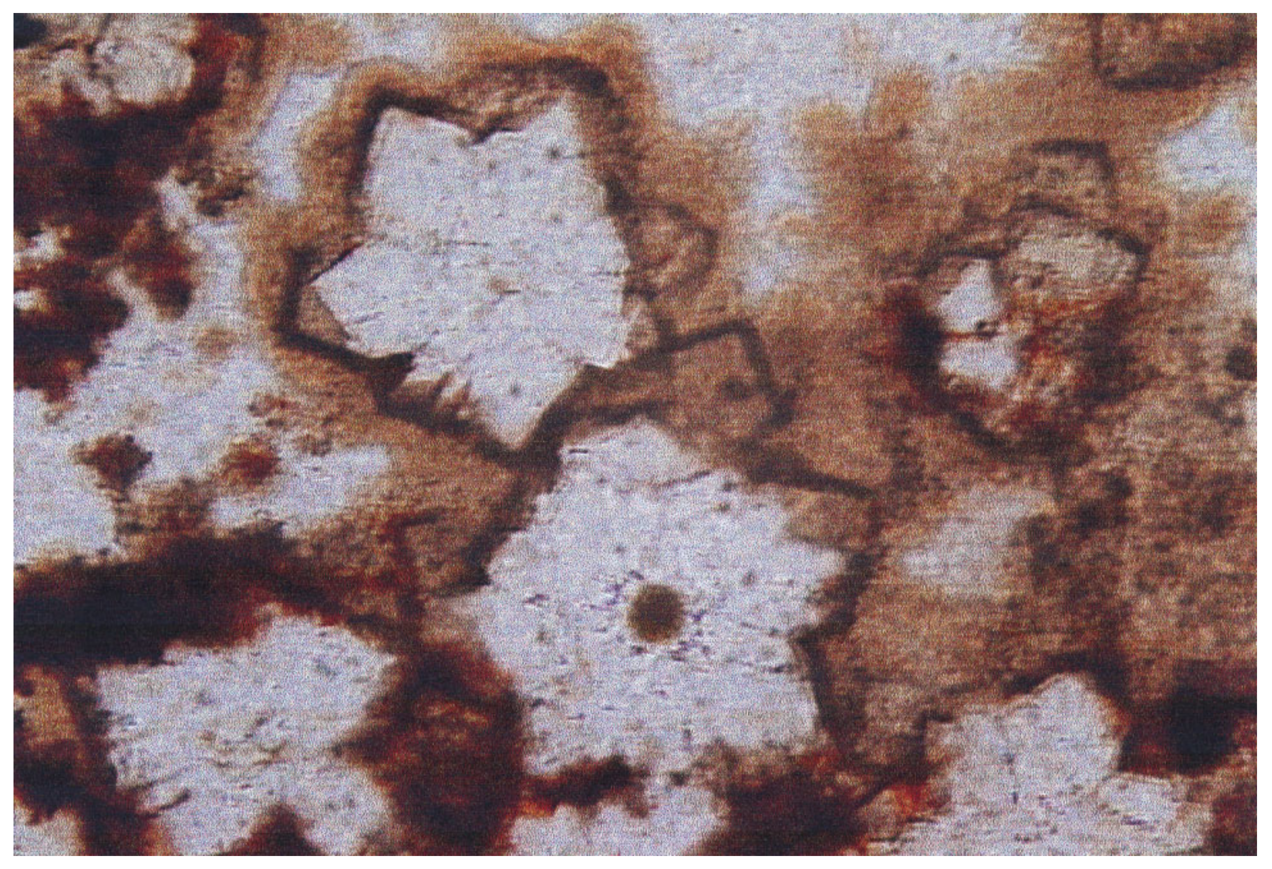
EXPLANATORY NOTES

GOVERNMENT OF WESTERN AUSTRALIA

GEOLOGY OF THE CUNYU 1:100 000 SHEET

by N. G. Adamides, F. Pirajno, and T. R. Farrell

1:100 000 GEOLOGICAL SERIES



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

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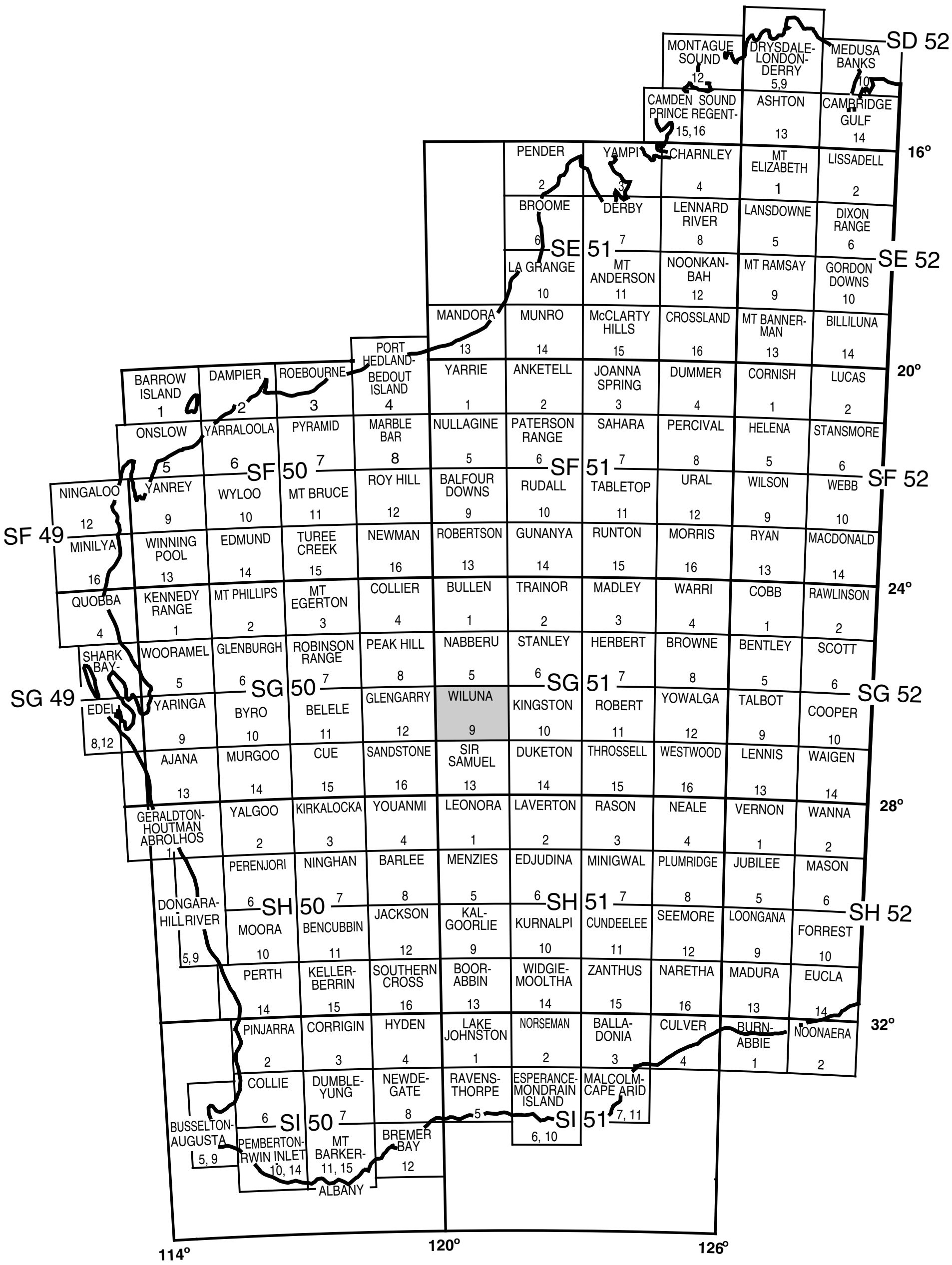

