EXPLANATORY NOTES

GOVERNMENT OF WESTERN AUSTRALIA

DUKETON
1:250 000 SHEET
WESTERN AUSTRALIA
SECOND EDITION

1:250 000 GEOLOGICAL SERIES

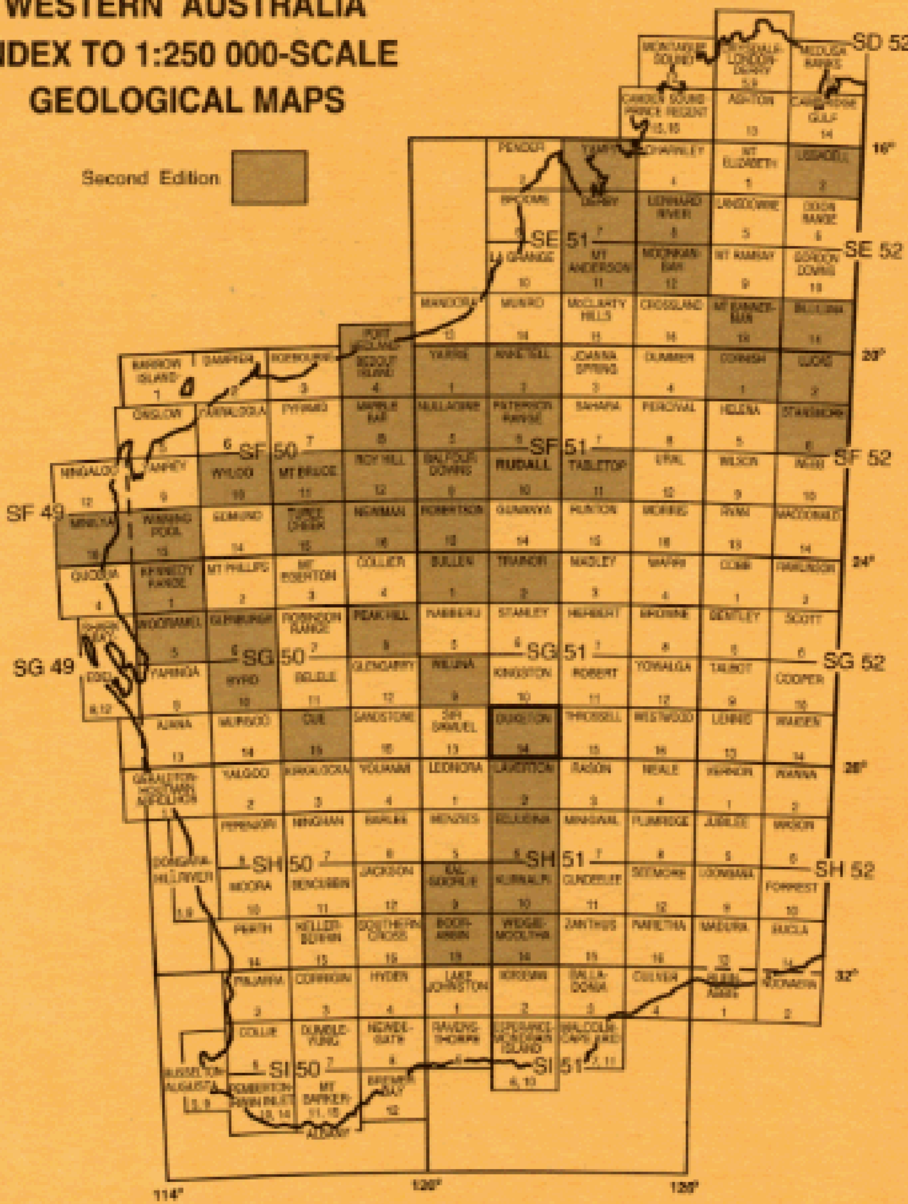
SHEET SG 51-14 INTERNATIONAL INDEX

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

DEPARTMENT OF MINERALS AND ENERGY

WESTERN AUSTRALIA
INDEX TO 1:250 000-SCALE GEOLOGICAL MAPS

Second Edition



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GEOLOGICAL SURVEY OF WESTERN AUSTRALIA
1:250 000 GEOLOGICAL SERIES — EXPLANATORY NOTES

DUKETON

WESTERN AUSTRALIA

SECOND EDITION

SHEET SG 51-14 INTERNATIONAL INDEX

by
T. R. FARRELL

Perth, Western Australia 2001

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The Hon. Clive Brown MLA

DIRECTOR GENERAL

L. C. Ranford

DIRECTOR, GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

Tim Griffin

Copy editor: D. P. Reddy

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Information Centre
Department of Minerals and Energy
100 Plain Street
EAST PERTH, WESTERN AUSTRALIA 6004
Telephone: (08) 9222 3459 Facsimile: (08) 9222 3444
www.dme.wa.gov.au

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by T. R. Farrell

INTRODUCTION

The DUKETON* 1:250 000 geological sheet (SG 51-14) is bounded by latitudes 27°00'S and 28°00'S, and longitudes 121°30'E and 123°00'E. The sheet covers an area in the Eastern Goldfields region, about 70 km north of the town of Laverton (Fig. 1). The map is named after the Duketon mining centre in the southern-central part of the area.

Access to the area is by graded roads from Laverton in the south, Leonora to the west, and Lake Wells and Prenti Downs in the northeast and north respectively. Station tracks and numerous mineral exploration gridlines provide good access to most areas underlain by greenstone, but access to areas underlain by granitoid rocks is difficult due to the scarcity of tracks.

The sheet area is sparsely populated. The only permanent settlements are small aboriginal communities at Cosmo Newbery† and Mulga Queen, and the pastoral stations of Banjawarn, North Bandya, and Deleta (Fig. 2).

PHYSIOGRAPHY, CLIMATE, AND VEGETATION

DUKETON is typically flat to undulating, ranging in altitude from about 450 m Australian Height Datum (AHD) around Lake Wells (in the northeast) and Lake Darlot (in the southwest), to about 580 m in the northwest (Fig. 2). The main physiographic features are the Lake Darlot and Lake Wells saline drainage basins, and a subdued northwesterly trending topographic high that marks the drainage divide between the two lake systems. The drainage divide is marked by a series of prominent breakaways in the Grant Duff and Sandstone ranges, and by a number of prominent hills (Fig. 2).

The landscape on DUKETON is largely the result of erosion of a deeply weathered Tertiary land surface (the Old Plateau of Jutson, 1950). The northeastern half of DUKETON is characterized by an undulating sandplain over the Tertiary surface. There are small breakaways in areas of recent erosion, and the present-day drainage consists of ephemeral watercourses that dissipate into the sandplain.

In the southwestern half of DUKETON, the Tertiary land surface has largely been removed by recent erosion, exposing low hills of rocky outcrops and breakaways along the margins of plateau remnants. Extensive areas of colluvium and sheetwash derived from erosion of

* Capitalized names refer to standard 1:250 000 map sheets, unless otherwise indicated.

† Australian Map Grid (AMG) coordinates of localities on DUKETON mentioned in the text are listed in the Appendix.

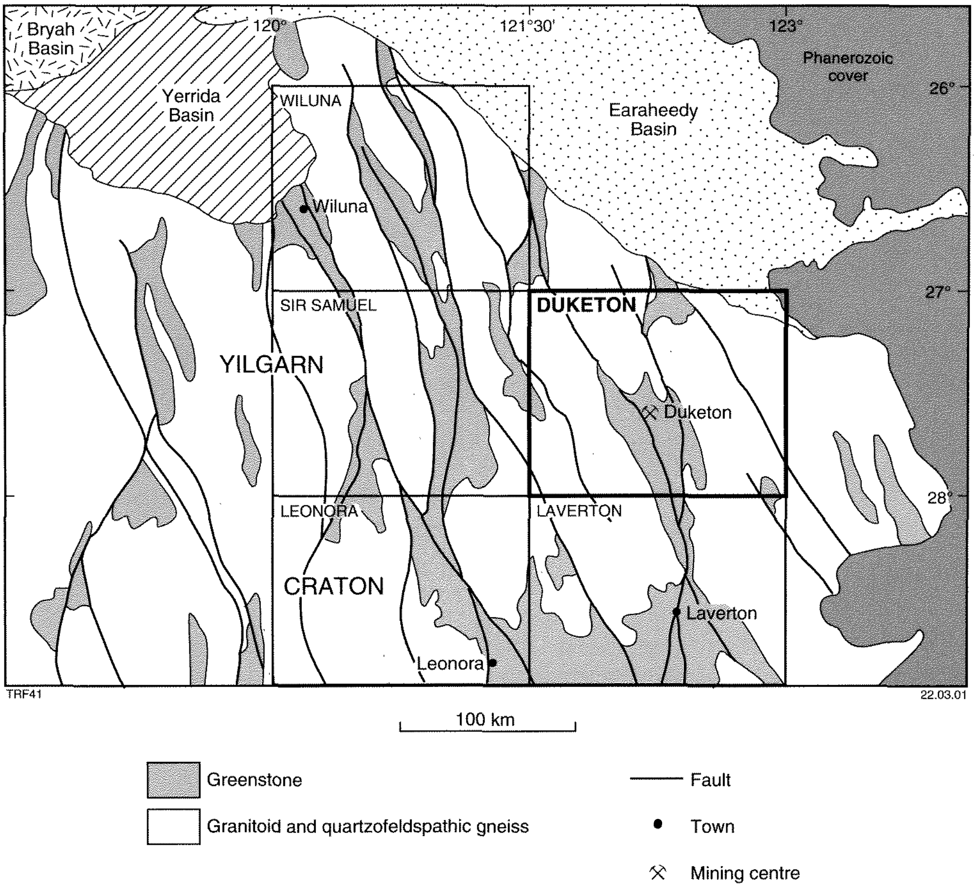

Figure 1. Regional geological setting of DUKETON (modified from Myers and Hocking, 1998)

