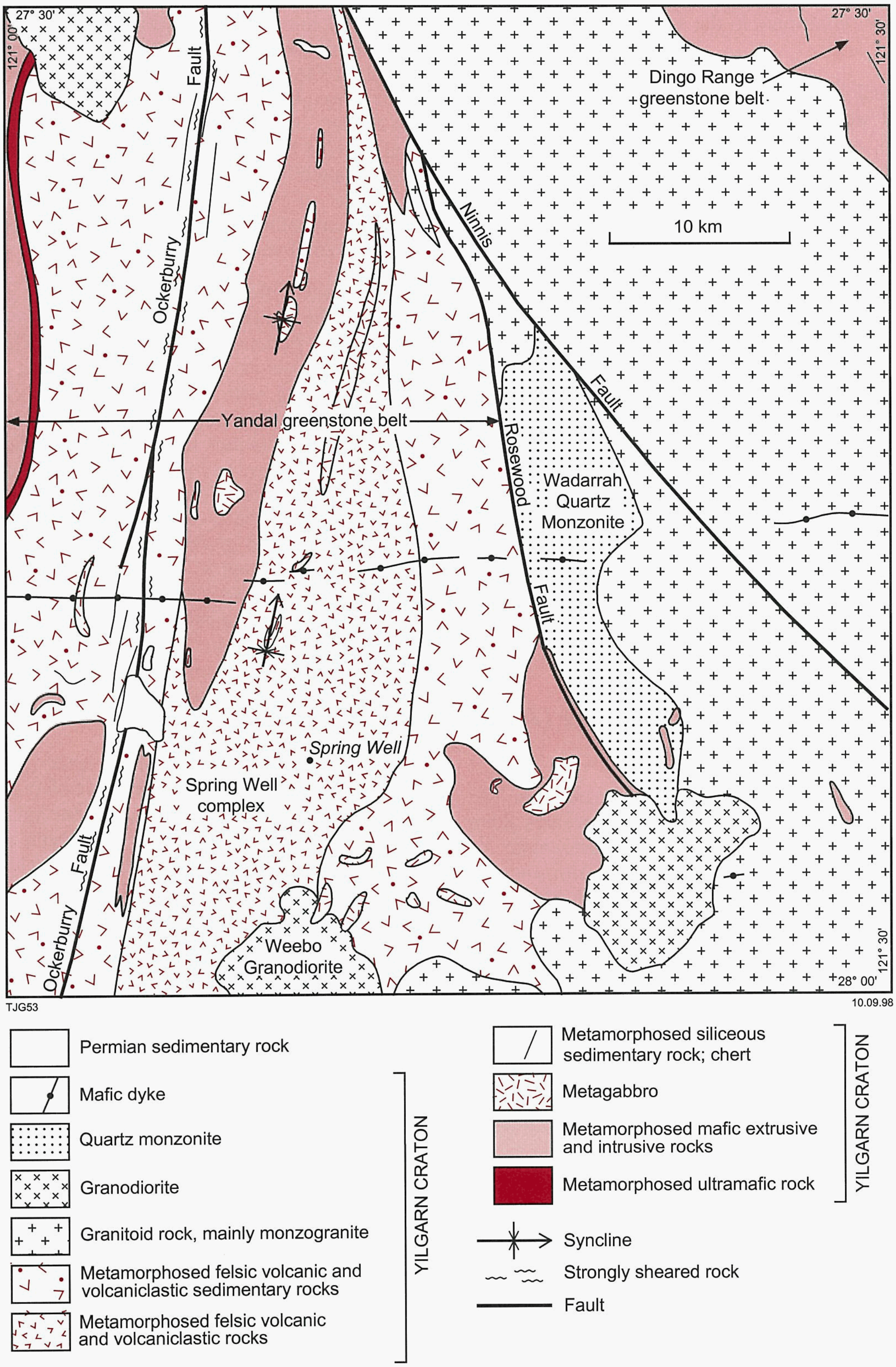

Figure 3. Simplified geological map of DARLOT

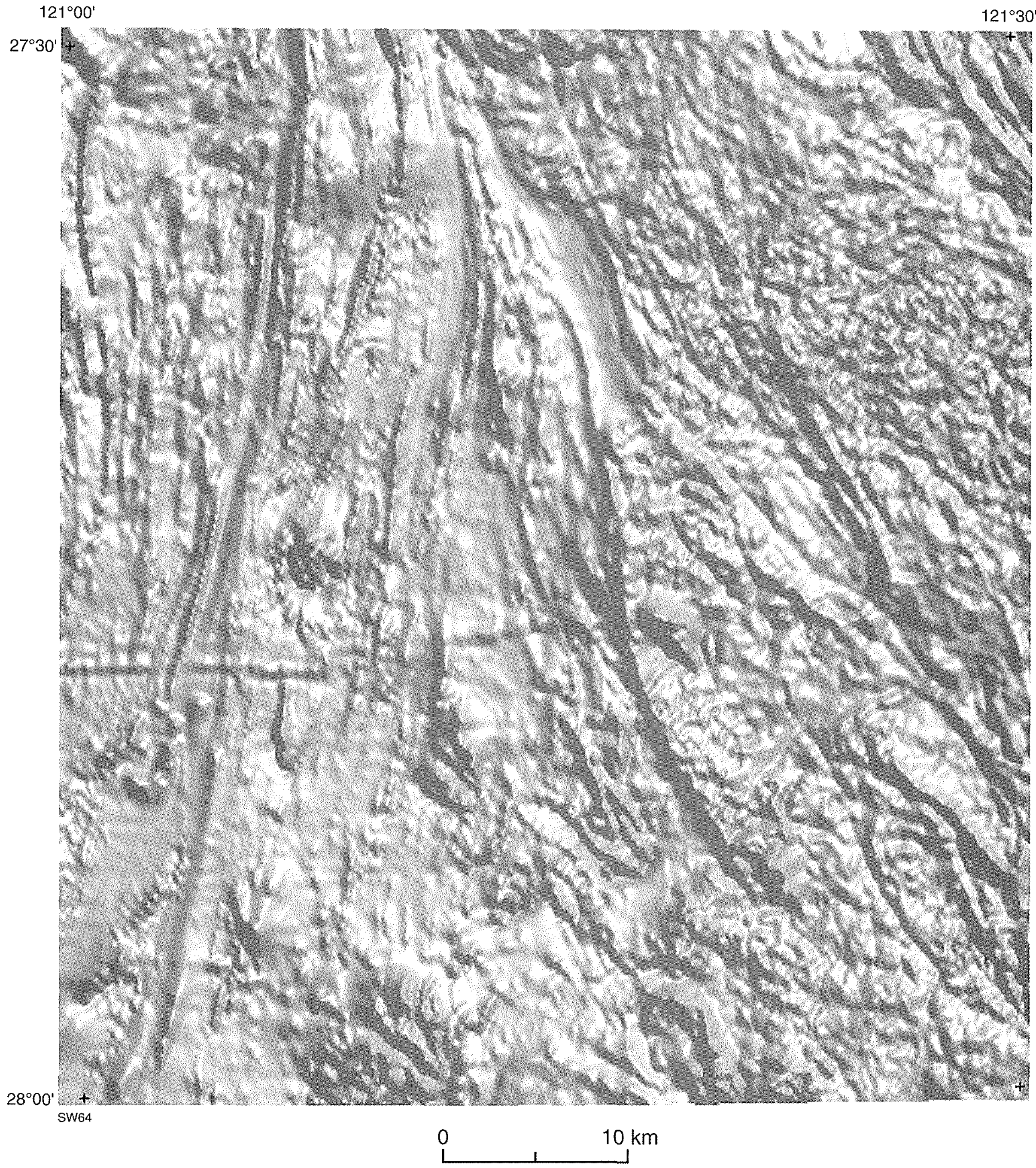

Figure 4. Aeromagnetic image of DARLOT

it is not possible to determine whether they are extrusive, fine-grained intrusive or sedimentary in origin. They are generally deeply weathered and outcrop in areas of laterite and breakaways. Near-surface occurrences of basalt are indicated by patches of fresh basaltic float.

Metabasalt (*Abv*) is well exposed in many areas on DARLOT, generally forming low, rounded ridges and hills covered by scree and scattered low outcrop. The basalt is commonly foliated and, in places, highly fractured with thin veins of quartz and carbonate. Primary depositional features are only rarely preserved. For example, there is a basaltic breccia 2 km south of Hope Bore (AMG 156276) with subangular basaltic clasts averaging 2 cm in diameter in a sandy matrix of similar composition. The basalt here also contains pipe vesicles up to 3 cm long. Amygdaloidal basalts with small (<1 cm) quartz-filled amygdales occur locally. Pillowed basalt has been observed in the pit at the Darlot gold mine.

Metabasalt designated *Abv* is mainly tholeiitic. The original texture in the form of fine, randomly oriented plagioclase laths is partially preserved in less-deformed rock. Some high-Mg basalt may have been included within this unit where primary textures are not well preserved. The basalt is metamorphosed to the greenschist facies, and primary pyroxene is rare to absent. Where there is a foliation, it is typically defined by the alignment of bladed actinolite crystals. Carbonate, chlorite and epidote alteration is common. In some samples, plagioclase is completely converted to clinozoisite. Veinlets less than 1 mm in diameter of epidote(–carbonate–quartz) are common. There are small aggregates of very fine grained titanite, and some minor secondary quartz. Iron oxide (mostly hematite) is rare.

In coarsely plagioclase-phyric metabasalt (*Abp*), the plagioclase phenocrysts, which are locally up to 1.5 cm, can constitute up to 15% of the tholeiitic metabasalt. This rock is commonly found in patches within tholeiitic metabasalt, but is rarely able to be mapped as a separate unit. A number of the larger areas of plagioclase-phyric metabasalt are west of Ockerburry Hill around AMG 071163.

High-Mg or komatiitic metabasalt (*Abm*) with relict pyroxene spinifex texture occurs in low outcrop and boulder float 2 km west of Desperation Well (AMG 033466). It is associated with metaperidotite and tremolite–chlorite schist. Coarse relict spinifex texture is clearly visible in hand specimen, with randomly oriented tremolite–actinolite needles up to 2 cm long and 2 mm in diameter replacing original pyroxene crystals. The rock also contains chlorite, minor fine-grained plagioclase and magnetite, with carbonate and secondary quartz. There is another small outcrop of this rock type about 5 km along strike to the south (AMG 042414).

Strongly carbonated mafic rock (*Abc*) outcrops in a group of low hills north of Yandal Lagoon around AMG 201395. They are generally fine grained and locally amygdaloidal with small quartz- and calcite-filled amygdales up to about 1 cm. Very little evidence of primary texture is preserved in thin section. Fine, pale-green metamorphic amphibole is the major constituent. There is abundant calcite, both as porphyroblasts up to about 1 mm, and as very fine interstitial material. Other secondary minerals include fine quartz and epidote-group minerals. Strongly carbonated mafic rocks in drillholes north of Ockerburry Hill (around AMG 069219) are deformed and recrystallized and may originally have been basaltic or gabbroic in character.

Epidote-rich metabasalt (*Abe*) is known only from drillholes north of Yandal Homestead.

Intermediate volcanic and high-level intrusive rocks (*Abi*) in the southwest are associated with the more felsic rocks of the Spring Well felsic volcanic complex. They range in composition from basaltic andesite to andesite. Outcrops are generally dull grey-green and grey in colour, and typically consist of rounded boulders. Some have a patchy texture that weathers to form shallow hollows up to 3 cm across. These appear to be secondary features and may reflect varying degrees of epidotization. The intermediate rocks form isolated hills and are found in recessive areas between outcrops of resistant, more siliceous units.

Although generally fine grained, intermediate rocks are locally porphyritic and glomeroporphyritic, with phenocrysts of plagioclase and/or clinopyroxene in places up to 5 mm across. Some of the finer varieties contain devitrified glass. Plagioclase is the most abundant constituent, both as a phenocryst phase and in the groundmass. In coarser varieties, for example southeast of Spring Well (AMG 198124), plagioclase phenocrysts may exceed 5 mm in length. They are extensively saussuritized but commonly retain traces of zoning. Finer grained plagioclase occurs as laths and microlites. Grains typically have a random orientation, but in places are weakly aligned; for example, 1 km south of Spring Well (AMG 188118). A pronounced trachytic texture developed locally, for example 2 km southeast of Mount Doolette (AMG 173154). Clinopyroxene, commonly altered to amphibole and chlorite, is abundant both as phenocrysts (Fig. 5) and in the groundmass. Primary quartz is present in some of the fine-grained varieties. Fibrous pale-green amphibole replaces clinopyroxene in places. Opaque oxides are locally abundant, commonly altered to leucoxene. Secondary epidote-group minerals are common and there is local carbonate alteration.