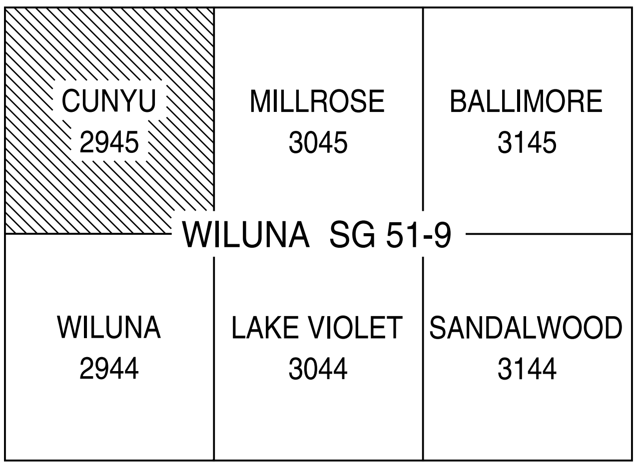

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by
N. G. Adamides, F. Pirajno, and T. R. Farrell

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Cover photograph:
Euhedral dolomite crystallized from a central dubiofossil globule in banded chert. Bartle Member, GSWA sample 133245, 12.1 km southwest of Fyfe Well. Field of view is 0.54 mm wide.