the Tertiary land surface occupy broad, poorly defined drainage systems that feed into the Lake Darlot – Lake Carey (on LAVERTON) system to the south.

The region is semi-arid to arid, with an average annual rainfall of about 230 mm*. Rainfall tends to be sporadic and varies markedly from year to year. The summers are hot, with temperatures commonly in excess of 40°C, whereas the winters are mild with occasional frosts and an average maximum temperature in July of 17–18°C.

The following description of the vegetation on DUKETON is drawn mainly from Beard (1990). DUKETON straddles the boundary between the Murchison Region and Great Victoria Desert Region of the Eremaean Botanical Province (Beard, 1990). The western two-thirds of the sheet lies in the Murchison Region, which is characterized by extensive low woodland with open areas adjacent to salt lakes and over granitoid rocks. Vegetation on areas of alluvium and sheetwash is dominated by mulga (*Acacia aneura*) woodland with a variety of small shrubs (mainly *Cassia* and *Eremophila*), and various grasses and ephemeral herbs. Small trees (including *Eucalyptus camaldulensis* and *Casurina obesa*) grow adjacent to the larger

* Climate data from Commonwealth Bureau of Meteorology website, 2001.

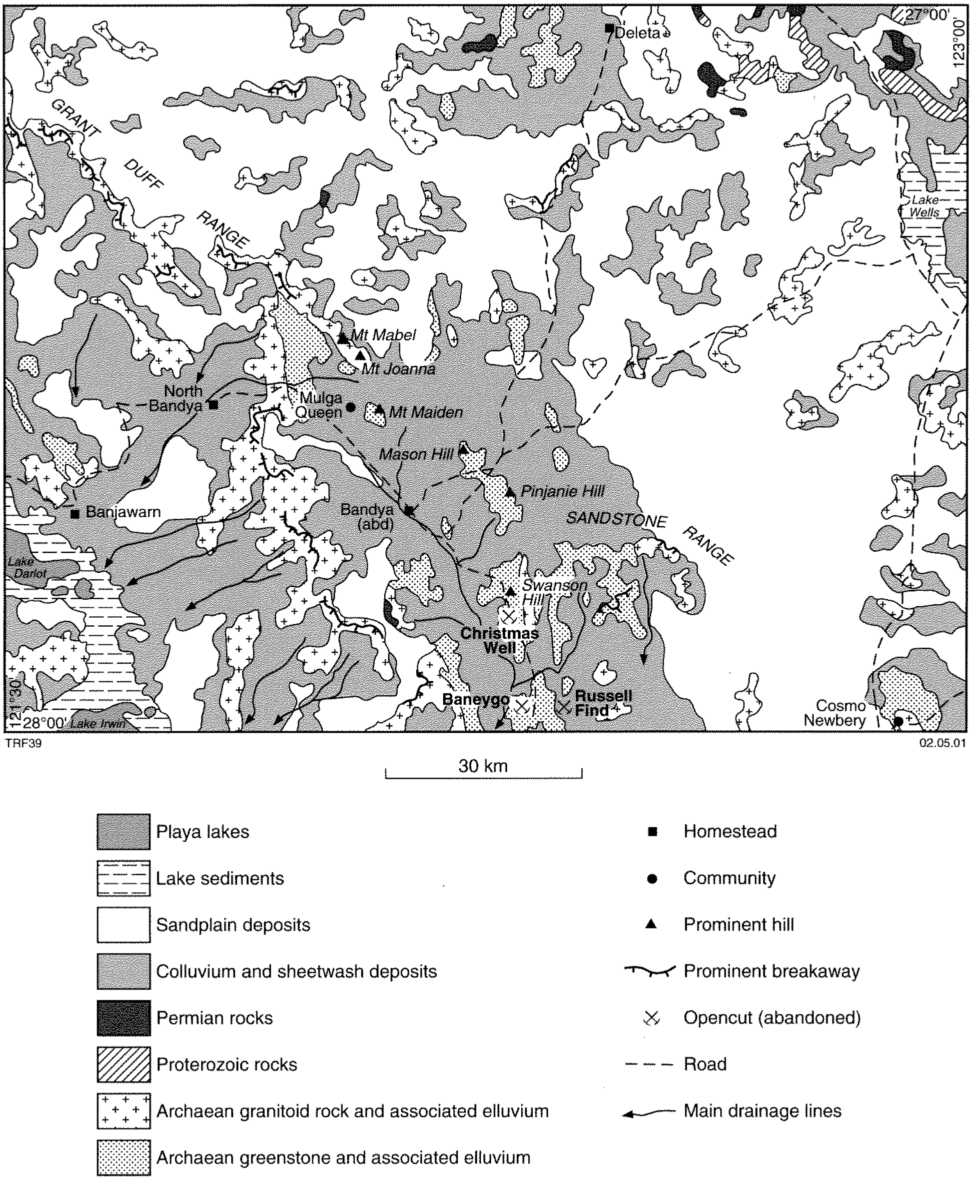

Figure 2. Physiography and simplified Cainozoic geology of DUKETON

watercourses. The vegetation in areas of outcrop typically consists of mulga scrub with *A. quadrimarginea*, *A. ramulosa*, *A. grasbyi*, and a variety of shrubs (including *Eremophila* and *Cassia* species). Spinifex (*Triodia basedowii*) and marble gum (*Eucalyptus gongylocarpa*) grow in sandy areas. Salt-tolerant plants, including saltbush (*Atriplex* species), bluebush (*Maireana* species), and samphire (*Halosarcia* species), are present in open, low-lying areas around lake systems.

The eastern third of DUKETON lies within the Great Victoria Desert Region (Beard, 1990). This area is dominated by open country of extensive sandplains covered by spinifex (*Triodia* *basedowii*), and scattered stands of marble gum (*Eucalyptus gongylocarpa*) and mallee (mainly *Eucalyptus youngiana*).

PREVIOUS INVESTIGATIONS

Early geological investigations on DUKETON were mainly on individual gold mines (Burt, 1899; Montgomery, 1905; Gibson, 1906a,b; Cleland, 1910; Honman, 1917; Clarke, 1919). The earliest geological maps covering the area were reconnaissance maps by Talbot (1920, 1926) and Clarke (1925). Hobson and Miles (1950) produced the first map of the Duketon greenstone belt, and carried out some petrological work. Bunting and Chin (1977, 1979) produced the first edition of the 1:250 000 geological sheet, and provided the first systematic description of the rocks in the area.

The area was remapped at 1:100 000 scale in the 1990s by the Geological Survey of Western Australia (GSWA) and the Australian Geological Survey Organisation (AGSO). Maps covering the northern half of DUKETON were published by AGSO: TATE (Champion, 1996), URAREY (Champion and Stewart, 1996), and DE LA POER (Stewart, 1996). The map sheets on the southern half were published by GSWA: BANJAWARN (Farrell, 1997a), DUKETON (Farrell and Langford, 1996), and COSMO NEWBERY (Griffin and Farrell, 1998).

Mineral occurrences on DUKETON are summarized in Ferguson (1998), and brief descriptions of aspects of the geology, exploration, and mineralization of various small parts of the area, mainly in the greenstone belts, can be found in open-file statutory mineral exploration reports held in the Department of Minerals and Energy (DME) library. Langford (1995) described felsic lavas at Mason Hill, and Bell (1980) gave a brief account of the zinc(–lead) mineralization in that area. Published works on the structural geology of parts of DUKETON include Farrell (1995, 1997b), Harris et al. (1997), and Langford and Farrell (1998).