In most instances, there is no clear field evidence to indicate whether the intermediate rocks are extrusive or represent high-level intrusions of microdioritic to microgranodioritic composition. No pillow structures have been seen in the Spring Well complex, but there are textures indicative of a volcanic origin for at least some of these rocks. There are some rare pyroclastic rocks, for example immediately north of Spring Well (AMG 182140), where an analysis of lapilli tuff indicates an andesitic composition (Wyche et al., in prep.). Although no lava flows have been recognized, amygdales are locally abundant, and range in size from 1–2 mm to 7 cm diameter; for example in the trachytic material southeast of Mount Doolette (AMG 173154). They are typically filled with quartz but may contain calcite, epidote and possibly chlorite.

Amphibolite (*Aba*) is probably derived from basalt, gabbro and sedimentary rock. It is recrystallized, usually with a planar and/or linear fabric, generally fine to medium grained, and is slightly coarser grained and darker in colour than metabasalt. The amphibolite contains dark-green hornblende, plagioclase (commonly altered to sericite, carbonate or clinozoisite), and quartz. Epidote and locally euhedral titanite are common accessories and there are traces of biotite. Opaque iron oxide minerals occur in small aggregates which are commonly aligned to form trails, or as scattered grains. In places there is a layering defined by differing proportions of ferromagnesian and finer grained quartzofeldspathic minerals. The foliation is defined by weak alignment of hornblende and plagioclase. Local quartz veins are commonly less than 1 mm thick, but may reach about 1 cm. These veins may also contain epidote(–carbonate).

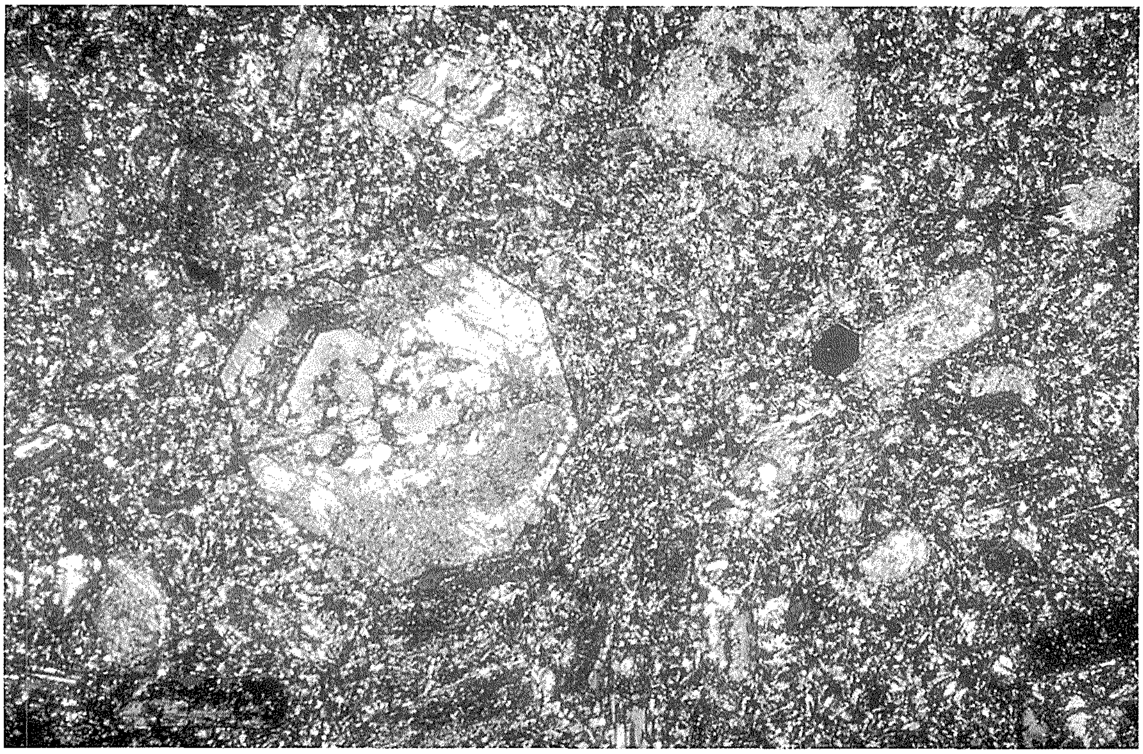

Figure 5. Porphyritic andesite dyke with phenocrysts of plagioclase and twinned clinopyroxene in a microcrystalline groundmass (AMG 186068; GSWA 121216). Field of view is 6.5 mm

Metamorphosed coarse-grained mafic rocks (*Aog, Aoga, Aogl, Aogp, Aop*)

Metagabbro (*Aog*) is common throughout DARLOT, with the most spectacular examples forming large hills such as Mount Von Mueller. Where relationships can be observed, they are generally concordant with surrounding units, suggesting that they are sill-like bodies. However, in many instances relationships with other rock types cannot be determined from the outcrop.

Metagabbro outcrops as low hills or masses of rounded dark-brown to red-brown boulders. Where affected by deformation, these rocks may also outcrop as tall (≤1.5 m), elongate, rounded to angular blocks, most of which have a rough mottled surface. Porphyritic varieties are commonly pitted, with indentations averaging 5 mm in diameter formed by preferential weathering of former pyroxene phenocrysts.

Gabbroic layers that reflect chemical differentiation trends from which younging can be determined are rare. One such body, 3 km west of Paul Well (AMG 032414) is about 120 m thick and has compositions which vary in an easterly direction from pyroxenitic gabbro at the base, through a series of thin units of leucogabbro, pyroxene-phyric gabbro and microgabbro up into coarse, quartz-bearing gabbro and microgabbro. Other gabbro bodies have clear compositional and grain-size layering, for example colour and grain-size banding in gabbro south of Boundary Well (AMG 073245) and grain-size variation in the folded gabbro body north of Mica Mica Waterhole (AMG 177209), but these features are not reliable indicators of younging directions.

The mineralogy of the mafic intrusive rocks is similar to that of the mafic extrusive rocks. Actinolite and minor hornblende are the main mafic constituents. Amphibole generally occurs as coarse (≤1 cm in the porphyritic varieties), blocky subhedral to anhedral grains usually with acicular (feathery) margins and has replaced the primary pyroxene which is preserved locally in the cores of amphibole grains. Some specimens contain, in addition to the equant amphibole grains, coarse, simply twinned amphibole laths. The amphibole commonly contains inclusions of epidotized plagioclase suggesting a relict subophitic to ophitic texture. Fresh plagioclase is rare; it has been partially or totally altered to fine-grained aggregates of epidote-group minerals or, less commonly, sericitized. Opaque oxide minerals (probably magnetite to ilmenite) are mostly altered to titanite or leucoxene. Medium-grained epidote and clinozoisite are common. Accessory minerals include chlorite, apatite, secondary quartz, and carbonate and there is minor quartz and epidote veining.

Metamorphosed leucogabbro and diorite (*Aogl*) have been mapped in several places through the western half of the sheet area. The most extensive of these is in the area adjacent to and south of Popes Patch where they intrude tholeiitic basalt and correspond to a significant aeromagnetic feature on maps (Geological Survey of Western Australia, 1996; Fig. 4). Around Popes Patch, this unit includes a range of rock types which represent differentiates of a large basic to intermediate intrusion. In the southern part of the Popes Patch district, there is abundant coarse-grained to pegmatitic gabbro in which mafic phenocrysts constitute between 10 and 40% of the rock. The rock has a very high magnetic susceptibility ($\leq 2000 \times 10^{-5}$ SI units). Original clinopyroxene has largely been replaced by actinolite, although primary clinopyroxene is present in some coarser grained varieties. Medium- to coarse-grained plagioclase grains are typically saussuritized, and there is up to about 5% fine quartz, some of which may be primary. Chlorite, epidote, and carbonate are common secondary minerals. The presence of abundant magnetite grains accounts for the very strong magnetic response.

Rock of more clearly dioritic composition (also mapped as *Aogl*) occurs over a small area at the northern end of the Popes Patch district (AMG 134291). The diorite is generally finer grained and more leucocratic than the leucogabbro at the southern end. Medium-grained, zoned, partially saussuritized plagioclase (andesine) makes up more than 80% of the rock. Fine- to medium-grained mafic minerals constitute less han 10% of the rock and are generally strongly altered to actinolite and chlorite, but include sparse grains of biotite up to 1 mm. The rock contains up to 15% quartz, both as primary medium-sized grains and fine interstitial aggregates which may be secondary. There are abundant fine-grained opaque oxides (mainly magnetite) and secondary chlorite and epidote. This rock probably represents a leucocratic differentiate of the coarser, more mafic gabbro at the southern end of the outcrop.

A small outcrop of medium-grained leucogabbro 2 km west of Jarrah Well (AMG 170065) also has an unusually high magnetic susceptibility. Plagioclase is almost completely saussuritized and chlorite and actinolite partially replace original clinopyroxene. This rock contains abundant magnetite and may have been of dioritic composition, as may the strongly altered leucogabbro 1 km north of Jarrah Well (AMG 188071). The small patch of leucogabbro 4.5 km west of Ockerburry Hill (AMG 048175) does not have a high magnetic susceptibility.

A distinctive porphyritic dyke (*Aop*) intrudes the leucogabbro at Popes Patch in the vicinity of some abandoned workings (AMG 133284). The dyke contains coarse, zoned, commonly saussuritized plagioclase phenocrysts, locally in glomeroporphyritic clusters, with subordinate medium- to coarse-grained phenocrysts of actinolite and chlorite after pyroxene in a fine, altered, felsic matrix. Chlorite, epidote and carbonate are common secondary minerals, and there are abundant grains of magnetite. This dyke probably represents a late-stage part of the larger intrusion and may be dioritic in composition, but the strong alteration of the plagioclase grains does not allow determination of their composition.

Metamorphosed felsic volcanic and volcaniclastic rocks (*Af, Afb, Afl, Afp, Afs, Afv, Afvs, Afx*)

There are extensive areas of metamorphosed felsic volcanic and volcaniclastic rocks on DARLOT, mainly associated with a major calc-alkaline volcanic centre in the southwestern part of the sheet area.

The volcanic centre of the Spring Well felsic volcanic complex (Giles, 1980, 1982) is situated in the vicinity of Spring Well, where an assortment of felsic volcanic, volcaniclastic and high level intrusive rocks ranging in composition from rhyolite to basaltic andesite outcrop in a group of low hills and ridges. Rocks around Spring Well are described as igneous rocks as they are generally fresh, and little deformed or metamorphosed, and preserve a wide range of primary igneous textures. Away from the volcanic centre, rocks have a more limited range of volcanic textures with finer grained pyroclastic and volcaniclastic sedimentary rocks predominant. The lateral lithological and compositional changes, high proportion of pyroclastic rocks, and large volume of volcanic breccias near the volcanic centre suggest that the Spring Well complex represents a continental stratavolcano (Cas and Wright, 1987).

Whole-rock analyses from a range of rock types from the Spring Well complex are presented in Wyche et al. (in prep.) and Giles (1980, 1982). Hallberg and Giles (1986) compared the geochemistry of a number of felsic volcanic centres in the northeastern part of the Yilgarn Craton and concluded that the Spring Well complex is one of a series of calc-alkaline rock suites whose primary magmas were derived by shallow, hydrous partial melting of large-ion-lithophile-element-enriched mantle.

Outcrops designated as undifferentiated felsic volcanic and volcaniclastic rocks (*Af*) are generally deeply weathered or altered but retain relict textural or compositional evidence, for example quartz phenocrysts, of a felsic volcanic association. Where these rocks are strongly deformed, they have been labelled *Afs*, indicating felsic schist. Some felsic schist may be deformed metasedimentary rocks. Biotite-bearing quartzofeldspathic schist (*Afb*) in the northwest has been identified in chip samples from exploration drillholes.