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Geology of the Cunyu 1:100 000 sheet

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N. G. Adamides, F. Pirajno, and T. R. Farrell

Abstract

CUNYU lies across the boundary between the southeastern part of the Palaeoproterozoic Yerrida Basin and the Yilgarn Craton. On CUNYU, the Yilgarn Craton consists of extensive granitoids and parts of the Agnew–Wiluna, Cunyu, and Yandal greenstone belts, which, elsewhere, host gold mineralization. The Yerrida Group was deposited in the Yerrida Basin, which is part of the Capricorn Orogen. At the base of the Yerrida Group, quartz arenite and intercalated carbonate rocks of the Juderina Formation rest unconformably on Archaean rocks of the Yilgarn Craton. Carbonate rocks of the Juderina Formation locally contain stromatolites and evaporitic features. The formation was probably deposited in a shallow-water, intertidal to subtidal environment. The Juderina Formation is overlain by basalts of the Killara Formation and intruded by dolerite sills. The basalts are capped by a thin unit of chert. This last unit (the Bartle Member) reflects the final stages of the Killara volcanism and is partly a chemical precipitate. The Killara Formation is interpreted as the product of continental mafic magmatism associated with rifting.

KEYWORDS: Proterozoic, Yerrida Group, Archaean, Yandal greenstone belt, Cunyu greenstone belt, Agnew–Wiluna greenstone belt

Introduction

Location and access

The CUNYU* 1:100 000 map sheet (SG51-9-2945) occupies the northwestern corner of the WILUNA (1:250 000) map sheet between latitudes 26°00'S and 26°30' S and longitudes 120°00'E and 120°30'E (Fig. 1). The sheet area encompasses the extensions of both the Wiluna and Yandal greenstone belts, with the former concealed beneath Proterozoic cover. The southern extension of the Cunyu greenstone belt is represented by minor outcrops at the northern edge of the map.

Access to the area is via the unsealed Wiluna North road, which joins Wiluna with New Springs Homestead 27 km north of the northern boundary of CUNYU. This road passes through the central part of the map area in a north-northwesterly direction. Elsewhere, access can be gained using four-wheel drive vehicles on station tracks.

* Capitalized names refer to standard map sheets. Where 1:100 000 and 1:250 000 sheets have the same name, the 1:100 000 is implied unless otherwise indicated.

Climate and vegetation

The climate on CUNYU is semi-arid with long, hot summers and mild winters. Summer temperatures commonly exceed 40°C. Maximum temperatures of 48°C in January–February (average 37°C) and 28°C in July (average 20°C) are recorded on CUNYU (Commonwealth Bureau of Meteorology, Australia, Department of the Environment and Heritage, 1998, pers. comm.). Average annual rainfall is about 250 mm with potential evaporation exceeding this figure by a factor of 10 (Elias and Bunting, 1982).

CUNYU is located in the Murchison Region (Austin Botanical District) of the Eremaean Botanical Province (Beard, 1990). Detailed descriptions of the vegetation in this region with relation to rock type are below. In addition, Mitchell and Wilcox (1994) provided descriptions of predominant shrubs in the arid regions of Western Australia. Mulga (*Acacia aneura*) is the predominant shrub in all habitats. Sandplains are covered mainly by spinifex grass (*Triodia basedowii*) with scattered stunted gum trees (*Eucalyptus* sp.). Species of the *Eremophila* family are abundant, with Wilcox bush (*Eremophila forrestii*) and members of the *Cassia*