NOMENCLATURE

All greenstones on DUKETON have undergone low- to medium-grade metamorphism. In many cases, primary textures are preserved and it is commonly possible to identify the parent rock. In view of this, igneous or sedimentary terminology has been used wherever possible. Metamorphic rock names have only been used in areas where the rocks have been extensively recrystallized and the protolith is not clear.

The nomenclature of the igneous rocks largely follows the recommendations of the International Union of Geological Sciences (Le Maitre et al., 1989). On DUKETON, komatiite refers to ultramafic rocks with a platy olivine-spinifex texture, and komatiitic basalt refers to mafic volcanic rocks with varioles or a relict pyroxene-spinifex texture (cf. Arndt and Nisbet, 1982).

REGIONAL GEOLOGICAL SETTING

Duketon covers an area of Archaean granite–greenstone terrain on the northeastern margin of the Yilgarn Craton, as well as a small section of the Proterozoic Earaheedy Basin (Figs 1 and 3). Much of the bedrock geology is obscured by various Cainozoic regolith deposits. The granite–greenstone terrain is part of the c. 2.7 Ga Eastern Goldfields Province (Gee et al., 1981; Griffin, 1990), which comprises elongate belts of deformed and

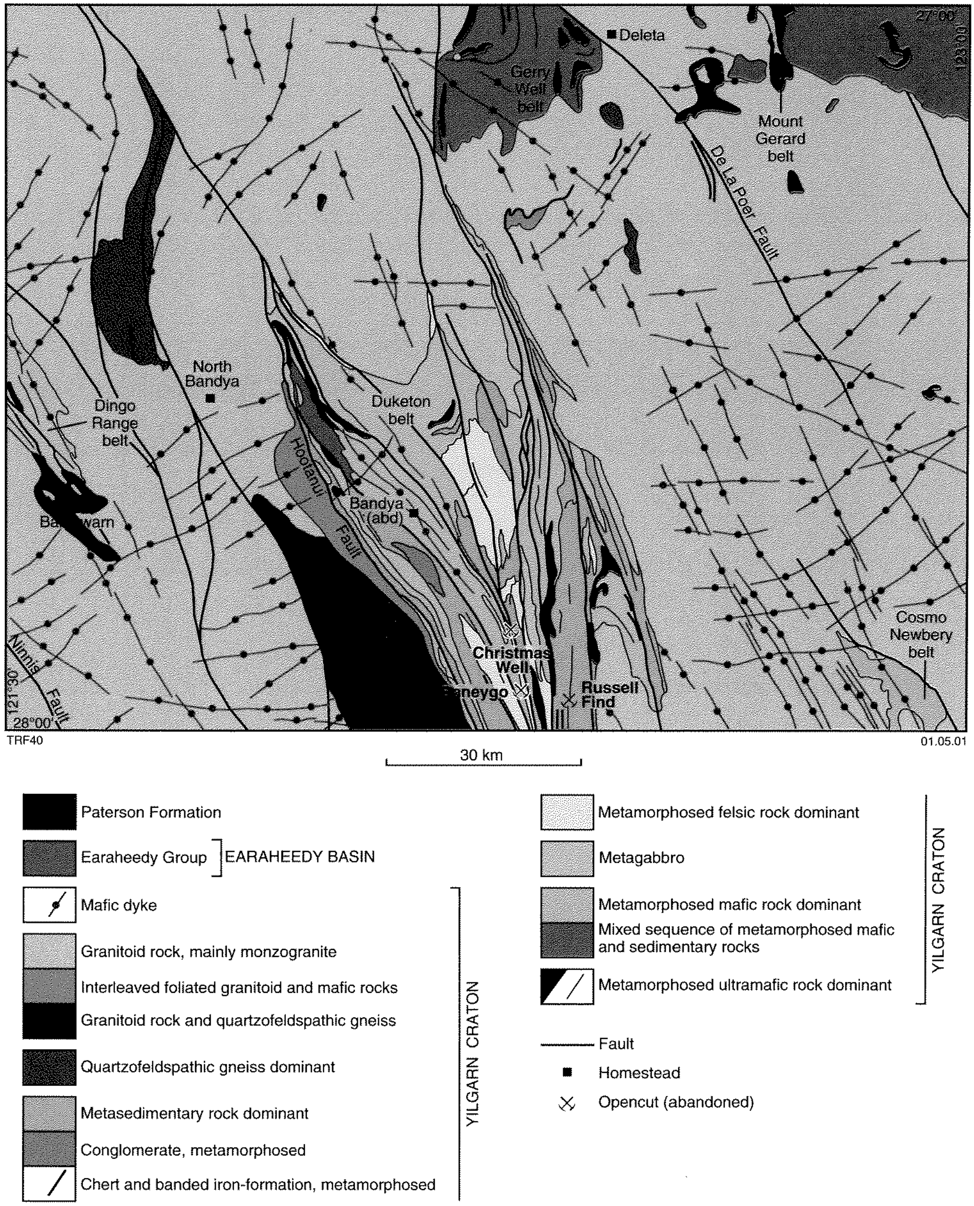

Figure 3. Simplified geological map of DUKETON

metamorphosed volcano-sedimentary rocks, and large intervening areas of granitoid rock and quartzofeldspathic gneiss. The Earaheedy Basin unconformably overlies the Yilgarn Craton in the northeast (Fig. 1), and contains a sequence of shallow-marine, clastic and chemical sedimentary rocks, thought to be deposited in a passive-margin setting (Pirajno et al., 2000).

To the east, the Yilgarn Craton and Earaheedy Group are overlain by Phanerozoic sedimentary rocks of the Gunbarrel Basin (formerly part of the Officer Basin; Hocking

Table 1. Summary of the geological history of DUKETON

Age (Ma)	*Tectonic event*
c. 2750–2700	?Deposition of early greenstone succession (greenstones of this age elsewhere in north Eastern Goldfields)
2697 ± 6	Intrusion of granitoid precursor to quartzofeldspathic gneiss; western side of Duketon greenstone belt
	D_1 deformation: tight to isoclinal folding in gneisses; possible foliation in some greenstones
	?Deposition of greenstones
c. 2685–2655	D_2 deformation: strong foliation parallel to granite–greenstone contact; main phase of granitoid intrusion
	Uplift and erosion of granitoids; deposition of conglomerate in Duketon greenstone belt
2650–2635[a]	Late-stage granitoids; syenite to diorite and low-Ca monzogranite
c. 2640[a]	D_3 deformation: north to northwesterly trending shear zones and upright folds
	D_4 deformation: kink folds and crenulations
c. 2400	Intrusion of Palaeoproterozoic mafic dykes
c.1850–1800	Deposition of Earaheedy Group in a passive-margin setting
?c. 290	Deposition of Paterson Formation

SOURCE: (a) Nelson (1997, 1998)

1994). There are scattered outliers of the Gunbarrel Basin succession in the northeastern corner of DUKETON.

PRECAMBRIAN GEOLOGY

Greenstone belts in the north Eastern Goldfields Province contain a wide range of rocks, including ultramafic, mafic, and felsic volcanic and volcaniclastic rocks; chert; banded iron-formation (BIF); clastic sedimentary rocks; and local areas of conglomerate that postdate the main greenstone sequences. Zircon U–Pb sensitive high-resolution ion microprobe (SHRIMP) geochronology data indicate that the greenstones were deposited between c. 2750 and c. 2660 Ma (Kent and Hagemann, 1996; Nelson, 1997, 1998). The rocks were subsequently deformed and metamorphosed at grades ranging from prehnite–pumpellyite to amphibolite facies (Binns et al., 1976).