Fine-grained felsic volcanic rocks (*Afv*) include both tuffaceous varieties and lavas, although it is not always possible to determine the style of deposition. The very fine grained quartzofeldspathic groundmass may, in some instances, represent devitrified glass. Elsewhere the groundmass consists of very fine plagioclase laths which may be randomly arranged or aligned in an apparent trachytic texture. The felsic volcanic rocks may be porphyritic, with fine-grained quartz and plagioclase phenocrysts, and may contain small glomeroporphyritic aggregates of fine-grained plagioclase. The presence of broken crystals and glass shards in some specimens is suggestive of a pyroclastic origin for much of this material. Spherulites are rare but devitrification textures including spherulites and perlitic cracks are preserved in some glassy clasts in the coarse volcanic breccia, for

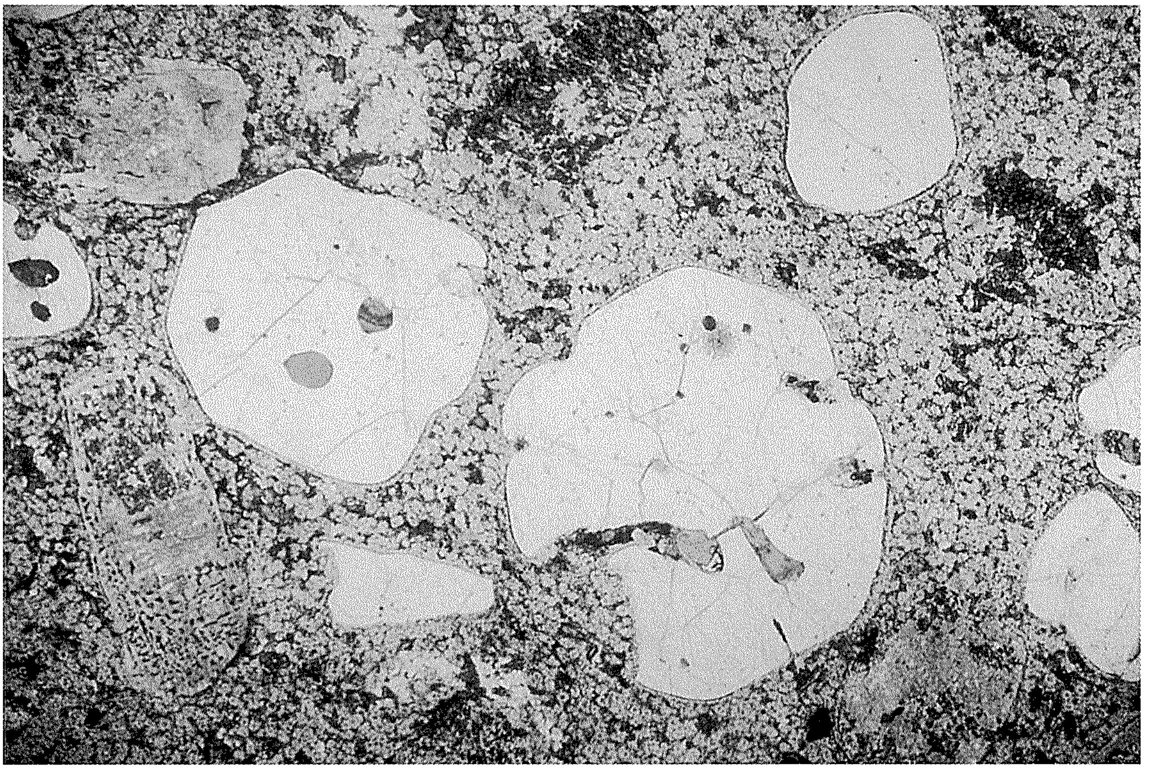
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Figure 6. Embayed quartz phenocryst with reaction rim in porphyritic rhyodacite; devitrified matrix (AMG 183124; GSWA 106280). Field of view is 6.5 mm

example 1 km north of Spring Well (AMG 190138). Amygdaloidal varieties are present locally, for example 2 km north of Spring Well (AMG 182150) where a very fine grained quartzofeldspathic rock contains numerous amygdales up to 3 mm in diameter filled with quartz, calcite, epidote, and chlorite. Chlorite and epidote are common secondary minerals in these rocks, and calcite is present locally.

Felsic volcanic rocks are clearly pyroclastic in origin 2 km southeast of Mount Doolette (AMG 165151) where they occur in a small wedge between a gabbro unit to the west and an extensive area of intermediate rocks to the east. The relationships between the different rock types is not apparent in outcrop. Here, the felsic volcanic rocks include thinly laminated ashstone with some slightly crystal-rich bands and very fine grained quartzofeldspathic material with variously abundant, commonly broken, grains of quartz and feldspar, and scattered glass shards.

Some rhyolite lava in the vicinity of Mount Doolette has the texture of a matrix-supported breccia with distinctive, uniform angular 'clasts' up to 5 cm across. This material may be hyaloclastite but more likely represents large perlitic fractures (macro-perlite) in a coherent rhyolite lava (McPhie, J., 1997, pers. comm.). Rhyolite lava on the eastern side of the hill 1 km east of Mount Doolette (around AMG 162162) forms a glassy autobreccia with angular clasts up to 20 cm with very well-preserved flow banding. On top of the hill, there are outcrops of very fine grained siliceous rock with diffuse, regular layering on a scale of about 5 cm. Although this layering resembles bedding, suggesting that this material may represent an ash-cloud deposit, the association with nearby coherent rhyolite lava makes it more likely that this texture is a planar flow foliation.

Porphyritic felsic volcanic rocks (*Afp*) ranging in composition from rhyolite to dacite have been mapped mainly to the west and south of Spring Well. There are numerous fresh outcrops in which phenocrysts of plagioclase, commonly saussuritized, and quartz constitute 10 to 40% of the rock. Phenocrysts up to 3 mm across are embedded in a very fine grained, probably recrystallized, felsic matrix. Plagioclase may occur as euhedral and broken crystals, and glomeroporphyritic aggregates. Quartz grains are typically anhedral, rounded, and embayed as a result of resorption. Some have thin reaction rims (Fig. 6). Broken quartz grains have a jigsaw-fit texture indicating fragmentation in situ. Epidote, chlorite and calcite are common secondary minerals.

The porphyritic felsic volcanic rocks may represent lavas, subvolcanic intrusions, or pyroclastic deposits. Near Spring Well, where they form small hills and rocky outcrops, they are commonly associated with fine-grained tuffaceous rocks and appear to be locally intruded by fine-grained intermediate rocks (*Abi*). These outcrops vary in overall phenocryst abundance and in the relative abundance of quartz and plagioclase phenocrysts. A discontinuous line of outcrops in the hills 500 m to the west of Spring Well displays well-preserved, strongly

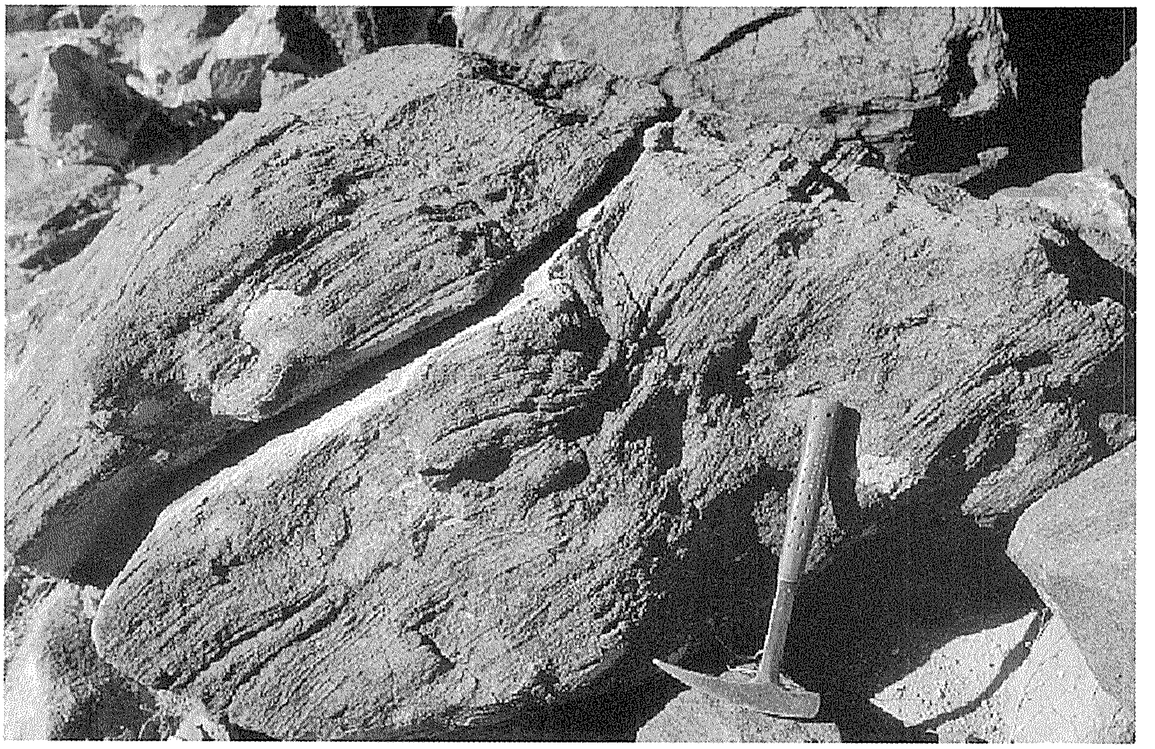

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Figure 7. Flow banding in porphyritic rhyolite southwest of Spring Well (AMG 180126)

contorted flow banding with local autobrecciation (Fig. 7). These outcrops have been interpreted by Giles (1980, 1982) as rheoignimbrite, i.e. ignimbrite that has flowed while still in a plastic state. However, the generally uniform texture and lack of broken crystals suggest that it is more likely that this material represents a rhyolite lava flow. Further west, in the area southeast of Overland Well around AMG 133106, relatively fresh felsic porphyritic rocks, very similar in character to the less quartz-rich types near Spring Well, outcrop over an area of several square kilometres. They are massive, homogeneous, and lack any internal structure including bedding or layering. Giles (1980, 1982) has interpreted these rocks as crystal tuffs but the massive, uniform nature of the outcrops suggests that they may be subvolcanic intrusions.

A SHRIMP (Sensitive High-Resolution Ion Microprobe) U–Pb zircon age of 2690 ± 6 Ma has been obtained on a sample of porphyritic rhyolite from about 1 km southwest of Spring Well (Nelson, 1997).

Lapilli tuff (*Afl*) is a widespread rock type, but most occurrences are too small to be shown on the map. They consist of a mixture of angular, poorly sorted, altered, devitrified, glassy volcanic clasts in a very fine-grained, felsic, devitrified glassy matrix, and may also contain broken quartz and feldspar grains. The range of mainly fine grained felsic clast types includes altered material that may represent original pumice fragments and glass shards. Compaction and welding is evident at both outcrop and microscopic scales. Flattening and alignment of clasts producing a eutaxitic texture is commonplace, and some outcrops, particularly those distal to the volcanic centre (e.g. southeast of Katherine Well around AMG 183395), have a weakly developed layering which is probably also a primary feature.

Coarse volcanic breccias (*Afx*) form prominent ridge cappings and isolated outcrops at Spring Well, in the hills immediately to the south and southwest, and at Mount Doolette to the north. These rocks are generally poorly sorted and matrix-supported, with a range of volcanic clast types which can include volcanic glass, flow-banded rhyolite, porphyritic rhyolite and dacite, individual quartz and feldspar grains, and andesitic lava. Aphanitic and finely porphyritic rhyolitic to dacitic volcanic rocks are the most abundant clast types but more intermediate varieties are present locally (e.g. at Mount Doolette). Outcrops generally have no internal stratification or bedding although there is an overall fining-up and some local-scale graded bedding within this sequence north of Spring Well (AMG 189140) indicating a westward younging direction. Both clasts and matrix commonly have epidote and chlorite alteration. Some outcrops may have undergone secondary silicification.