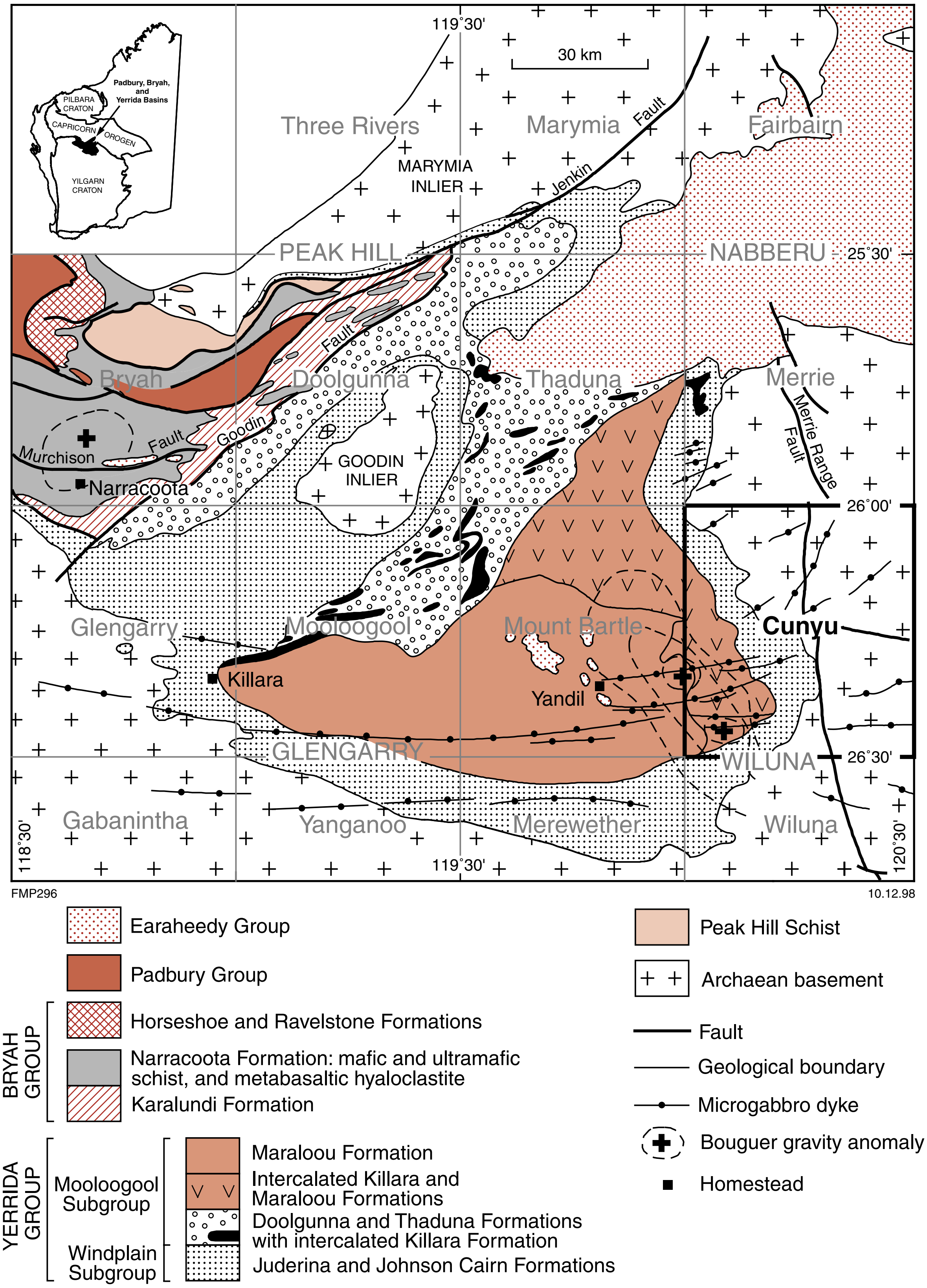

Figure 1. Map showing the location of CUNYU and the main tectonostratigraphic features of the Yerrida, Byrah, and Padbury Basins (modified from Pirajno et al., 1995)

family being particularly prevalent on richer soils around drainage channels. Tall eucalypts (*Eucalyptus camaldulensis)* commonly line major drainage channels. Quartz arenite units support various members of the *Eremophila* family with subordinate wattle (*Acacia* sp.). A lilac species of *Eremophila* is particularly abundant on basalt outcrops in association with mulga and wattle. A variety of grasses (*Poacae*) is present. In spring, members of the mulla-mulla family (*Amaranthaceae*) are abundant in all but the poorest soils.

Physiography

The physiography on CUNYU (Fig. 2) is a reflection of the underlying geology. Resistant quartz arenite units occupy high ground, such as the Finlayson Range and near Mount Alice. These areas are characterized by steep ridges with intervening valleys; the valleys mark the location of softer, less-resistant siltstone.

Hilly topography with dendritic drainage is associated with mafic units of the Killara Formation in the south-western part of CUNYU. These units are commonly covered by laterite with fresh rock exposed at lower topographic levels. Laterite capping results in rounded hills with steep slopes where erosion has exposed the underlying rocks.