Four regional Archaean deformation events (D_1–D_4) have been recognized in the north Eastern Goldfields Province (Hammond and Nisbet, 1992; Farrell, 1997b; Table 1). Evidence of an early deformation is locally preserved in c. 2750–2700 Ma quartzofeldspathic gneisses adjacent to greenstones (Farrell, 1997b), but the nature of this event is unclear. The second deformation coincided with extensive granitoid intrusion at c. 2685–2655 Ma, and was followed by a period of granitoid magmatism after c. 2650 Ma, including a suite of alkaline rocks (Smithies and Champion, 1999). The granitoid rocks range in composition from diorite to granite, but monzogranite is by far the most abundant rock type. The third deformation event occurred at c. 2640 Ma, within a broadly

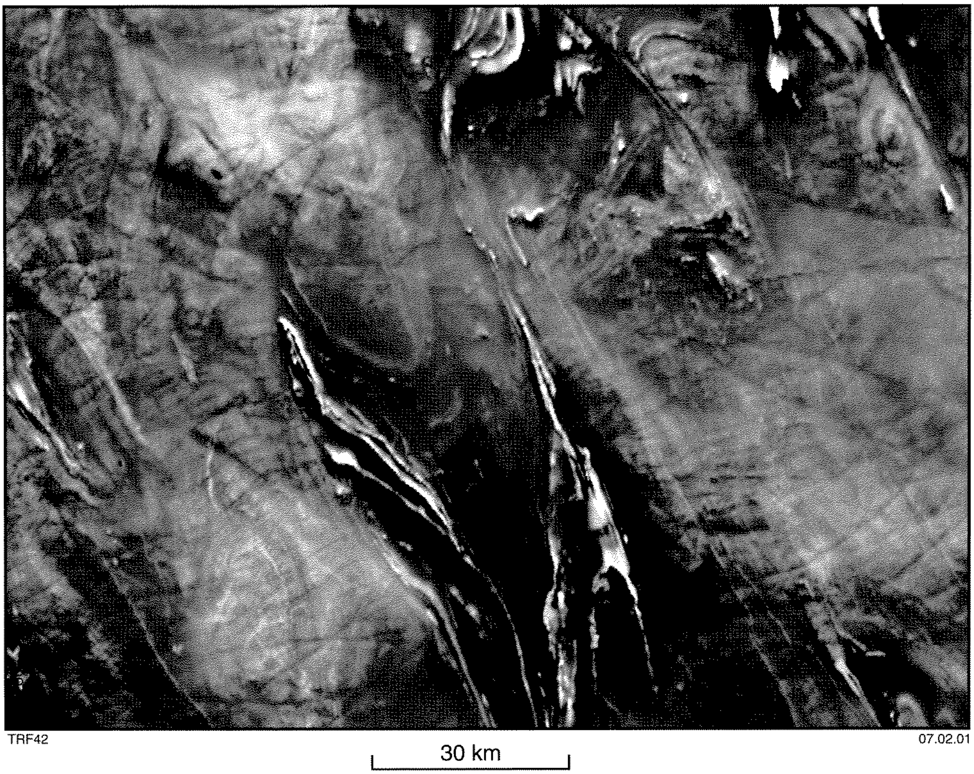

Figure 4. Grey-scale image of total magnetic intensity for DUKETON (400 m line spacing, data from AGSO and GSWA, 1994)

east–west compressional regime, and resulted in the development of major, northerly to northwesterly trending shear zones subparallel to the greenstone belts. This was followed by late-stage crenulation and kinking of all earlier structures. Numerous late faults and fracture zones cut across all Archaean structures. The faults correspond to prominent aeromagnetic lineaments, and many are intruded by Palaeoproterozoic mafic–ultramafic dykes (Hallberg, 1987) or quartz veins.

There are five greenstone belts on DUKETON (Fig. 3): the Cosmo Newbery, Dingo Range, Duketon, Gerry Well, and Mount Gerard greenstone belts (Griffin, 1990), as well as small rafts of greenstone within granitoid rocks. All the greenstone sequences in the region are poorly exposed, and much of the interpreted geology is based on data obtained from mineral exploration drilling programs and regional-scale (400 m line-spacing) aeromagnetic surveys (Fig. 4).

COSMO NEWBERY GREENSTONE BELT

The Cosmo Newbery greenstone belt lies in the southeastern corner of DUKETON. The belt is relatively small in size (less than 80 km^2) and contains a well-exposed, metamorphosed sequence of basalt and gabbro, with minor ultramafic rock (Bunting and Chin, 1979; Griffin and Farrell, 1998). The age of the greenstones is not known, and there is little published work on the geology of the belt.

DINGO RANGE GREENSTONE BELT

The Dingo Range greenstone belt, which extends onto the western side of DUKETON from SIR SAMUEL (Fig. 3), contains a metamorphosed mafic–ultramafic sequence with thin interbeds of chert and BIF (Farrell, 1997c). In the part of the belt exposed on DUKETON, the metamorphic grade reaches upper amphibolite facies, and the dominant rock type is a fine- to medium-grained amphibolite. Thin units of tremolite–chlorite schist and strongly deformed metamorphosed felsic rock are abundant. There are also rare layers of metamorphosed komatiite. The age of the Dingo Range greenstone belt is unknown.

DUKETON GREENSTONE BELT

The northern end of the Duketon greenstone belt (Langford and Farrell, 1998) occupies a large area in the south-central part of DUKETON (Fig. 3). The belt contains a varied assemblage of metamorphosed and heterogeneously deformed volcano-sedimentary rocks, including chert, shale, sandstone, conglomerate, felsic volcanic and volcaniclastic rocks, basalt, gabbro, and ultramafic rocks. The central, and possibly stratigraphically youngest, part of the belt around the Duketon mining centre is dominated by felsic volcanic and volcaniclastic rocks. Conglomerate containing granitoid clasts near the western margin of the belt may be equivalent to the Jones Creek Conglomerate (Durney, 1972; Marston and Travis, 1976; Marston, 1978; Liu et al., 1998) of the Agnew–Wiluna belt on WILUNA. The age of the succession is unknown, although there are Pb–Pb model ages of 2864 to 2776 Ma for base metal mineralization in the Duketon area (Browning et al., 1987).

GERRY WELL GREENSTONE BELT

The Gerry Well greenstone belt is a poorly exposed and little-known greenstone succession in the central-northern part of DUKETON (Fig. 3). Exposed parts of the belt have weathered metamorphosed basalt, ultramafic rock, and BIF, with associated fine-grained sedimentary rocks (Stewart, 1999). The belt is possibly a continuation of the Duketon greenstone belt.

MOUNT GERARD GREENSTONE BELT

A small area of weathered and poorly exposed greenstone on the northern border of DUKETON contains tight to isoclinally folded, metamorphosed ultramafic rock, basalt, and BIF (Stewart, 1999). Little is known about this succession.

ARCHAEAN ROCK TYPES

Ultramafic rocks (*Au, Auc, Aud, Auk, Aup, Aur, Aut, Aux*)

Ultramafic rocks on DUKETON are separated into eight units — undivided metamorphosed ultramafic rock (*Au*), talc–carbonate schist (*Auc*), serpentinized dunite (*Aud*), metamorphosed komatiite (*Auk*), serpentinized peridotite (*Aup*), tremolite schist (*Aur*), talc–chlorite schist (*Aut*), and metamorphosed pyroxenite (*Aux*). Ultramafic rocks typically form thin, laterally extensive units or lenticular bodies. They commonly correspond to highs on aeromagnetic images (Fig. 4) due to the presence of abundant, fine-grained magnetite. In most cases, the ultramafic rocks are poorly exposed and deeply weathered. A distinctive, light-brown silica caprock (*Czu*) forms locally over extremely weathered ultramafic rock.

Undivided metamorphosed ultramafic rock (*Au*) includes deeply weathered, altered or deformed ultramafic rocks where the original rock type cannot be positively identified, or where there are several different ultramafic rock types in the one outcrop.

There are small, isolated exposures of talc–carbonate schist (*Auc*) in the Duketon and Gerry Well greenstone belts. The rock is well foliated, and typically has brown iron-oxide spots or cavities after weathered carbonates. Talc–carbonate schist is composed of talc, carbonates, minor chlorite, and finely dispersed iron oxides.

Serpentinized dunite (*Aud*), exposed in the Baneygo area in the southernmost part of the Duketon belt on DUKETON, is a fine- to medium-grained, weakly deformed rock with a well-preserved adcumulate texture. Primary olivine is completely replaced by serpentine-group minerals and minor amounts of talc, chlorite, and very fine grained magnetite.

Metamorphosed komatiite (*Auk*) has only been mapped in small areas in the Cosmo Newbery and Dingo Range greenstone belts. Near Banjawarn Homestead, in the Dingo Range belt, the komatiite has relict olivine-spinifex textures pseudomorphed by metamorphic chlorite, tremolite, and fine-grained magnetite.

Serpentinized peridotite (*Aup*) is common throughout the Duketon belt, and is best exposed in the Hootanui area at the northwestern end of the belt. There are also fresh exposures of peridotite in the Baneygo area, near the central-southern boundary of DUKETON. The rock is weakly deformed and has well-preserved mesocumulate and orthocumulate textures pseudomorphed by serpentine-group minerals. Fine-grained aggregates of magnetite, plus one or more of talc, tremolite, and chlorite, occupy the intercumulus areas, which were probably originally filled by pyroxene and magnetite.

Tremolite schist (*Aur*) is a widespread, but minor rock type in the Duketon and Dingo Range greenstone belts. The rock is typically well foliated with abundant acicular tremolite and lesser amounts of chlorite and fine-grained opaque minerals (mainly iron oxides). Vague relics of a medium-grained granular igneous texture are preserved in some rocks in the Duketon belt, and these are possibly metamorphosed pyroxenite. Thin layers of tremolite schist in the southernmost part of the Dingo Range belt are interpreted as deformed and metamorphosed thin flows of komatiitic basalt or ultramafic rock.