Clasts in the volcanic breccias are angular and typically less than 10 cm across but may range to more than 30 cm long (Fig. 8). Boundaries between clasts and the enclosing matrix are generally sharp. However, some glassy fragments in the breccia do have thin (1–2 mm) reaction rims (Fig. 9). Bunting and Williams (1979) interpreted the rims as evidence of the incorporation of cold fragments into a hot matrix. The presence of perlite and broken crystals in the matrix, vitriclastic textures, and

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Figure 8. Very coarse volcanic breccia from north of Spring Well (AMG 190138)

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Figure 9. Reaction rim on glassy clast in coarse volcanic breccia; relict perlite fractures in the matrix (AMG 190138; GSWA 121724). Field of view is 6.5 mm

evidence of welding and flattening of glassy clasts in outcrops immediately north of Spring Well, supports Giles' (1980, 1982) interpretation of these rocks as pyroclastic deposits proximal to the volcanic centre. However, these features are not seen in all exposures and it is possible that some of the breccia units were deposited as debris flows adjacent to active volcanoes.

Felsic volcaniclastic rocks (*Afvs*) are abundant between 4.5 and 6.5 km east of Katherine Well. They occur as areas of deeply weathered float and bleached pavements. However, fresh outcrops form a 1.7 km long ridge, 6 km east-northeast of Katherine Well, and two smaller bodies 2 km east of Yandal Lagoon. These outcrops are made up of large boulders and tors up to several metres high, and look like granitoid bodies from a distance. They are locally foliated and jointed, with some boulders slightly lens shaped and oriented in the direction of the foliation.

Larger outcrops are massive to bedded, and pale cream to buff in colour. Bedding appears as diffuse greyish bands that vary from 2 to 10 cm but average 4 cm in thickness (Fig. 10). In places there is slight differential weathering of the darker bands, possibly reflecting a subtle compositional variation. Graded bedding allows determination of facing directions locally.

In thin section, the volcaniclastic rocks are crystal-rich with grains of quartz and lesser amounts of sericitized plagioclase, K-feldspar and accessory epidote and leucoxene constituting up to 75% of the rock. They are set in a very fine grained quartzofeldspathic groundmass. The grains are poorly sorted and range up to 3 mm. Individual grains are anhedral to euhedral with abundant broken crystals. Scarce, altered lithic fragments are also present. There is no evidence of welding.

The diffuse nature of the bedding and the textural and mineralogical immaturity of these rocks indicates that there has been very little reworking. They probably represent a pyroclastic fall deposit associated with the Spring Well felsic complex.

Metamorphosed sedimentary rocks (*As, Ascf, Ash, Ashf, Ac*)

Metasedimentary rocks are a widespread, but generally minor, component of the greenstone sequences throughout Darlot. Undivided metasedimentary rocks (*As*) are poorly exposed and deeply weathered. There may be a well-developed foliation and some outcrops are silicified. The protolith for most of these rocks is assumed to be fine-grained sandstone, siltstone and mudstone, but may include volcanic rocks, particularly in finely interbedded sequences.

The most abundantly exposed metasedimentary rocks on Darlot are metamorphosed shale and siltstone (*Ash*). They are mid to dark grey, and typically moderately to strongly foliated. Commonly very siliceous, they may also be ferruginous and locally carbonaceous. The mineralogy varies with metamorphic grade. Shale and siltstone typically comprise granoblastic quartz with lesser feldspar; muscovite and sericite content varies and

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Figure 10. Bedding in immature volcaniclastic rock from east of Katherine Well (AMG 209371)

there is subordinate biotite in some thin sections. The micas generally define the foliation. Other minerals present may include amphibole, poikiloblastic garnet up to 3 mm, coarse apatite, carbonate, chlorite, graphite, magnetite, and tourmaline. Andalusite porphyroblasts up to 4 cm long are found in felsic metasedimentary rocks around AMG 238492, and there are altered kyanite porphyroblasts up to 4 mm long 13 km northeast of the Yandal Homestead (AMG 214546). Fibrolitic sillimanite defines microscopic folds in a poorly outcropping band in a mixed metasedimentary rock and amphibolite package south of Andy Well.

Metamorphosed siltstone and shale are generally poorly exposed in low outcrops and blocky float. Layering mainly reflects the metamorphic fabric. However, in some of the lower grade rocks, thin primary compositional banding has been preserved. Although they can form units up to 300 m wide (e.g. west of Desperation Well), the fine-grained metasedimentary rocks generally occur in thin bands 1 to 20 m thick interbedded with felsic volcaniclastic and volcanic rocks and, to a lesser extent, with mafic rocks. Where they are interbedded with felsic rocks in areas of deep weathering and poor exposure, they have been included with the general felsic unit (*Af*).

Metamorphosed shale and siltstone with local quartz-rich intervals (*Ashf*) outcrops west of the Ockerburry Fault in the area west and north of Ockerburry Hill. These rocks are similar to the shale and siltstone described above but contain layers or beds with abundant quartz grains up to 2 mm in diameter. They may have been felsic pyroclastic or volcaniclastic sedimentary rocks. Outcrops are generally strongly cleaved and primary depositional textures are not well preserved.

A conglomeratic unit (*Ascf*), associated with felsic volcaniclastic rocks 13 km east-northeast of Katherine Well (AMG 233434), is poorly sorted and made up of felsic volcanic clasts, some of which are vesicular, in a quartzofeldspathic matrix. The size of the clasts increases towards the eastern side of the outcrop, with some up to 15 cm in diameter. The conglomerate is deformed, with flattened clasts aligned with the regional foliation.

Siliceous metasedimentary rock or chert (*Ac*) outcrops as long, narrow ridges no more than 2 m wide, or as low outcrop and rubble made up of rectangular blocks averaging about 25 cm wide and 40 to 50 cm long. Outcrop of siliceous metasedimentary rock occurs south-southeast of Lilly Well, north of Ockerburry Hill and at Mount Mundy in the northeastern corner of the map sheet. Colour varies from dark grey to white, and the rock is typically banded with laminae ranging from less than 1 mm to more than 1 cm in thickness. Local ferruginous laminae may contain pyrite. This unit is locally brecciated, and in places preserves complex fold structures, for example north of Mount Mundy (AMG 469567) and north of Ockerburry Hill (AMG 102192; Fig. 11). In many cases it is difficult to determine whether these rocks represent primary chemical sediments (i.e. cherts), fine-grained metasedimentary rocks that have been strongly silicified, or recrystallized fine-grained quartzite.

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Figure 11. Complex folding in a chert unit north of Ockerburry Hill (AMG 102192)

Medium-grade metamorphic rocks (*Ala*)

Layered amphibole-bearing rocks (*Ala*) have been mapped south of Andy Well (AMG 401159) and west of Ninnis Waterhole(AMG 240495). They are similar to amphibolites, and are of the same metamorphic grade, but contain up to 15% quartz and are commonly biotite-bearing. They are interpreted as having derived from intermediate to mafic sediments.

Outcrop of layered amphibole-bearing rocks is only locally abundant, but the rocks are generally fresh. They are interbedded with amphibolite and metashale, and range from clearly layered material with bands from a few millimetres to about 1 cm wide, to diffuse lenses. Layers are defined by slight grain-size variation (fine to medium) and variations in the amphibole content. Some samples contain thin micaceous bands.

Microscopic textures vary from granoblastic to moderately foliated. Where present, the layer-parallel fabric is defined by micas, the weak alignment of amphibole and, to a lesser extent, quartz and feldspar. The rocks contain amphibole, quartz, feldspar, epidote group minerals, biotite and muscovite in places, with accessory apatite, titanite, and zircon. There is local carbonate and minor sericite alteration.

Granitoid rocks (*Ag, Agg, Agm, Agwa, Agdp, Agwe, Agwef*)

Granitoid rocks constitute a significant portion of the Archaean rocks on DARLOT. These rocks are most abundant in the eastern part of the sheet area, with smaller plutons in the far northwest corner and along the southern sheet boundary.

Monzogranite (*Agm*) is widespread in the northeastern part of DARLOT in hills, tors, and low weathered outcrops. Bunting and Williams (1979) subdivided the monzogranite into coarser and finer grained varieties. However, the variation in grain size can be quite subtle, and boundaries between these varieties are not easily traced on the ground. In places, a weakly developed banding is defined by compositional layering and grain-size variation, for example 4 km east-northeast of Ninnis Well (AMG 285489). Elsewhere, there is a weakly developed fabric that may be tectonic and is difficult to measure in the outcrop, for example 2 km south-southeast of Mount Blackburn (AMG 361455).

The monzogranite can be fine to coarse grained, and is typically equigranular, although there are local porphyritic patches with coarse alkali-feldspar phenocrysts up to 3 cm. It has an anhedral to subhedral, granular texture. Quartz is commonly strained, and plagioclase is partially saussuritized. Perthitic texture is visible in some coarse alkali-feldspar grains. Biotite is the most widespread mafic constituent. Fine-grained muscovite is subordinate to biotite. Some specimens contain epidote, and euhedral to subhedral grains of titanite are present in most samples. Fluorite is a common accessory mineral in the equigranular monzogranite and is locally abundant, for example in coarser grained monzogranite around Mount Blackburn. Apatite and zircon are common accessory phases.

A small outcrop of quartz monzonite containing dark-green clinopyroxene 2.5 km south-southeast of Mount Blackburn (AMG 368450) is not shown on the map face. This rock is fine- to medium-grained, clinopyroxene is commonly altered to biotite, and titanite is an abundant accessory mineral. This rock is typical of alkali granitoids described elsewhere in the Eastern Goldfields (Smithies and Champion, in prep.) and may be related to similar rocks that outcrop to the north on WANGGANNOO (Lyons, 1996). A SHRIMP U–Pb zircon age of 2644 ± 13 Ma has been obtained for a syenitic granitoid from near Woorana Soak on WANGGANNOO (Nelson, 1998)

Monzogranite in the southeastern corner is poorly exposed as deeply weathered outcrop and coarse float. It comprises quartz, feldspar, clays, and iron oxide, is generally fine to medium grained, and is commonly foliated. A distinctive feature of this monzogranite body is that it has been cut by numerous aplite dykes. These dykes are a few centimetres to 2 m wide and are locally abundant, becoming the dominant rock type in some areas. Aplite dykes cut across the foliation in the monzogranite but are themselves unfoliated. The aplite is pink to pale cream, fine grained, and has a distinctive blocky outcrop with angular blocks averaging about 20 cm in diameter.

To the west of the monzogranite, east of Melrose Homestead, granodiorite (*Agg*) varies from poorly exposed, deeply weathered rubble that is indistinguishable from monzogranite, to large, fresh boulders 1 to 3 m in diameter. Granodiorite outcrops appear fresher than the monzogranite and contain fewer aplite veins. The granodiorite commonly contains elongate mafic xenoliths from 2 cm to 1 m long, and averaging 10 to 15 cm across. These xenoliths are common around AMG 390062 where elongate xenoliths are aligned. Apart from this alignment, there is no obvious fabric in the granodiorite.

The granodiorite is medium to coarse grained and equigranular. It is made up of quartz, zoned plagioclase, microcline, green biotite, minor hornblende, coarse euhedral titanite, epidote and apatite. The inclusions are ferromagnesian-rich (≤40%), with dark-green hornblende, biotite, opaque oxide, titanite aggregates, epidote, quartz, and fine- to medium-grained, simply twinned plagioclase. Most of the inclusions are quartz-bearing and similar in grain size to the granodiorite. Some contain feldspar phenocrysts while others are finer grained and appear to be biotite-rich.

The granodiorite has been intruded by an irregular body of biotite-rich porphyritic microdiorite (*Agdp*) at a locality 4.6 km south of Daylight Well (AMG 401081). This rock is medium grained, with coarse biotite, and subordinate amphibole and plagioclase phenocrysts in a fine-grained quartzofeldspathic groundmass with accessory apatite, titanite, and magnetite. The alignment of the biotite defines a weak foliation. Rounded mafic inclusions averaging 1 cm in diameter are made up of biotite and hornblende rimmed by pale-green amphibole. Some outcrops are strongly foliated (biotite schists), and others contain rounded clasts of the surrounding granodiorite. Associated with the microdiorite is a breccia with subangular granodiorite clasts averaging 7 cm, but up to 20 cm in diameter, in a mid-grey, finer grained, granodiorite matrix. The clasts have a jigsaw-fit texture in places suggesting that there may have been multiple intrusions of the granodiorite magma (Fig. 12).

A circular granitoid body in the far northwest corner of the map sheet is clear on aeromagnetic maps but very deeply weathered in outcrop. The relict texture suggests that this rock is plagioclase-rich and it is mapped as granodiorite. It is medium grained, equigranular, and outcrops form patches of orange clay-, quartz-, and iron oxide-rich rubble. Fresh monzogranite that outcrops within this body just north of the sheet boundary at Kens Bore has a SHRIMP U–Pb zircon age of 2669 ± 6 Ma (Nelson, 1997).