Another major physiographic feature on CUNYU is the extensive sandplain, which occupies the eastern half of the area and commonly overlies areas of granitoid. In places, this eolian material forms north-northwesterly trending dunes parallel to the prevailing wind.

Previous work

One of the earliest geological investigations of the broader region around CUNYU was by Talbot (1920), who accompanied A. W. Canning in a survey of the route between Wiluna and Halls Creek. Talbot (1920) correctly identified the unconformity between the Archaean and Proterozoic, but he included the Proterozoic sedimentary rocks on CUNYU in the Nullagine Series. Later, Sofoulis and Mabbutt (1963) examined the area as part of a broader geological study of the region between Wiluna and Meekatharra. Concurrently with these geological investigations, the geomorphology of the region was described by Mabbutt (1963). Brookfield (1963) gave an account of the groundwater potential of the area.

The first detailed investigation of CUNYU was carried out by Elias and Bunting (1982) as part of the 1:250 000 geological mapping of WILUNA. The area was also included in a geological synthesis of the Nabberu Basin by Gee (1990). Gee and Grey (1993) and Grey (1995) described stromatolites from localities in southwestern CUNYU.

Regional setting and stratigraphy

CUNYU covers the southeastern part of the Yerrida Basin (Pirajno et al., 1996), which was previously included in, and described as part of, the Glengarry Basin (Gee and Grey, 1993). The Yerrida Basin is part of the Capricorn Orogen, a major zone of deformed, low-grade volcanic and sedimentary rocks, high-grade metamorphic rocks, and granitoid intrusions (Tyler and Thorne, 1990). The orogen extends for more than 800 km from near the Indian Ocean coast, towards the interior of Western Australia in an east-northeasterly direction. The orogen formed as a result of the collision between the Archaean Pilbara and Yilgarn Cratons (Tyler and Thorne, 1990; Myers, 1993; Myers et al., 1996). The Yerrida Group (Table 1), which was deposited in the Yerrida Basin, rests unconformably on peneplained Archaean granite–greenstone basement. The Proterozoic rocks on CUNYU were deposited on the Paroo Platform, a term used by Gee (1990) to distinguish essentially undeformed rocks from the more deformed rocks surrounding the Goodin Inlier (Fig. 1), which were considered part of the Glengarry Fold Belt (Gee, 1987).

Table 1. Stratigraphy of the Yerrida Group

Basin/Group/Subgroup	*Formation*	*Rock type*
~ ~ ~ ~ ~ ~	*Unconformity*	~ ~ ~ ~ ~ ~
YERRIDA BASIN		
Yerrida Group		
Mooloogool Subgroup (rift succession)	Maraloou Formation	Black shale, siltstone, and carbonate
	Killara Formation	Mafic extrusive and intrusive rocks
	Doolgunna Formation	Mixtite and other clastic rocks
	Thaduna Formation	Lithic wacke, siltstone, shale, and minor arkose
Windplain Subgroup (sag-basin succession)	Johnson Cairn Formation	Siltstone, shale, carbonate, minor lithic wacke
	Juderina Formation	Arenite, conglomerate, and minor carbonate
	Bubble Well Member	Silicified carbonate with evaporites
	Finlayson Member	Arenite
~ ~ ~ ~ ~ ~	*Unconformity*	~ ~ ~ ~ ~ ~

SOURCE: Modified from Pirajno et al. (1996)