Strongly deformed talc–chlorite schist (*Aut*) is common in high-strain zones, particularly near granite–greenstone contacts, for example in the Murphy Hills near the south-central border of DUKETON (Langford and Farrell, 1998). The rock is soft, well foliated, typically fine grained, and contains various proportions of talc and chlorite, as well as minor amounts of carbonate and finely dispersed opaque minerals (probably magnetite).

A small body of metamorphosed pyroxenite (*Aux*) is exposed west of Biddy Well in the Dingo Range belt. The rock is fine to medium grained and weakly deformed, with needles of tremolite after pyroxene in a fine-grained tremolite-rich matrix. The pyroxenite is associated with amphibolite and talc-bearing schist.

Fine-grained mafic rocks (*Ab, Abdg, Aba, Abm, Abp, Abs, Aby*)

Mafic rocks are a major component of the greenstone sequences on DUKETON. Undivided, metamorphosed mafic rock (*Ab*) is widespread in the Duketon and Gerry Well greenstone belts, and includes deeply weathered and very fine grained mafic rocks, commonly with metamorphosed gabbro and thin interbeds of metasedimentary rocks. In the Cosmo Newbery greenstone belt, metamorphosed basalt is interleaved with abundant metagabbro (*Abdg*) at a scale too fine for the individual rock types to be shown separately on the map.

Amphibolite (*Aba*) is the dominant mafic rock type in areas of higher metamorphic grade. The rock consists mainly of acicular hornblende and plagioclase, and is typically well foliated with a strong lineation defined by the alignment of hornblende. In the Dingo Range belt, the amphibolite is typically interleaved with metagabbro and tremolite schist, and contains hornblende, plagioclase, and small amounts of clinopyroxene.

Metamorphosed komatiitic basalt (*Abm*) includes mafic volcanic rocks characterized by relict pyroxene-spinifex textures or varioles. The best exposure of komatiitic basalt is near the Christmas Well opencut in the Duketon belt. Here, the rock has a pyroxene-spinifex texture consisting of randomly oriented tremolite–actinolite pseudomorphs of igneous pyroxene in a fine-grained matrix of tremolite–actinolite, chlorite, epidote, albite, and fine-grained opaque minerals. Locally, the rock contains varioles up to 4 mm in diameter. The basalt is spatially associated with serpentinized peridotite, and metamorphosed gabbro and leucogabbro (Langford and Farrell, 1998).

Metamorphosed porphyritic basalt (*Abp*) in the Duketon belt contains sparse phenocrysts of plagioclase (up to 2 mm) in a fine-grained groundmass of amphibole, plagioclase, chlorite, and minor amounts of epidote and opaque minerals. This rock type is common in the greenstone sequence, but only locally forms mappable units.

Minor mafic rock types also include chlorite-rich mafic schist (*Abs*), in the Cosmo Newbery belt, and metamorphosed amygdaloidal basalt (*Aby*) in the Duketon belt. The amygdaloidal basalt contains small vesicles, less than 6 mm in size, filled with various proportions of quartz, epidote, and actinolite.

Medium- to coarse-grained mafic rocks (*Ao, Aog*)

Metamorphosed medium- to coarse-grained mafic rocks were probably either small intrusions or coarser intervals in a mafic volcanic succession. Undivided medium- to coarse-grained mafic rocks (*Ao*) are dominantly very deeply weathered gabbro. Metamorphosed gabbro (*Aog*), including dolerite, is common in all the greenstone belts on DUKETON. The primary textures are pseudomorphed by metamorphic assemblages of amphibole, plagioclase, minor amounts of fine-grained opaque minerals (?ilmenite), and local quartz. The rocks may have intergranular, granular or subophitic textures, or they may be locally porphyritic. Metagabbro in the Urarey Well area in the central part of DUKETON also contains accessory biotite (Stewart, 1999).

Felsic volcanic and volcaniclastic rocks (*Af, Afd, Afi, Afr, Afs, Aft, Afv*)

Felsic rocks are widely distributed throughout the Duketon belt, and are most abundant south and east of the Duketon mining centre. However, they are poorly exposed and widely affected by deep weathering.

Undivided metamorphosed felsic volcanic and volcaniclastic rocks (*Af*) are mostly deeply weathered, kaolinized, and silicified. Relict quartz phenocrysts are common in hand specimen and assist in identification of the rocks. The felsic rocks have been further subdivided, where the weathering and deformation are not extreme, using relict textures and the mineralogy of any phenocrysts.

Metamorphosed dacite (*Afd*) is exposed in rubbly outcrops near North Pinnacle, in the Duketon belt in the southern part of DUKETON (Langford and Farrell, 1998). The rock is relatively fresh and contains plagioclase and quartz phenocrysts in a very fine grained matrix of quartz, white mica, and plagioclase. In contrast, metamorphosed intermediate rocks (*Afi*) farther north near Swanson Hill typically contain plagioclase phenocrysts in a fine-grained, recrystallized, and foliated matrix of quartz, plagioclase, and chlorite, with or without epidote, actinolite, and biotite. In many cases, the intermediate rocks contain irregular aggregates of fine-grained chlorite or actinolite that may be recrystallized former mafic minerals.

Metamorphosed porphyritic rhyolite–dacite lava (*Afr*) at Mason Hill in the central part of DUKETON is in a succession of thin flows, up to 3 m thick, overlying a metamorphosed mudstone unit (Langford, 1995). The lava retains primary volcanic features, such as spherules and quartz phenocrysts. The phenocrysts are set in a fine-grained matrix of quartz, white mica, and plagioclase.

Strongly deformed felsic schist (*Afs*) is exposed in areas of higher metamorphic grade along the greenstone margins. The schist is typically well foliated and contains relict, partly recrystallized quartz grains in a foliated matrix of quartz, white mica, and plagioclase. The protolith is unclear, but it may have been a felsic volcanic or volcaniclastic rock.

Weathered metamorphosed felsic tuff (*Aft*) and felsic volcanic rock (*Afv*) outcrop near Pinjanie Hill in the Duketon belt in the south-central part of DUKETON. These rocks are completely weathered and consist of relict quartz crystals in a silicified and kaolinized matrix. A relict, coarse fragmental texture is preserved in some cases.

Sedimentary rocks (*As, Asc, Ascb, Ascf, Ash, Asq, Ass, Ac, Aci*)

Metamorphosed sedimentary rocks on DUKETON can be divided into two broad categories according to their composition and mode of deposition — clastic sedimentary rocks (*As, Asc, Ascb, Ascf, Ash, Asq, Ass*) and chemical sedimentary rocks (*Ac, Aci*).

Undivided metamorphosed clastic sedimentary rocks (*As*) are deeply weathered and poorly exposed. They form a major component of the Duketon greenstone belt, but are less abundant in the other greenstone belts. They are present both as thick units, 1 to 6 km wide, and thin layers in volcanic successions. Metasedimentary rocks are difficult to classify due to deep weathering and strong deformation.

Metamorphosed polymictic conglomerate (*Asc*) near Bandya Hill, in the southern part of DUKETON, contains rounded clasts up to 170 mm of siliceous sedimentary rock, chert, and rare basalt in a sandstone–siltstone matrix. The conglomerate is strongly deformed close to the greenstone margin, and weakly deformed to the northeast. Closely associated with the conglomerate are pebbly sandstone and siltstone with scattered, rounded clasts up to 15 mm of chert, ironstone, and felsic rock.

Deformed metamorphosed mafic conglomerate (*Ascb*) with clasts of basalt and gabbro forms a thin unit close to the western edge of the Duketon belt in the Murphy Hills area in the southern part of DUKETON (Langford and Farrell, 1998). Spatially associated with the mafic conglomerate is a deformed and metamorphosed felsic conglomerate (*Ascf*) containing clasts up to 150 mm in diameter of granitoid rock, felsic rock, vein quartz, and rare ultramafic rock. The felsic conglomerate has a steeply dipping foliation that encloses the flattened clasts, and is similar to the Jones Creek Conglomerate in the Agnew–Wiluna belt to the west (Durney, 1972; Marston and Travis, 1976; Marston, 1978; Liu et al., 1998).

Metamorphosed fine-grained sedimentary rocks (*Ash*) are commonly poorly exposed and deeply weathered. They are largely recrystallized, and in exploration drillholes are seen to consist of fine-grained quartz, plagioclase, and white mica, with or without chlorite and opaque minerals. Graphite-bearing varieties are present locally. Some fine-grained metasedimentary rocks contain scattered relict clasts of quartz or plagioclase up to about 1.2 mm in diameter. Quartz-rich siltstone (*Asq*) is a local variant.