The Wadarrah Quartz Monzonite (*Agwa*), which takes its name from the Wadarrah Rocks, is a hornblende–quartz monzonite which outcrops as tors and whalebacks northeast of the Darlot mine. It is a pink, medium- to coarse-grained porphyritic rock with alkali-feldspar phenocrysts averaging 1 cm in diameter, but with some elongate plagioclase phenocrysts up to 4 cm long. The abundance of these phenocrysts varies markedly. Narrow quartz veins and aplite and pegmatite dykes are common. The Wadarrah Quartz Monzonite comprises quartz, microcline, plagioclase, biotite (some of which is altered to chlorite), hornblende, abundant euhedral titanite and accessory apatite, epidote and magnetite. Minor fluorite is usually associated with biotite. The rock is recrystallized, and quartz is strained, with undulose extinction and some local granulation. It has a SHRIMP U–Pb zircon age of 2643 ± 6 Ma (Nelson, 1997).

The Wadarrah Quartz Monzonite is relatively massive although a locally prominent fabric, probably a flow foliation, is defined by the alignment of hornblende and biotite crystal aggregates. The pluton contains xenoliths of greenstone, tens to hundreds of metres across, especially in the vicinity of Andy Well where they are oriented roughly north–south and are cut by granitoid, aplite, and pegmatite dykes.

The contact between the quartz monzonite and the adjacent greenstone sequence forms a zone about 100 m wide where stringers of granitoid material are interlayered with basalt on a scale of 1 mm to 10 cm. Granitoid and pegmatite dykes up to 3 m wide intrude greenstones parallel to the contact, for example immediately west of Rosewood Bore.

The Weebo Granodiorite has two distinct phases: a coarse-grained phase (*Agwe*), and a finer grained marginal phase (*Agwef*). It forms a distinctive outcrop of tors and boulders in the south of the map sheet east of Weebo Homestead (on WEEBO), from which it takes its name. The Weebo Granodiorite is very similar to, and may be comagmatic with, the granodiorite described above from east of the Melrose Homestead (*Agg*). It contains zoned plagioclase, quartz, hornblende, with minor biotite and alkali feldspar. Quartz forms polycrystalline recrystallized aggregates with weakly sutured grain margins and undulose, strained extinction.

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Figure 12. Granodiorite breccia from south of Daylight Well (AMG 401081)

Hornblende is strongly pleochroic. Titanite, epidote, apatite, and opaque oxide minerals are common accessories. Fine-grained alkali feldspar is interstitial to the dominant coarser components, and is not always apparent in thin sections.

The fine-grained phase, which forms a distinct margin to the pluton adjacent to the felsic volcanic rocks which it intrudes, is similar in composition to the coarse-grained phase, but generally has a much higher magnetic susceptibility. The pluton appears as a clear magnetic high on aeromagnetic maps (Fig. 4; Geological Survey of Western Australia, 1996). The Weebo Granodiorite has a SHRIMP U–Pb zircon age of 2658 ± 7 Ma (Nelson, 1997).

Minor intrusions (*a, g, lp, p, q*)

Aplite (*a*) occurs as small, discontinuous dykes within the greenstone sequence. Granitoid dykes (*g*) and pegmatite veins (*p*) are generally found near or adjacent to granitoid contacts. Quartz veins (*q*) cut across both granitoid rocks and greenstones and commonly trend in a west-northwesterly direction. They contain gold in the Darlot area and at the Hamster prospect (AMG 086529).

Deeply weathered lamprophyre dykes (*lp*) in the vicinity of the Darlot gold mine cut across the Archaean greenstone sequence. Unpublished petrographic descriptions of samples from the vicinity of the Darlot gold mine indicate the dykes comprise mainly biotite(–clinopyroxene) lamprophyre (minette and augite minette) with subordinate hornblende–plagioclase lamprophyre (spessartite). Although commonly deeply weathered, fresh examples of these rocks have a well-preserved panidiomorphic granular texture. The descriptions were carried out for Plutonic Resources Ltd by J. A. Hallberg, M. H. Lloyd, and M. J. Gole (Utley, J., 1996, pers. comm.).

Structure and metamorphism

There are three areas of granite–greenstone on DARLOT that are separated by major shear zones (Fig. 3). Major structures have been interpreted from aeromagnetic images (Fig. 4) and Landsat TM images. The western area, which lies west of the Ockerburry Fault and extends west onto SIR SAMUEL, contains a sequence of metamorphosed mafic, ultramafic, felsic and sedimentary rocks. The central area, which lies east of the Ockerburry Fault and west of the Ninnis and Rosewood Faults, contains calc-alkaline volcanic rocks in the south and mafic volcanic and intrusive rocks interleaved with felsic and sedimentary rocks in the north and east. The Ninnis Fault, named after the Ninnis Waterhole, corresponds to the Celia Lineament of Bunting and Williams (1979). The Rosewood Fault, named after Rosewood Bore, is probably a splay off the Ninnis Fault. East of the Ninnis Fault is a broad area of locally well-exposed granitoid rock of mainly monzogranitic composition. Part of the Dingo Range greenstone belt (Griffin, 1990), which extends north onto WANGGANNOO (Lyons, 1996) and east onto BANJAWARN (Farrell, 1997), is exposed in the northeastern corner of the sheet area. The belt consists mainly of basalt with subordinate ultramafic and metasedimentary rocks, which is a sequence similar to that observed west of the Ockerburry Fault.

The western contact of the Yandal greenstone belt lies to the west of DARLOT on SIR SAMUEL where it is represented by a strongly deformed and metamorphosed zone up to about 13 km wide of complexly interleaved granitoid, mafic and felsic rock (Liu et al., 1996, in prep.). Mafic rocks at the contact and in the interleaved zone immediately to the west are metamorphosed to the amphibolite facies whereas those within the greenstone sequence to the east on DARLOT are mainly in the greenschist facies. A SHRIMP U–Pb zircon age of 2738 ± 6 Ma (Nelson, 1998) obtained on a foliated monzogranite from the zone of interleaved granitoid and greenstone along the western side of the Yandal greenstone belt on SIR SAMUEL (Liu et al., 1996) is the oldest published age yet determined in the northern part of the Eastern Goldfields. It is likely that the greenstone sequences were deposited onto sialic basement that was significantly older than the foliated granitoid.

The eastern contact of the Yandal greenstone belt is poorly exposed. In the south, there appears to be a mainly intrusive relationship between the Wadarrah Quartz Monzonite and the adjacent greenstones to the west. The quartz monzonite intruded along the Rosewood Fault. Mafic rocks are hornfelsed at the contact, and there are mafic xenoliths within the quartz monzonite. In the north, the contact between the greenstones and the adjacent monzogranites is not well exposed, but outcrop patterns and aeromagnetic data suggest that it is a fault (the Ninnis Fault), though without the complex interleaving seen along the western contact. There is a zone up to 1 km wide of higher grade rocks immediately west of the Ninnis Fault in which moderately deformed mafic and sedimentary rocks have been metamorphosed to amphibolite facies.

There are two major, recognizable episodes of deformation — a northerly to north-northwesterly trending upright folding event which is responsible for most of the observed foliations, and a subsequent shearing event in which major regional shear zones have north-northeast to northwest trends. Evidence of the earlier folding event is displayed in two north-plunging synclines; one defined by a sequence of interbedded felsic volcanic, mafic volcanic, and mafic intrusive rocks southeast of Katherine Well (AMG 181391), and the other defined by a differentiated mafic sill north of the Mica Mica Waterhole (AMG 177209). The western limb of the Katherine Well fold may have been faulted out during the subsequent shearing event. Further evidence of the upright folding event comes from aeromagnetic data (Fig. 4), in which traces of unexposed magnetic units, probably either ultramafic units or mafic sills, appear to outline large-scale folds. Some of these structures are clearly truncated by the regional shearing event.

The north-northeasterly to northwesterly trending regional shearing event may be the result of partitioning of the compression responsible for the upright folding into discrete shear zones, resulting in strong deformation along the Ockerburry and Ninnis Faults. The Ockerburry Fault, which corresponds to a marked discontinuity on aeromagnetic images, is represented by a zone of strongly sheared rock, in places more than 1 km wide, known mainly from exploration drillholes. Folds in chert units, and lineations in associated sedimentary rocks adjacent to the fault zone, are both shallow south plunging. The sense of movement and amount of displacement is not known but the similarity of sequences on either side of the structure suggests that it is not a terrane boundary. Other parallel structures suggested by discontinuities in aeromagnetic images and structures which host gold mineralization at Darlot, and in the line of workings to the north of Mount McClure (SIR SAMUEL), may also be related to this event.

The upright folding and the regional shearing correspond to the regional D_2–D_3 deformation regime described by Langford and Farrell (in prep.) to the east on DUKETON, and by Liu et al. (in prep.) to the west on SIR SAMUEL. They are probably analogous to D_2 and D_3 in the Kalgoorlie region to the south (Swager et al., 1995). Evidence of an earlier deformation in areas to the east and west (Langford and Farrell, in prep.; Liu et al., in prep.) has not been seen on DARLOT.

Stratigraphy

Local stratigraphic correlations can be made on DARLOT and adjacent sheets, but no regional stratigraphic succession has been established.

The western side of the Yandal greenstone belt, west of the Ockerburry Fault (Fig. 3), appears to young to the east. The lowest rocks in the sequence are the mafic and ultramafic rocks that lie immediately east of the granite–greenstone contact. To the east, the sequence includes sedimentary rocks, and felsic and mafic volcanic rocks. In the south, west of Warrida Well, the Mount McClure sequence includes some clastic sedimentary rocks in the lower part, but is characterized by prominent ridges of thinly bedded to laminated chert and silicified shale interspersed with mafic and ultramafic rocks. East-younging is indicated by differentiation trends in a gabbroic sill 3 km west of Paul Well (AMG 032414), by poorly preserved cross-beds in weathered metasedimentary rocks on SIR SAMUEL (1996), by graded bedding in volcaniclastic metasedimentary rocks in the Parmelia openpit on SIR SAMUEL (1996), and by relationships between sedimentary and mafic rocks in drillcore obtained by Arimco Mining Pty Ltd (Harris, J., 1994, pers. comm.). Aeromagnetic data and outcrop patterns in the area to the west and northwest of Ockerburry Hill suggest a structural or stratigraphic discontinuity between the northern and southern parts of this sequence (Liu et al., in prep.), but the discontinuous nature of the outcrop and vague aeromagnetic patterns preclude any conclusive resolution of relationships in this area.

Farther east, towards the Ockerburry Fault, there are poorly exposed sedimentary and felsic volcanic rocks in the north, and an extensive area of tholeiitic basalt in the south. Stratigraphic relationships are unclear. Close to the Ockerburry Fault zone in the vicinity of Ockerburry Hill, there are cherts interspersed with shales and cleaved, felsic schists. A similar association with some interleaved ultramafic rocks can be observed in a poorly outcropping part of the fault zone southeast of Lilly Well. There are intrusions of differentiated, mafic sills throughout the greenstone sequences on DARLOT.

The eastern part of the greenstone succession, east of the Ockerburry Fault, is dominated by the Spring Well felsic volcanic complex (Giles, 1980, 1982). The intricate association of acid to intermediate lavas, pyroclastic rocks and coarse volcanic breccias at Spring Well appears to mark the volcanic centre. Here, the felsic rocks are generally very fresh and relatively undeformed. This area also contains the greatest range of volcanic rock types, with coarse volcanic breccia being almost exclusively restricted to the immediate vicinity of Spring Well. There are also large volumes of andesitic rocks, some of which may represent subvolcanic intrusions.

Felsic volcanic and volcaniclastic rocks to the north, south and east of Spring Well are generally less well exposed than those at Spring Well, and are commonly deeply weathered. The abundant immature volcaniclastic rocks include sandstone, conglomerate, and fine-grained pyroclastic rocks, suggesting that they represent a distal facies to the Spring Well complex. They are interleaved with mafic volcanic rocks, mainly tholeiitic basalts, to the north and east. There are some thin, poorly outcropping ultramafic units in the north, and the whole sequence has been intruded by gabbroic sills.

There is no indication of the overall younging of the sequence, and structural complications and large-scale facies variations make it difficult to estimate the true thickness. Graded bedding in tuffs in the hills just north of Spring Well (AMG 189140) youngs to the west but this may not be regionally significant. The syncline that is outlined by a gabbro sill north of Mica Mica Waterhole is not necessarily a regional-scale feature. Graded bedding in immature volcaniclastic rocks to the northeast of Katherine Well (AMG 217418, AMG 220448) indicates both easterly and westerly younging directions. This suggests that the sheared-out syncline southeast of Katherine Well may be one of a series of D_2 upright folds with wavelengths of the order of 1–3 km. In the east, east-younging is indicated by pillowed basalt lavas and scour-and-fill structures in volcaniclastic sedimentary rocks in the Darlot openpit.

There is no evidence on DARLOT that would allow determination of a stratigraphic succession in the small area of the Dingo Range greenstone belt (Griffin, 1990) in the northeast. However, the association of basalt, chert and ultramafic rocks is similar to that on the western side of the Yandal greenstone belt in the vicinity of the Dragon openpit.

The greenstones on DARLOT differ from those in the Mount Keith–Perseverance greenstone belt to the west on SIR SAMUEL (Liu et al., 1996) in that the Yandal sequence appears to contain less mafic and ultramafic rock, and more felsic and sedimentary rock.

There is no strong supporting evidence in the Yandal greenstone belt for a simple regional stratigraphy like that described for the Kalgoorlie Terrane to the south (Swager et al., 1995). The overall mix of rock types is more like that described by Hallberg (1985) for the Leonora–Laverton region immediately to the south. Although he did not produce a regional stratigraphy, Hallberg (1985) divided rocks in the Leonora–Laverton region into a lower sequence (Association 1) with abundant ultramafic rocks and rare felsic volcanic rocks, and an upper sequence (Association 2) with only rare ultramafic rocks and abundant felsic volcanic rocks. The sequence of sedimentary, mafic and ultramafic rocks along the western side of the Yandal greenstone belt, the Mount McClure sequence described above, may correspond to the upper part of Hallberg's Association 1. The sequence in the east, particularly east of the Ockerburry Fault, may correspond to Hallberg's Association 2.

Mafic dykes (*Edy*)

The only exposed mafic dyke (*Edy*) that has been observed on DARLOT is a small body of dolerite which intruded granites about 1.5 km northwest of Corktree Mill. The dyke trends about 080° and the outcrop forms scattered, dark-brown, well-rounded, fresh boulders. In thin section, it is a fine- to medium-grained, holocrystalline, seriate-textured rock made up of plagioclase, subhedral to anhedral olivine, clinopyroxene and magnetite. It has an intergranular texture with plagioclase laths occurring in fan-like arrangements in some parts, and forming a trachytoid texture in others.

A major east–west magnetic feature across the middle of the sheet area has been interpreted as a Proterozoic dyke from comparison with similar features elsewhere in the Eastern Goldfields. However, a SHRIMP U–Pb zircon age of 2627 ± 6 Ma has been determined on a granophyric dyke (Nelson, 1998), interpreted as a felsic differentiate of a mafic dyke, on DEPOT SPRINGS (Wyche and Griffin, in prep.). This dyke coincides with the western extension of the prominent east–west magnetic feature on DARLOT. The geochronological data suggest an Archaean age for at least some of the mafic dykes. However, it is possible that the zircon age reflects the age of the granitoid rock that the dyke has intruded on DEPOT SPRINGS.

Palaeozoic geology

Permian sedimentary rocks (*Psc, Psh*)

Areas of Permian rocks have been mapped in the northern and western parts of the sheet area. These rocks have been correlated with the Paterson Formation of the Officer Basin in previous studies (MacLeod, 1969; Bunting and Williams, 1979). The most extensive exposures are around Ockerburry Hill where a Permian sequence of conglomerate, sandstone and mudstone is locally well exposed. Away from Ockerburry Hill, the Permian is typically represented by float of mainly granitoid boulders, which are probably erosional remnants of a tillite unit. Recent mineral exploration drilling in the southwest suggests that there may be a more extensive Permian sequence under Cainozoic cover in the vicinity of the Ockerburry Fault.

Polymictic conglomerate (*Psc*) occurs mainly as a boulder float on low, rounded hills. Clasts can be more than a metre across, and are commonly faceted. Most are composed of granitoid rock and include foliated, massive, porphyritic and non-porphyritic varieties. Other clasts are composed of felsic and mafic volcanic rock, metasedimentary rock including banded iron-formation and chert, and vein quartz. The conglomerate appears to overlie a fine- to medium-grained, poorly sorted, medium-bedded, immature, quartz-rich sandstone but the relationship is not clear in outcrop. In a good exposure in a breakaway east of Ockerburry Hill (AMG 118169), deeply weathered conglomerate consists of granitoid clasts in a poorly sorted, crudely bedded, silty to sandy matrix. There is a disconformity between the conglomerate and the overlying thinly bedded claystone and siltstone unit (Fig. 13). The poor sorting, the faceting of the clasts, and the wide variety of clast types which include banded iron-formation and several types of granitoid rock, none of which are found in outcrop in the surrounding region, suggest that the conglomerate is a glacial deposit.

Claystone and siltstone (*Psh*) disconformably overlie the conglomerate. The succession was described by MacLeod (1969), and consists of thinly bedded to laminated siltstone overlain by well-bedded sandy claystone, mudstone, and siltstone. The total thickness is about 50 m. An outcrop 2.5 km east-southeast of Ockerburry Hill (AMG 116168) contains well-developed, ribbon-like, sinuous trace fossils in bedding planes; scattered, monaxon-type sponge spicules; and fragments of an organism with regular rows of very fine nodules (10 rows to 1 mm). These fragments may represent decalcified moulds of a thin, sheet-like bryozoan. This fossil assemblage suggests that the rock is younger than early Ordovician, and is consistent with a Permian age (Webby, B. D., 1996, pers. comm.). The lower part of this unit contains distinctive and spectacular liesegang banding and is known as 'Weebo Stone'.

The claystone and siltstone unit outcrops in gently undulating but mainly flat-topped hills east of Ockerburry Hill. However, at the southern end of the outcrop, there is a series of small, north-trending strike ridges with shallow to moderate dips (≤45°) to the east and to the west. Some of the material here appears to have a weak tectonic fabric, but as all of the rock is deeply weathered, this cannot be confirmed.

Figure 13. Disconformity between Permian conglomerate and overlying mudstone west of Ockerburry Hill (AMG 118169)

Cainozoic geology

DARLOT is dominated by a relatively stable, ancient landscape developed on deeply weathered rock. Consolidated and unconsolidated Cainozoic regolith units are widespread. Most of these units have been developing since the Tertiary and include a veneer of unconsolidated Quaternary material. The type of Cainozoic unit, including its distribution and thickness, are closely related to the landform and the source material. For example, ferruginous units are common in areas of greenstone. The Cainozoic units on DARLOT can be broadly classified into four categories: residual, proximal depositional, distal depositional, and active alluvial.

Residual varieties, developed on weathered rock, include lateritic duricrust (*Czl*), massive ironstone ridges and cappings (*Czli*), silica caprock developed over ultramafic rocks (*Czu*), and areas of residual sand and soil over granitoid (*Czg*). Duricrust units over mafic greenstones are commonly ferruginous with a reddish-brown to black colour, whereas those on granitoid are usually silica-rich and paler in colour. Silcrete (*Czz*) is a hard, siliceous crust containing angular quartz grains and silicified breccia, and is developed over granitoid, felsic volcanic and sedimentary rocks.

Proximal depositional units are the colluvial deposits on slopes and low hills. They include degraded lateritic duricrust and massive ironstone rubble (*Czf*) in iron-rich source areas; and colluvial deposits of gravel and sands as sheetwash and talus (*Czc*), which are locally dominated by quartz vein rubble and debris (*Czcq*).

Distal depositional deposits contain significant clay and fine sand and can form extensive sheetwash fans (*Cza*). Extensive sandplains (*Czs*) are dominated by unconsolidated red, quartz-rich sand and typically overlie granitoid rocks. Where dunes are present, they are stable and well-vegetated with spinifex and a variety of small trees and shrubs.

There are deposits of saline and gypsiferous evaporites, clay, and sand (*Czp*) in Lake Darlot, and sand, silt, clay, and gypsum (*Czd*) form stabilized dunes in and around the lake. The drainage basin associated with the Darlot lake system contains areas of calcrete (*Czk*) deposition, and eolian and alluvial sheets and dunes made up of sand, silt, and clay (*Czb*). These deposits are cut by both ancient and present drainage channels resulting in a strongly reticulated land surface, leaving a series of mounds, typically only a few metres high, covered in dense vegetation. These remnant mounds produce a distinctive pattern that is clearly visible on aerial photographs and satellite images. This pattern has a west-northwesterly trend, and is most evident in the area south of Lake Darlot. Scattered throughout the Czb unit are numerous small claypans of which only the larger bodies have been delineated. This material and the associated lake deposits define the channel of the Carey Palaeoriver (Hocking and Cockbain, 1990).

Active alluvial deposits (*Qa*) occupy both narrow and broad fluvial channels. Small claypans (*Qac*) may be part of the active system.

Economic geology

Gold

DARLOT covers parts of the Mount Malcolm District of the Mount Margaret Mineral Field and the Lawlers District of the East Murchison Mineral Field. The majority of the gold deposits and occurrences on DARLOT are grouped in the southern part of the sheet, within a 6 km arc north and west of Melrose Homestead. Descriptions of major and minor deposits in the area are contained in Ferguson (1998). The two main historical producers are the Darlot Group, including Monte Christo, Zangbar, and Filbandint, and the British King Group. The Dragon pit, the southernmost deposit of the Mount McClure line of workings, lies on the boundary between DARLOT and SIR SAMUEL. Production figures for the historical and more recent mining in the Darlot district are given in Table 1.

At Darlot, pits over the Monte Christo, Zangbar and Filbandint orebodies were combined into a single openpit. This pit has been mined out and underground mining commenced in late 1995. In October 1996,

Table 1. Gold production from the Darlot district to 31 December 1996 (from Department of Minerals and Energy records)

Mining centre	*Mine/project*	*Ore treated (t)*	*Total gold (kg)*	*Period*
Darlot group	Monte Christo	6 943	103.691	1902–1913
		13 077	29.742	1951–1966
		97	0.772	1980–1984
	Zangbar	21 678	262.012	1900–1918
		741	3.405	1946–1948
	Monte Christo/Zangbar	3 124 992	13 941.225	1989–1996
	Filbandint	1 015	28.556	1902–1906
	St George	927	248.804	1897–1936
	King of the Hills	2 379	61.621	1898–1914
	Waikato	4 440	163.010	1898–1906
Ballangarry		7 381	99.076	1898–1946
Amazon		3 912	195.497	1898–1913
British King		15 643	286.291	1898–1913
		1 115	34.452	1946–1951
		1 529	23.946	1977–1985
Darlot district total		**3 229 962**	**15 855.250**	**1898–1996**

Plutonic Resources Ltd announced the discovery of a major new deposit, Darlot Centenary, 1.2 km east of the mined-out Darlot openpit. This mine, with resource estimate of 8.4 Mt at 7.7 g/t Au in April 1997, will be worked as an underground operation (Gonnella, 1997).

The Darlot orebody consists of a laminated quartz reef occupying a shear zone about 1.3 km long. The reef strikes at about 320°, and has a shallow easterly dip. The deposit is hosted mainly in basalt and dolerite, with felsic to intermediate porphyritic rock, minor chert and felsic tuff in the hangingwall. Lamprophyre dyke swarms both pre- and post-date mineralization. Gold found in the quartz veins is coarse grained. The alteration halo around the quartz reef is made up of hematite and limonite clay in the weathered zone. Fresher rocks are silicified, with pyrite–quartz–carbonate–hematite alteration. The local weathering profile dips to the north and can extend to a depth of around 60 m (Fallon, M., and Smedley, B., Plutonic Resources Ltd, 1994, pers. comm.).

Quartz reefs also occupy a northwest-trending shear zone at Ballangarry. At British King, the main reef (up to 1.2 m thick in the old workings) runs east–west and dips to the south (Gibson, 1907). Jutson (1914) described a southwest-trending alluvial deep lead some 2 km west of the Darlot Group that was being worked to a depth of about 20 m.The auriferous material was found in angular and sub-angular fragments of quartz in a matrix of white clay.