Metamorphosed sandstone (*Ass*) is present in several areas in the Duketon belt, particularly between Moolart Well and Butcher Well in the southern part of DUKETON. The sandstone contains a variety of clasts, but is dominantly felsic in composition. Near Butcher Well, the sandstone is interbedded with minor, locally graphitic metasiltstone and thin layers of metamorphosed chert (Langford and Farrell, 1998).

Metamorphosed chert (*Ac*) forms extensive strike ridges throughout the greenstones in the Duketon belt, and is typically ferruginous, with a well-developed 1 to 30 mm-thick layering defined by variations in iron-oxide and silica content. In some areas there is a gradation along strike from ferruginous chert to iron-poor chert and layered siltstone over a distance of 1–2 km. The chert units commonly have small-scale folds, and are locally brecciated or cut by late-stage fractures.

Metamorphosed banded iron-formation (*Aci*) is a minor rock type in the Duketon belt, but forms extensive units in the Gerry Well and Mount Gerard greenstone belts (Stewart, 1999). Hematite-bearing BIF in the Duketon belt outcrops in the Six Mile Hill area, and near McKenzie Well, where it has a well-developed black and dark-red to red-brown layering. Hematite-bearing BIF in the Gerry Well greenstone belt is typically associated with weathered shale. Magnetite-bearing BIF is present in the Deleta greenstone belt, and in several outliers of greenstone within the granitoids southwest of Mount Gerard and north of Quondong Well (Stewart, 1999).

Granitoid rocks and gneiss

Large areas of DUKETON are underlain by granitoid rocks and quartzofeldspathic gneiss, but are obscured by extensive sandplains and Cainozoic sheetwash. The quartzofeldspathic gneisses are multiply deformed and intruded by monzogranite in many locations, suggesting that they are older than the main phase of monzogranite magmatism. This interpretation is supported by a SHRIMP U–Pb zircon age of 2697 ± 6 Ma for a gneiss from Lizzar Soak in the southern part of DUKETON (Nelson, 1997), and granitoid ages of 2654–2637 Ma (Nelson, 1997; AGSO, OZCRON database). It is not clear if the quartzofeldspathic gneiss is locally the basement to the greenstone belts.

Quartzofeldspathic gneiss (Anq)

Quartzofeldspathic gneiss outcrops in distinct, mappable units (*Anq*), and is a component of a mixed unit of granitoid rock and quartzofeldspathic gneiss (*Agnq*, see **Granitoid rocks**). The rock commonly shows a diffuse layering defined by variations in grain size and modal mineralogy, and is multiply deformed. Locally, the gneiss contains two generations of leucosomes and granitic veins. Early leucosomes are thin, rich in quartz, and parallel to a relict foliation (S_1, see **Structural geology**). The leucosomes were folded during D_2, and in high-strain zones are largely transposed into the S_2 foliation. The first-generation leucosomes are cut by a second generation of thicker, monzogranite leucosomes commonly subparallel to S_2. The host gneiss and the early leucosomes are, in turn, cut by a range of weakly deformed medium-grained monzogranite leucosomes dated at 2654 ± 9 Ma (Nelson, 1997).

Granitoid rocks (Ag, Agm, Agg, Agl, Agmf, Agzq, Agb, Agf, Aggh, Agnq)

Many areas of exposed granitoid rock are deeply weathered and have been mapped as undivided granitoid rocks (*Ag*) where the primary mineralogy could not be ascertained. In areas where the rocks can be positively identified, biotite monzogranite (*Agm*) is by far the dominant rock type. Minor granitoid rock types include granodiorite (*Agg*) and fine-grained leucocratic granitoid rock (*Agl*).

Biotite monzogranite (*Agm*) is widespread on DUKETON. The rock is variously deformed, typically fine to medium grained, and has local sparsely porphyritic zones. The monzogranite consists of quartz, plagioclase, K-feldspar, small amounts of biotite, opaque minerals, and accessory epidote, allanite, sphene, and zircon. A strongly deformed porphyritic biotite monzogranite (*Agmf*) near Cosmo Newbery in southeastern DUKETON contains phenocrysts of plagioclase and numerous aplite and pegmatite veins. An elongate body of deeply weathered, biotite-bearing quartz monzonite to monzogranite (*Agzq*) in the central part of the Duketon belt is fine to medium grained, weakly porphyritic, and contains various amounts of quartz and equal amounts of plagioclase and K-feldspar, both now completely altered to clay minerals.

Areas of foliated granitoid rock with interleaved mafic rocks (*Agb*) are present along the western side of the Duketon greenstone belt. The mafic rocks form discontinuous layers or lenses, along with minor amounts of high-grade metasedimentary rock. Strongly deformed granitoid rock with minor quartzofeldspathic gneiss (*Agf*) on the edge of the Duketon belt, in the central part of DUKETON near Hootanui, has local biotite-rich schlieren and a diffuse layering. Dykes of pegmatite and fine-grained massive granitoid are abundant in this area.

Hornblende granodiorite (*Aggh*) within the Duketon greenstone belt at Hootanui contains coarse, radiating aggregates of hornblende (after ?pyroxene), with interstitial plagioclase and quartz, minor sphene, and accessory epidote, apatite, and ?ilmenite. Locally the rock contains deformed and partly recrystallized intergrowths of plagioclase and quartz. The granodiorite appears to be a component of the greenstone sequence, and is associated with metamorphosed medium- to coarse-grained intergranular gabbro. It is interpreted as a metamorphosed, differentiated gabbro.

In large parts of DUKETON, granitoid rocks are intimately associated with quartzofeldspathic gneiss and migmatite on a scale too small for the individual rock types to be shown separately. Deep weathering and poor exposure also make it difficult to determine the proportions of each rock type, so these areas are mapped as a mixed unit of granitoid rock and quartzofeldspathic gneiss (*Agnq*). The granitoid rocks in these areas commonly have a diffuse layering and abundant biotite-rich schlieren.

Veins and dykes (*g, p, q*)

Dykes of fine-grained granitoid rock (*g*) and pegmatite (*p*) are common in many areas of granite, but are commonly too small to be shown on the map.

Quartz veins (*q*) are ubiquitous on DUKETON, but mostly too small to be shown on the map. There are two main types of quartz veins. The oldest are deformed veins of milky quartz in the greenstones that parallel the regional foliation. These types of veins are commonly boudinaged or folded. The younger quartz veins are undeformed and contain interlocking crystals of milky quartz up to 120 mm in length. These veins typically cut across the main regional structural trends, and are parallel to linear aeromagnetic features that correspond to Proterozoic dykes in other parts of the Eastern Goldfields (Hallberg, 1987).

PALAEOPROTEROZOIC ROCK TYPES

Mafic dykes (*Edy*)

Mafic dykes (*Edy*) that cut across the granite–greenstone terrain on DUKETON belong to a suite of mafic to ultramafic dykes found throughout the Yilgarn Craton (Hallberg, 1987). The dykes rarely outcrop, but are apparent on aeromagnetic images as distinct, linear anomalies (Fig. 4). The only exposures of mafic dykes on DUKETON are near Cosmo

Newbery in southeastern DUKETON, and near Point Sheila in the Neckersgat Range in central-western DUKETON. The dyke at Point Sheila is extremely weathered, but has the relict texture of a fine-grained, granular gabbro. The mafic dykes are commonly considered to range in age from c. 2400 to c. 2000 Ma (Hallberg, 1987), based on limited geochronological data.

Earaheedy Group

Palaeoproterozoic sedimentary rocks of the Earaheedy Group (Hall et al., 1977; Pirajno et al., 2000) outcrop in the northeastern corner of DUKETON. These rocks are typically undeformed and dip gently to the east and northeast. The Earaheedy Group is interpreted to be a passive-margin succession that was deposited on the northern margin of the Yilgarn Craton at c. 1.85 – 1.8 Ga (Jones et al., 2000). The two lowermost formations in the group are exposed on DUKETON.

Yelma Formation (ⱣEy, ⱣEya, ⱣEyc)

On DUKETON the Yelma Formation (*ⱣEy*) consists of a basal feldspathic sandstone (*ⱣEya*)*, and a thin overlying unit of stromatolitic dolostone (*ⱣEyc*)*. The feldspathic sandstone unit (*ⱣEya*) is about 10 m thick and comprises fine- to coarse-grained, cross-bedded sandstone at the base, an interval of glauconitic sandstone, and a clayey quartz sandstone at the top (Stewart, 1999). Scattered pebbles and cobbles of vein quartz are common near the base of the unit. The glauconitic interval has been dated at 1700 Ma using the K–Ar method (Preiss et al., 1975). The stromatolitic dolostone (*ⱣEyc*) was described by Bunting and Chin (1979) as a lens up to 5 m thick with locally abundant stromatolites of the form *Tarioufetia yilgarnia* (Preiss et al., 1975).

Frere Formation (ⱣEf, ⱣEfa, ⱣEfs)

The Frere Formation (*ⱣEf*) on DUKETON consists of an interval of oolitic sandstone (*ⱣEfa*) overlain by laminated siltstone (*ⱣEfs*). The oolitic sandstone (*ⱣEfa*) is a massive, well-sorted rock consisting of oolites with a poorly developed concentric zoning of microcrystalline quartz, cryptocrystalline quartz, and hematite, in a matrix of partly recrystallized cryptocrystalline quartz and extremely fine, dispersed iron oxides (Stewart, 1999). The laminated siltstone (*ⱣEfa*) is a fine-grained rock containing clasts of quartz, rare detrital muscovite, monazite, zircon, and rutile in a clay matrix (Stewart, 1999).

STRUCTURE

Four phases of Archaean deformation (D_1–D_4) have been recognized in the north Eastern Goldfields Province from regional 1:100 000-scale mapping carried out by GSWA and AGSO (Farrell, 1997b). The recognition of these structures is based on overprinting relationships of outcrop-scale structures, interpretation of aeromagnetic images, and correlation of structures in different parts of the area. All four phases of deformation are recognizable on DUKETON.

First deformation (D_1)

First-generation (D_1) structures were overprinted during later events, but relict steeply dipping D_1 fabrics are preserved in quartzofeldspathic gneisses, and possibly in some

* The 1:250 000 map legend shows the units in reverse stratigraphic order.

greenstones. However, it is not clear how the early structures in different parts of the area are related, or even if they are due to the same event. Gneisses at Lizzar Soak and near Point Sheila in the southwestern part of DUKETON commonly contain a composite S_1–S_2 fabric with rootless isoclinal folds of S_1 leucosomes. A SHRIMP U–Pb zircon date of 2697 ± 6 Ma (Nelson, 1997) for the gneiss at Lizzar Soak constrains the timing of D_1 to c. 2700 Ma or later.

Low-angle thrusting or recumbent folding, such as has been argued for the central (Hammond and Nisbet, 1992) and southern Eastern Goldfields areas (Archibald et al., 1981; Martyn, 1987; Swager and Griffin, 1990), has not been recognized.

Second deformation (D_2)

The second deformation event (D_2) coincided with peak metamorphism in the greenstones and craton-wide granitic magmatism. The effects of D_2 are recognized throughout the area, but are most pronounced in high-strain zones in amphibolite-facies rocks adjacent to granite–greenstone contacts. This deformation may be equivalent to the early extension (D_E) of Hammond and Nisbet (1992).

The characteristic D_2 structure is a steeply dipping foliation (S_2) subparallel to greenstone margins. Layered cherts in the Duketon greenstone belt commonly contain a strong composite (S_0–S_2) fabric with abundant steeply plunging, tight to isoclinal, intrafolial folds (F_2). The fold axes are typically subparallel to a prominent, steeply plunging, combined intersection – mineral lineation (L_2). Second-generation structures have been re-oriented and overprinted during D_3, and in many areas the dominant foliation is probably a composite S_2–S_3 fabric.

The timing of granitoid intrusion has been inferred from structural relationships of dated granitoid intrusions. At Lizzar Soak a 2697 ± 6 Ma gneiss contains F_2 folds of S_1 leucosomes, and is cut by monzogranite with a weakly developed S_2 fabric that has been dated at 2654 ± 9 Ma (Nelson, 1997), indicating that D_2 had ceased by c. 2655 Ma.

The second deformation was followed by the uplift and erosion of the granitoids, and the deposition of conglomerates in small, fault-bounded basins. Felsic conglomerate in the Murphy Hills area, west of Steer Creek Well in the southern part of DUKETON, contains granitoid clasts, has only one recognizable fabric, and is deformed in D_3 shear zones. It is therefore interpreted to be pre-D_3 to early syn-D_3 in age.

Third deformation (D_3)

The last major penetrative deformation event (D_3) was largely responsible for shaping the present-day disposition of the greenstone belts. Strong east–west to east-northeast–west-southwest shortening produced large-scale, upright, and shallow to moderately plunging folds (e.g. the Christmas Well antiform in the southern part of the DUKETON 1:100 000 sheet; Langford and Farrell, 1998) and north to northwesterly trending shear zones (Fig. 3). Some of the regional shear zones contain S–C fabrics and asymmetric porphyroclasts that indicate dextral movement (e.g. Hootanui Fault; Langford and Farrell, 1998), whereas others have kinematic indicators of sinistral movement. In some instances, a sinistral shear sense on north-northwesterly trending shear zones is suggested by patterns in aeromagnetic images (e.g. De La Poer Fault, Figs 3 and 4). Outcrop-scale F_3 folds are typically upright and open to tight, with shallow-plunging axes subparallel to a fine mineral lineation (L_3). Many of the larger F_3 folds are broadly symmetric and plunge at 20–30°. High-strain areas in the hinge zones of F_3 folds contain a prominent, shallow-plunging 'pencil cleavage' due to the intersection of S_3 and S_0–S_2 (Farrell, 1997b).

The timing of D_3 is not well constrained, but it must have occurred after the emplacement of a 2647 ± 3 Ma (AGSO, unpublished data) strongly deformed monzogranite adjacent to the Hootanui Fault at the northwestern tip of the Duketon belt.

Fourth deformation (D_4)

The last recognized deformation event in the region (D_4) produced outcrop-scale kinks, crenulations, and quartz-filled tension-gash arrays. These features may be related to brittle faults and fractures that form the high-angle conjugate structures described by Vearncombe (1998).

METAMORPHISM

All greenstones on DUKETON are metamorphosed. The greenstone belts show a distinctive metamorphic zoning from amphibolite facies in areas close to granitoid contacts to greenschist facies in the central parts of the belts. Smaller greenstone belts, such as Dingo Range and Cosmo Newbery, lack a lower grade core and are metamorphosed throughout to amphibolite facies. This type of metamorphic zonation is developed throughout the Eastern Goldfields Province (Binns et al., 1976), and is common in Archaean granite–greenstone terrains worldwide (Condie, 1981; Wilkins, 1997).

Greenstones at the southern end of the Dingo Range greenstone belt have undergone upper amphibolite-facies metamorphism, with local partial melting. Here, the greenstones are intruded by granitoids, and there are greenstone remnants up to 2.5 km long within the granitoids. Amphibolites in this area contain clinopyroxene, hornblende, Ca-plagioclase, quartz, and minor sphene and ilmenite, indicating upper amphibolite-facies conditions. Partial melting of the greenstones, coupled with the presence of clinopyroxene in amphibolite, indicates a peak temperature greater than about 650–700°C (Bucher and Frey, 1994). The metamorphic grade decreases to lower amphibolite facies in the northwestern part of the belt.

In the Duketon belt, the greenstones are metamorphosed to lower amphibolite facies in narrow zones along the greenstone margin. The rocks in these areas are almost completely recrystallized, although igneous textures are pseudomorphously preserved in some cases, particularly in metamorphosed gabbro. The characteristic assemblage in mafic rocks is hornblende–Ca-plagioclase(–epidote–sphene–quartz). Felsic schists dominantly contain quartz, Ca-plagioclase, and white mica. The stable co-existence of quartz and white mica and the absence of partial melting in the felsic schists indicates a maximum possible temperature of 680°C at 4 kbar (Bucher and Frey, 1994).

In lower grade parts of the Duketon belt, the characteristic assemblage in metamorphosed mafic rocks is epidote–albite(–chlorite–actinolite–quartz–sphene). Commonly, the strain is lower than in the amphibolite-facies zone and igneous textures are preserved. Pyroxene is typically pseudomorphed by actinolite or chlorite, and plagioclase by albite and aggregates of epidote(–sphene). Felsic to intermediate rocks contain quartz, albite, and white mica, with or without chlorite and biotite. Biotite is only present in areas close to the quartz monzonite – monzogranite (*Agzq*) in the centre of the belt where the rocks were metamorphosed to upper greenschist facies. The peak temperature in the lower greenschist-facies areas was probably 350–400°C, based on the absence of biotite and the stable co-existence of chlorite, white mica, and albite. The metamorphic pressure is not well constrained, but must have been less than 8 kbar, considering the absence of blueschist-facies assemblages in metamorphosed basalt (Liou et al., 1985).

Metamorphic conditions in the Gerry Well greenstone belt are not well known because of the poor exposure. The presence of chlorite and white mica in metamorphosed mafic rocks (Stewart, 1999) is suggestive of lower greenschist-facies metamorphism. The grade in the Mount Gerard greenstone belt is unknown due to the poor exposure and lack of fresh outcrop.