An unrecorded amount of gold has been recovered from alluvial workings at Langfords Find (AMG 199522) in the northern part of the map sheet.

Nickel

Extensive exploration for ultramafic-hosted nickel–copper mineralization in the early 1970s, principally by Swiss Aluminium Australia Pty Ltd, failed to locate any notable prospects.

Volcanic-hosted massive sulfide deposits

The discovery, in 1976, of a copper–lead–zinc–silver deposit at Teutonic Bore, about 45 km south of DARLOT on WEEBO (Hallberg and Thompson, 1986), encouraged widespread interest in the search for volcanic-hosted massive sulfide deposits in felsic volcanic sequences throughout the Eastern Goldfields. However, exploration in the Yandal belt in the 1970s and early 1980s failed to locate significant anomalism. A key component in the development of volcanic-hosted massive sulfide deposits is a deep-water environment (Cas, 1992), whereas the best exposed felsic volcanic rocks on DARLOT at Spring Well, appear to be dominated by subaerial components.

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References

BEARD, J. S., 1990, Plant life of Western Australia: Kenthurst, N.S.W., Kangaroo Press, 319p.

BUNTING, J. A., van de GRAAFF, W. J. E., and JACKSON, M. J., 1974, Palaeodrainages and Cainozoic palaeogeography of the Eastern Goldfields, Gibson Desert and Great Victoria Desert: Western Australia Geological Survey, Annual Report 1973, p. 45–50.

BUNTING, J. A., and WILLIAMS, S. J., 1979, Sir Samuel, W.A.: Western Australia Geological Survey, 1:250 000 Geological Series Explanatory Notes, 40p.

CAS, R. A. F., 1992, Submarine volcanism: eruption styles, products, and relevance to understanding the host-rock successions to volcanic-hosted massive sulphide deposits: Economic Geology, v. 87, p. 511–541.

CAS, R. A. F., and WRIGHT, J. V., 1987, Volcanic successions, modern and ancient: London, Allen and Unwin, 528p.

FARRELL, T. R., 1997, Banjawarn, W.A. Sheet 3242 (1st edition plot): Western Australia Geological Survey, 1:100 000 Geological Series.

FERGUSON, K. M., 1998, Mineralization and geology of the Northeastern Goldfields: Western Australia Geological Survey, Report 63, 40p.

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA, 1996, Darlot, W.A. Sheet SG51–13 (3142): Western Australia Geological Survey, Total Magnetic Intensity Image.

GIBSON, C. G., 1907, The geology and mineral resources of Lawlers, Sir Samuel, and Darlot (East Murchison Goldfield), Mount Ida (North Coolgardie Goldfield) and a portion of the Mount Margaret Goldfield: Western Australia Geological Survey, Bulletin 28, p. 51–60.

GILES, C. W., 1980, A comparative study of Archaean and Proterozoic felsic volcanic associations in southern Australia: University of Adelaide, PhD thesis (unpublished).

GILES, C. W., 1982, The geology and geochemistry of the Archaean Spring Well felsic volcanic complex, Western Australia: Geological Society of Australia, Journal, v. 29, p. 205–220.

GONNELLA, P., 1997, Register of Australian Mining 1997/98: Perth, Western Australia, Resource Information Unit, p. 92.

GRIFFIN, T. J., 1990, Eastern Goldfields Province, *in* Geology and mineral resources of Western Australia: Western Australia Geological Survey, Memoir 3, p. 77–119.

HALLBERG, J. A., 1985, Geology and mineral deposits of the Leonora–Laverton area, northeastern Yilgarn Block, Western Australia: Perth, Hesperian Press, 140p.

HALLBERG, J. A., and GILES, C. W., 1986, Archaean felsic volcanism in the northeastern Yilgarn Block, Western Australia: Australian Journal of Earth Sciences, v. 33, p. 413–427.

HALLBERG, J. A., and THOMPSON, J. F. H., 1985, Geologic setting of the Teutonic Bore massive sulfide deposit, Archean Yilgarn Block, Western Australia: Economic Geology, v. 80, p. 1953–1964.

HOCKING, R. M., and COCKBAIN, A. E., 1990, Regolith, *in* Geology and mineral resources of Western Australia: Western Australia Geological Survey, Memoir 3, p. 590–602.

JUTSON, J. T., 1914, Darlot deep lead: Western Australia Geological Survey, Annual Report 1913, p. 24.

JUTSON, J. T., 1917, The deep lead at Darlot, East Murchison Goldfield: Western Australia Geological Survey, Bulletin 74, p. 58–64.

LANGFORD, R. L., and FARRELL, T. R., in prep., Duketon, W.A.: Western Australia Geological Survey, 1:100 000 Geological Series Explanatory Notes.

LIU, S. F., GRIFFIN, T. J., WYCHE, S., and WESTAWAY, J. M., 1996, Sir Samuel, W.A. Sheet 3042: Western Australia Geological Survey, 1:100 000 Geological Series.

LIU, S. F., GRIFFIN, T. J., WESTAWAY, J. M., and WYCHE, S., in prep., Sir Samuel, W.A.: Western Australia Geological Survey, 1:100 000 Geological Series Explanatory Notes.

LYONS, P., 1996, Wanggannoo, W.A. Sheet 3143: Australian Geological Survey Organisation, 1:100 000 Geological Series Map, preliminary edition.

MacLEOD, W. N., 1969, Geological aspects of the Weebo Stone: Western Australia Geological Survey, Record 1969/12, 6p.

MONTGOMERY, A., 1909, Report on the progress of mining in the district between Leonora and Wiluna: Western Australia Department of Mines, Report of the State Mining Engineer, p. 62–73.

MONTGOMERY, A., 1928, Report on deep alluvial lead at Lake Darlot: Western Australia Department of Mines, Report of the State Mining Engineer, 9p.

NELSON, D. R., 1997, Compilation of SHRIMP U–Pb zircon geochronology data, 1996: Western Australia Geological Survey, Record 1997/2, 189p.

NELSON, D. R., 1998, Compilation of SHRIMP U–Pb zircon geochronology data, 1997: Western Australia Geological Survey, Record 1998/2, 242p.

OVERSBY, B. S., 1995, Weebo, W.A. Sheet 3141: Australian Geological Survey Organisation, 1:100 000 Geological Series Map, preliminary edition.

SMITHIES, R. H., and CHAMPION, D. C., in prep., Geochemistry of felsic igneous alkaline rocks in the Eastern Goldfields, Yilgarn Craton, Western Australia: implications for late Archaean tectonic evolution: Journal of the Geological Society of London.

SWAGER, C. P., GRIFFIN, T. J., WITT, W. K., WYCHE, S., AHMAT, A. L., HUNTER, W. M., and McGOLDRICK, P. J., 1995, Geology of the Archaean Kalgoorlie Terrane — an explanatory note: Western Australia Geological Survey, Report 48, 26p.

WYCHE, S., FARRELL, T. R., GRIFFIN, T. J., LANGFORD, R. L., LIU, S. F., and WESTAWAY, J. M., in prep., Geochemical analyses of Archaean greenstone and granitoid rocks, northern Eastern Goldfields Province, Western Australia: Western Australia Geological Survey, Record.

WYCHE, S., and GRIFFIN, T. J., in prep., Depot Springs, W.A. Sheet 2942 (1st edition plot): Western Australia Geological Survey, 1:100 000 Geological Series.

Appendix

Gazetteer of localities

Locality	*AMG(E)*	*AMG(N)*
Andy Well	339900	6916600
Ballangarry	333300	6908000
Boundary Well	306500	6927400
British King	326900	6908200
Corktree Mill	345100	6907600
Darlot gold mine	329700	6913500
Daylight Well	340200	6912800
Desperation Well	305200	6946600
Dragon	302700	6942500
Hamster prospect	308600	6952900
Hope Bore	315800	6929700
Jarrah Well	318900	6906100
Katherine Well	317000	6941400
Langfords Find	319900	6952200
Lilly Well	311900	6951000
Melrose Homestead	333100	6909500
Mica Mica Waterhole	317600	6919000
Mount Blackburn	335300	6947400
Mount Doolette	315600	6916200
Mount MacDonald	335500	6915700
Mount McClure[(a)]	301700	6939900
Mount Mundy	347500	6955800
Mount Von Mueller	319300	6925400
Ninnis Waterhole	324200	6950500
Ockerburry Hill	309200	6917600
Overland Well	312000	6912000
Paul Well	306200	6941300
Popes Patch	313000	6929500
Rosewood Bore	316800	6935400
Spring Well	318800	6913000
Wadarrah Rocks	318900	6935200
Warrida Well	304500	6910900
Yandal Homestead	317200	6949800
Yandal Lagoon	319000	6936500

NOTES: (a) on SIR SAMUEL — 3042

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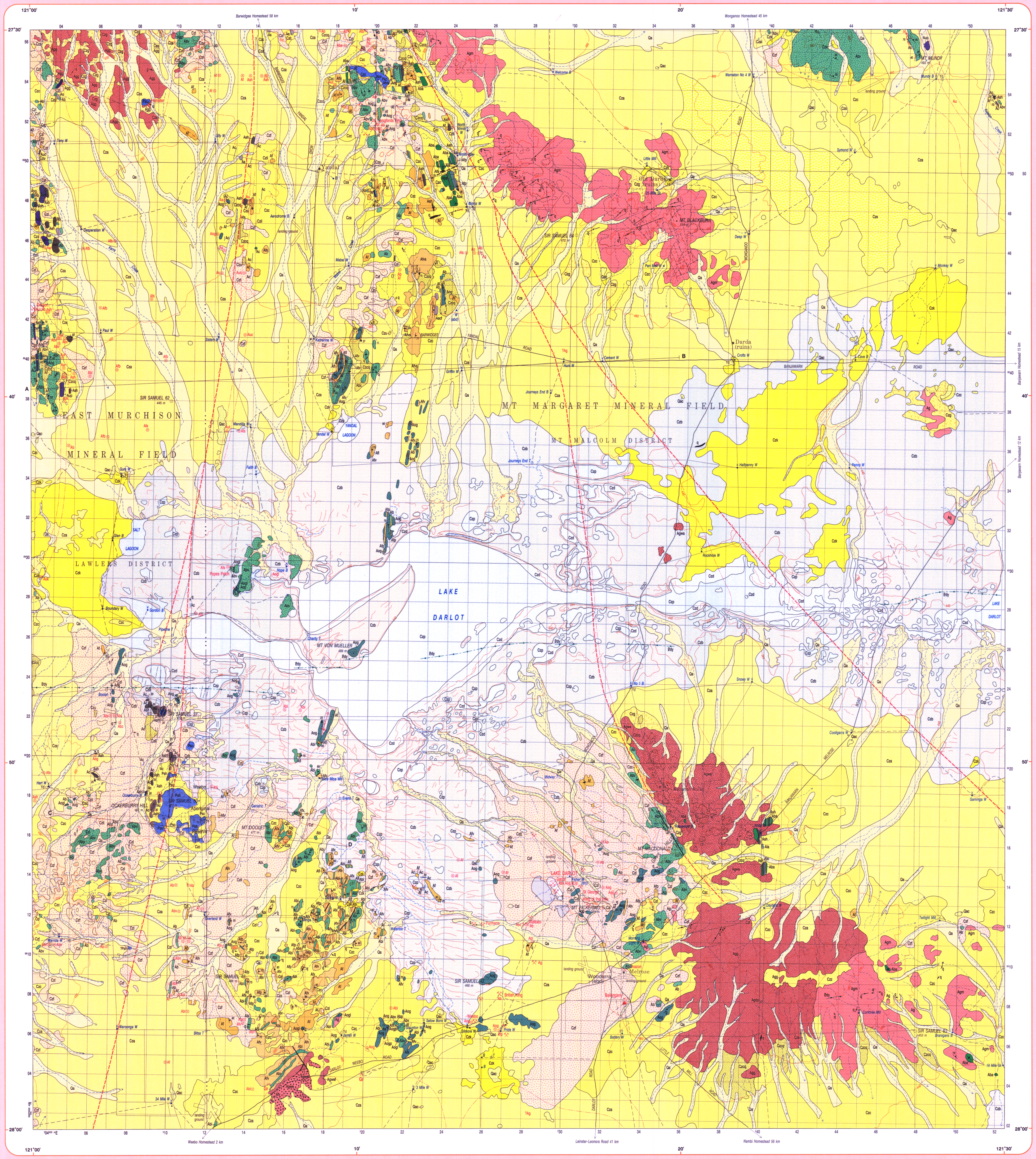
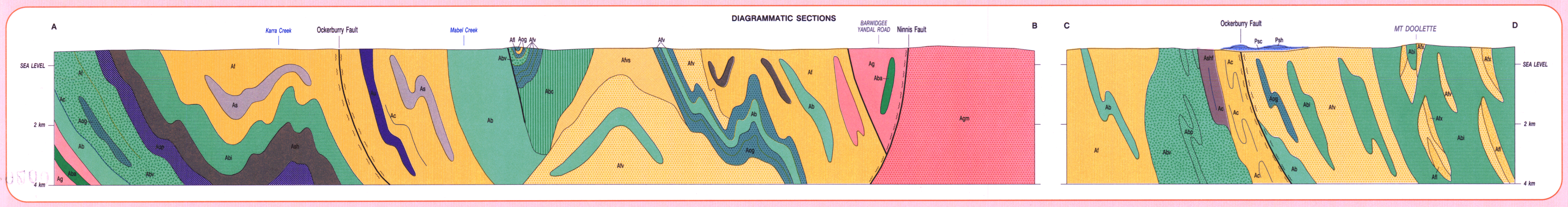
DARLOT

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SHEET 3142





Legend

PHANEROZOIC

CAINOZOIC — QUATERNARY

Qa — Alluvium — clay, silt, sand, and gravel in channels
Qac — Clay and silt in claypans

Czb — Ephemeral lake and dune deposits — clay, silt, and sand in drainage basins adjacent to playa lakes; numerous claypans and channels
Czd — Dune deposits — sand, silt, gypsum, and carbonate as stabilized dunes adjacent to playa lakes
Czp — Playa deposits — saline and gypsiferous evaporites, clay, and sand in playa lakes
Cza — Sheetwash deposits — silt, sand, and gravel; red soil plains
Czs — Sandplain deposits — unconsolidated sand with minor silt and clay; includes low vegetated dunes
Czc — Colluvium — gravel, sand, and silt as sheetwash and scree
Czcq — Quartz vein debris
Czf — Ferruginous rubble and colluvium — ferruginous rock and ironstone rubble; degraded lateritic duricrust
Czg — Sand over granitoid rock — quartzo-feldspathic sand; includes areas of low, weathered outcrop

Czk — Calcrete
Czl — Lateritic deposits — lateritic duricrust and ferricrete; massive and rubbly
Czli — Massive ironstone as ridge and capping
Czu — Silica caprock over ultramafic rock
Czz — Silcrete

PALAEOZOIC — PERMIAN

Psc — Conglomerate; polymictic, poorly sorted; fluvioglacial deposit
Psh — Claystone and siltstone

PROTEROZOIC

Edy — Mafic dyke; interpreted from aeromagnetic data where dashed

ARCHAEAN

Veins and dykes: a — aplite, g — granitoid, lp — lamprophyre (subsurface only), p — granitoid pegmatite, q — quartz

Ag — Granitoid rock, undivided
Agdp — Porphyritic microdiorite
Agg — Granodiorite
Agm — Monzogranite; fine- to coarse-grained
Agwa — **WADARRAH QUARTZ MONZONITE:** hornblende quartz monzonite with local platy alignment
Agwe — **WEEBO GRANODIORITE:** granodiorite, coarse-grained phase
Agwef — Granodiorite, fine-grained phase

Ala — Amphibole-bearing metamorphic rock; generally layered

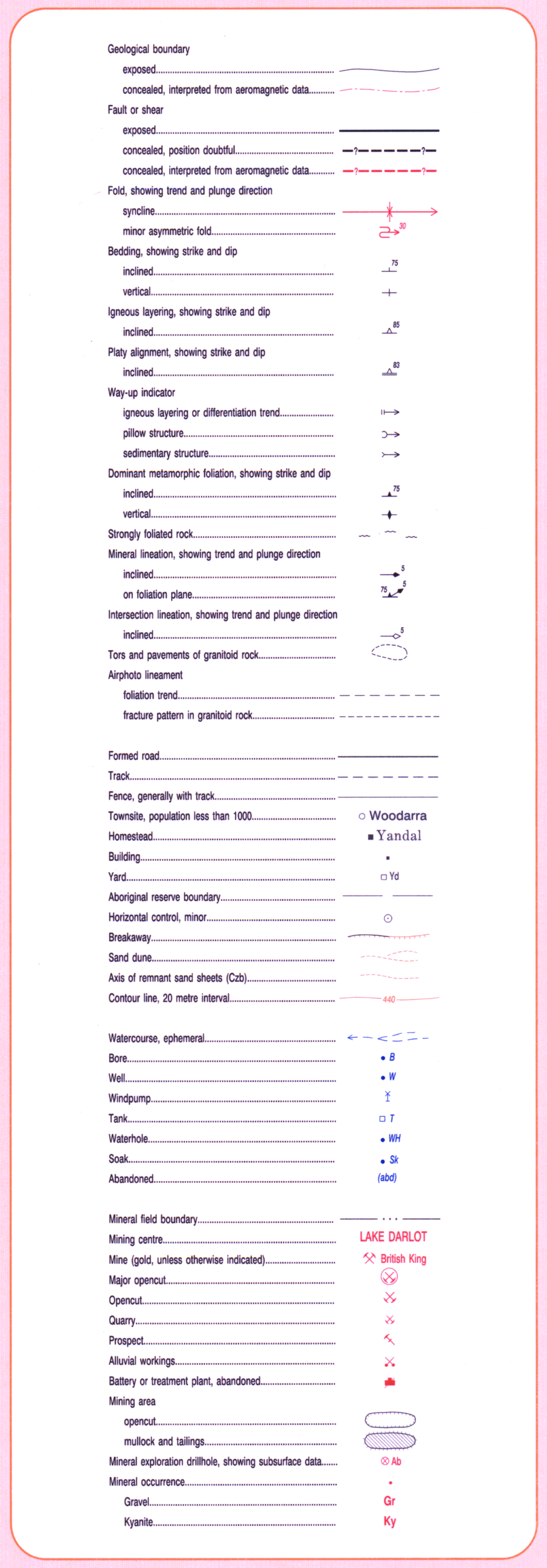
As — Metasedimentary rock, undivided; generally deeply weathered
Ascf — Conglomerate with felsic volcanic rock clasts; poorly sorted; metamorphosed
Ash — Shale and siltstone; metamorphosed; local andalusite, kyanite, or garnet porphyroblasts
Ashf — Shale and siltstone; local quartz phenocrysts; metamorphosed
Ac — Siliceous sedimentary rock and chert, mainly grey and white banded; locally ferruginous and/or pyritic; metamorphosed

Af — Metamorphosed felsic igneous, and clastic rocks, undivided; generally deeply weathered
Afb — Quartzo-feldspathic schist with biotite (subsurface only)
Afl — Felsic lapilli tuff; metamorphosed
Afp — Porphyritic felsic rock with quartz and feldspar phenocrysts; locally flow banded; metamorphosed
Afs — Felsic schist
Afv — Felsic volcanic and volcaniclastic rock; metamorphosed
Afvs — Bedded felsic volcaniclastic rock; minor felsic volcanic rock; metamorphosed
Afx — Felsic volcanic breccia; metamorphosed

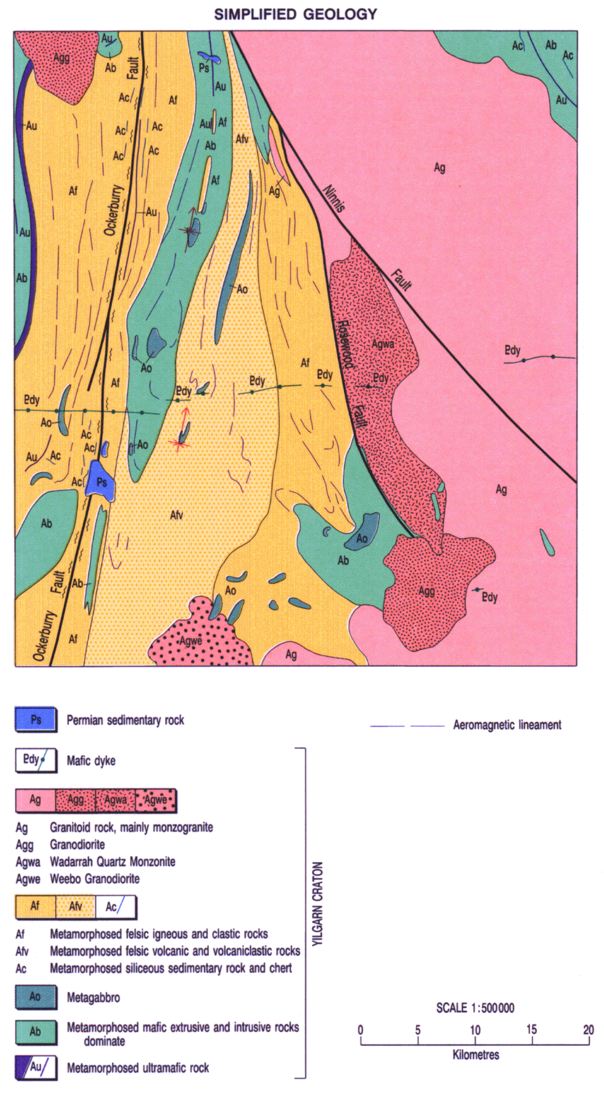
Aog — Gabbro; metamorphosed
Aogl — Leucogabbro and minor diorite; locally magnetite-rich; metamorphosed
Aogp — Plagioclase-phyric gabbro; metamorphosed
Aop — Porphyritic mafic dyke; metamorphosed

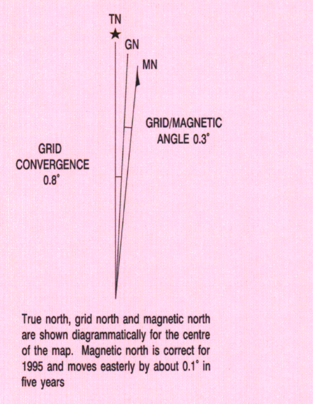
Ab — Metamorphosed fine- to very fine-grained mafic rock, undivided; generally deeply weathered
Aba — Amphibolite
Abc — Mafic rock, strongly carbonated
Abe — Epidotized basalt; metamorphosed (subsurface only)
Abi — Basaltic andesite and andesite; locally intrusive; metamorphosed
Abm — High-Mg basalt; pyroxene spinifex texture; metamorphosed
Abp — Basalt, coarsely plagioclase-phyric; metamorphosed
Abv — Basalt; mainly tholeiitic, locally doleritic; moderately to strongly foliated; metamorphosed

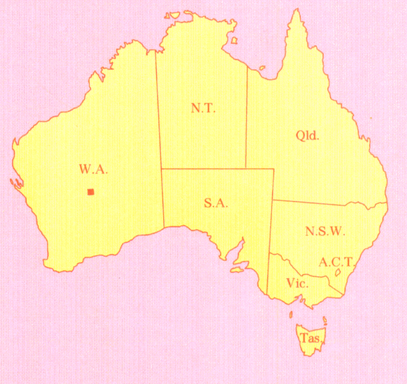
Au — Metamorphosed ultramafic rock, undivided; generally deeply weathered
Auc — Talc-carbonate rock; schistose
Auk — Komatiite; olivine spinifex texture; metamorphosed (subsurface only)
Aup — Serpentinized peridotite; common relict cumulate texture
Aur — Tremolite-chlorite(-magnetite) schist; includes foliated metakomatiite
Aut — Talc-chlorite(-carbonate) rock; commonly schistose (subsurface only)

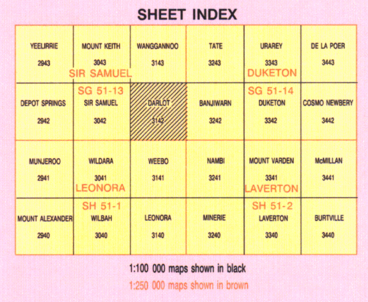


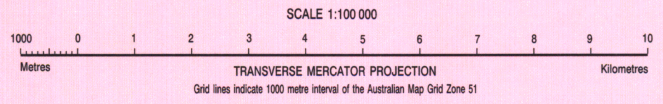
SIMPLIFIED GEOLOGY











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NGMA

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