In quartzofeldspathic gneisses the metamorphic assemblages are not diagnostic, but the presence of Ca-plagioclase is indicative of amphibolite-facies conditions (or higher). Additionally, the presence of clinopyroxene-bearing amphibolite lenses and localized partial melting suggest upper amphibolite-facies metamorphism and a peak temperature higher than about 700°C.

PALAEOZOIC GEOLOGY

PERMIAN ROCK TYPES

Paterson Formation (*Paf, Pal, Pag*)

Outliers of flat-lying sedimentary rocks on DUKETON are interpreted to be Permian in age on the basis of similarities with the rocks of the Gunbarrel Basin to the east. Poorly sorted, medium- to coarse-grained sandstone and pebbly sandstone (*Paf*), with subordinate thin beds of siltstone and conglomerate, is the most abundant Permian rock type. Conglomerate and pebbly sandstone are more common near the base of the unit. Individual sandstone beds have local cross-bedding, basal scour structures, and upward-fining graded beds (Langford and Farrell, 1998; Stewart, 1999). The sandstone is composed of subangular to well-rounded quartz grains in a matrix of secondary silica and iron oxides (Stewart, 1999). Conglomeratic zones have subangular to subrounded clasts of quartz and chert, up to 280 mm in diameter, in a poorly sorted, silty to sandy matrix.

Claystone and siltstone (*Pal*) are minor components of the Permian succession in the central-northern part of DUKETON. The claystone is interpreted as a lacustrine deposit (Bunting and Chin, 1979; Stewart, 1999). Glacigene conglomerate, sandstone, and siltstone (*Pag*) is present in an outlier north of the Grant Duff Range in the central-western part of DUKETON (Stewart, 1999).

CAINOZOIC GEOLOGY

Cainozoic regolith deposits, comprising residual indurated material exposed by erosion and younger alluvial, eluvial, eolian, and lacustrine deposits, cover large areas of DUKETON. Individual regolith units have been mapped using field observations, aerial photography, and Landsat TM (Thematic Mapper) images.

The oldest regolith units typically form residual deposits on low hills and in breakaways, and are interpreted to be remnants of the Tertiary weathering surface. These units include ferruginous duricrust and ferricrete (*Czl*), massive ironstone (*Czli*), silcrete (*Czz*), and silica caprock over ultramafic rocks (*Czu*). The massive ironstone units (*Czli*) are typically thin, ridge-forming units that may be deeply weathered relics of sedimentary rock.

Proximal slope deposits, comprising rock debris, sand, and silt, lie on or adjacent to low hills and on slopes beneath breakaways. They include colluvium (*Czc*), quartz-vein debris (*Czcq*), and ferruginous rock debris and ironstone rubble (*Czf*). The latter unit forms by the degradation of ferruginous duricrust and is typically developed on low hills. Quartz-vein debris (*Czcq*) is used for large areas of vein-quartz rubble, typically adjacent to large quartz veins.

Distal parts of the regolith are dominated by sheetwash (*Cza*) and sandplain deposits (*Czs*). Sheetwash deposits (*Cza*) are extensive adjacent to the main drainage systems and on the margins of sandplains. They consist of a thin layer of sand, silt, and clay over weathered rock, and are gradational into sandplain deposits. Areas underlain by granitoid rocks are covered by extensive sandplains (*Czs*) consisting of unconsolidated quartz sand and silt. Ridges of wind-blown sand are present locally in the north and east. Areas adjacent to fresh exposures of granitoid rock are commonly covered by quartzofeldspathic sand (*Czg*), comprising granule- and sand-sized grains of quartz, feldspars, and granitoid rock.

The Lake Darlot – Lake Irwin drainage system in the southwest and the Lake Wells drainage in the northeast contain a range of ephemeral lake deposits. Playa lakes (*Czp*) contain saline or gypsiferous evaporites, along with minor amounts of sand, silt, and clay. The playas are associated with saline or gypsiferous dune deposits (*Czd*) that contain low, crescent-shaped dunes formed by wind action during dry periods. Around the dune deposits, extensive, low-lying areas contain hummocky deposits (*Czb*) of sand, silt, and clay, with small interspersed playas, claypans, and patchy deposits of calcrete. Larger deposits of calcrete (*Czk*) are present in areas around the margins of the lake deposits.

Younger deposits of unconsolidated to semiconsolidated sandy alluvium and gravel (*Qa*), of probable Quaternary age, lie along intermittently active fluvial channels and on adjacent flood plains. These deposits grade laterally into sheetwash and may have undergone some degree of eolian reworking. Lake and sheetwash deposits may also contain small claypans (*Qac*), consisting of thin deposits of silt and clay in shallow depressions that are filled with water after heavy rainfall.

ECONOMIC GEOLOGY

Mineral production from DUKETON is restricted to gold and accessory silver, with recorded production to 30 June 2000 totalling about 1587 kg of gold. Despite some exploration, no economic base-metal sulfide deposits have yet been discovered. The mining industry during the first half of the twentieth century is described in Hobson and Miles (1950), and much information on the subsurface geology of individual gold mining leases can be found in Gibson (1906b), Honman (1917), and Miles (1940). Mining and exploration data, and a summary of the mineral occurrences on DUKETON, are contained in Ferguson (1998). Data on more recent exploration activity in the region can be obtained from the DME library of open-file statutory company reports.

GOLD

DUKETON covers parts of the Mount Margaret and East Murchison Mineral Fields, and includes two historic gold mining centres — Erlistoun and Duketon. These centres were active mainly during the first decade of the twentieth century. Gold production dropped dramatically after this, although a few mines were worked sporadically up to about 1945. There was renewed gold mining activity between 1988 and 1993, and opencuts were worked by Golconda Minerals NL at Baneygo, Russell Find, and Christmas Well (Fig. 2) in the southern part of DUKETON. In mid-2000, mining by Minerichie Investments Pty Ltd commenced at the Anchor gold deposit.

Historically, most gold production has been from mineralization in or adjacent to quartz veins or lodes (Miles, 1940) within the Erlistoun and Duketon–Hootanui mining centres in the Duketon belt. Minor amounts of gold were recovered from small workings in the Cosmo Newbery and Banjawarn areas in the southeastern and western parts of DUKETON respectively. Gold is principally present as liberated grains, and sulfides are rare (Miles, 1940). Gold-bearing quartz veins may either cut across or lie parallel to the regional foliation, typically along fault or fracture zones at the contact between different rock types. Most of the gold-bearing quartz veins are probably related to D_4 structures, as they commonly postdate the regional foliation.

A significant deposit of alluvial gold was worked at The Patch (Fields Find) in the central-southern part of DUKETON in 1912–13 (Honman, 1917). Later mining in the area focused on gold-bearing quartz veins associated with a small fault zone along the contact between a mafic intrusion and foliated greenstone sequences (Honman, 1917; Miles, 1940).

BASE METALS

Exploration for volcanogenic copper–zinc deposits was carried out in the north-central Duketon greenstone belt, in a succession of felsic volcanic rocks between Swanson Hill and Mason Hill (Ferguson, 1998). Subeconomic concentrations of sphalerite–galena–chalcopyrite–pyrite were found at Mason Hill, but no significant mineralization was discovered. Exploration over the ultramafic units has so far failed to locate significant nickel deposits.

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Appendix

Gazetteer of localities

Locality	*AMG coordinates*	
	Easting	*Northing*
Anchor gold deposit[(a)]	435404	6938973
Bandya Hill	416400	6925700
Bandya Homestead	414600	6936100
Baneygo opencut	432200	6906500
Banjawarn Homestead	363100	6934700
Biddy Well (abd)	365700	6945300
Butcher Well (abd)	436100	6928100
Christmas Well opencut	428800	6919500
Cosmo Newbery (community)	489500	6903200
Deleta Homestead	444800	7009600
Hootanui	395400	6955700
Lizzar Soak	403000	6914300
McKenzie Well	433800	6912700
Mason Hill	422200	6945400
Moolart Well (abd)	441100	6926000
Mount Gerard	474900	6990600
Mulga Queen	405200	6951400
North Bandya Homestead	384200	6951900
North Pinnacle	430300	6903100
Pinjanie Hill	428900	6937600
Point Sheila	395600	6993300
Quondong Well	436500	6967500
Russell Find opencut	438500	6905400
Six Mile Hill	398800	6963100
Steer Creek Well	426700	6907300
Swanson Hill	429600	6922800
The Patch (Fields Find)	424900	6940300
Urarey Well	435000	6962200

NOTES: (a): Not marked on the map because production started in 2000

abd: abandoned

Localities are specified by Australian Map Grid (AMG) coordinates, Zone 51, to at least the nearest 100 m