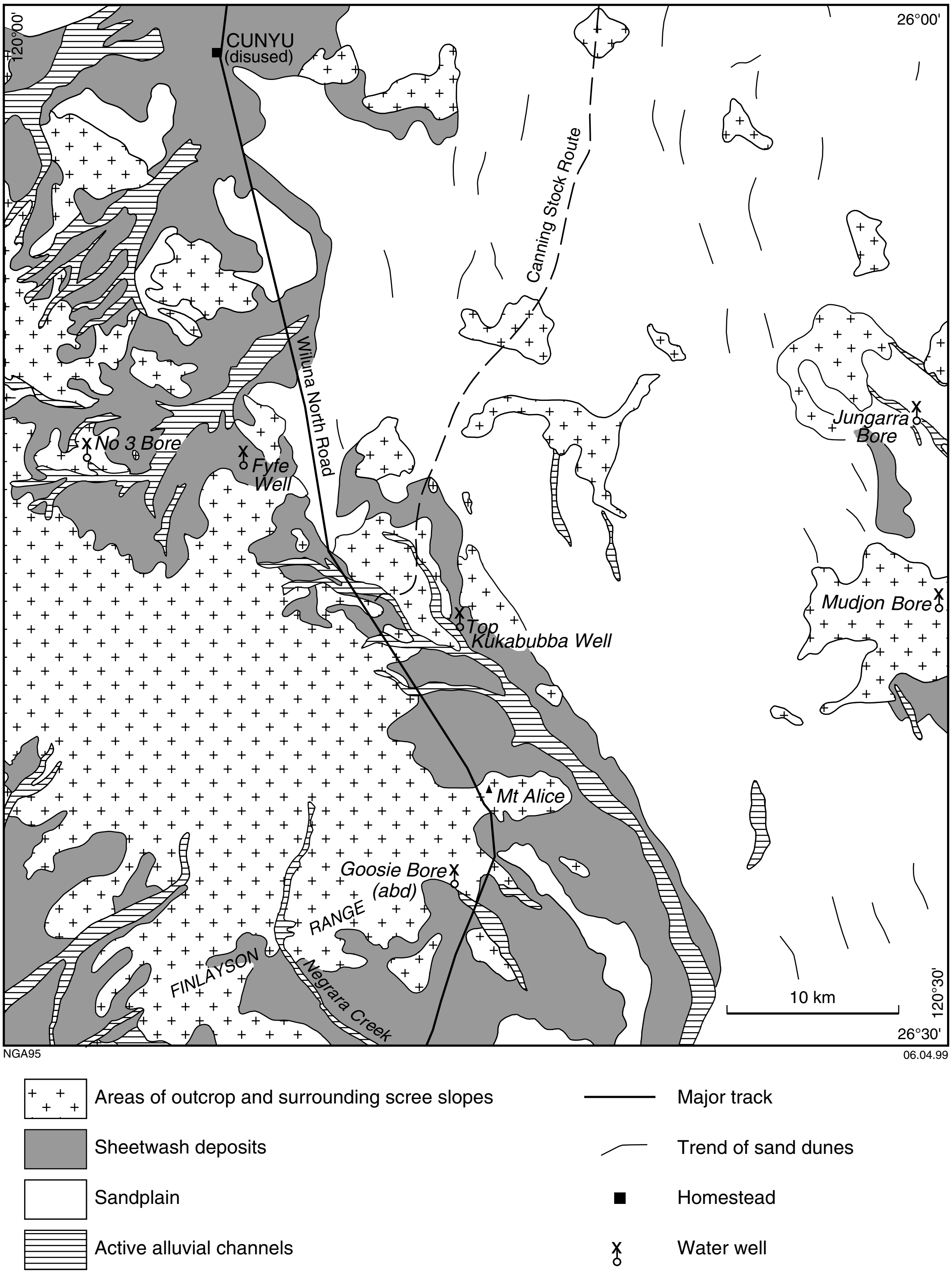

Figure 2. Main physiographic units of CUNYU

The Paroo Platform is characterized by predominantly shallow-water sedimentation in contrast to areas further northwest where rift-related turbidite activity prevailed (Gee, 1990). Intercalated with these sedimentary rocks are mafic volcanic rocks of the Killara Formation, which are interpreted to be associated with rift development that followed early platform-type sedimentation.

CUNYU contains the northernmost part of the Eastern Goldfields Province of the Archaean Yilgarn Craton. The

Archaean rocks are characterized by large areas of granitoids with north-northwesterly trending greenstone belts.

The stratigraphy of the Archaean greenstones can not be established on CUNYU due to poor outcrop. However, the Yandal greenstone belt, part of which is poorly exposed on eastern CUNYU, is interpreted from better exposed areas to consist of a lower sequence of banded iron-formation (BIF) and basalt; a middle greenstone sequence of ultramafic rock, basalt, and dolerite; and an upper sequence of felsic to intermediate rocks, chert, and clastic sedimentary rocks (Phillips et al., 1998). All rocks in the belt are heterogeneously deformed, locally forming schist and mylonite.

The northwestern extension of the Wiluna greenstone belt is inferred to underlie part of southwest CUNYU based on aeromagnetic data, and outcrops on WILUNA to the south. Where the belt underlies the unconformity with the Proterozoic rocks, it consists of felsic lavas and pyroclastic rocks; however, further east mafic and ultramafic units predominate (Elias and Bunting, 1982; Langford and Liu, 1997).

Geochronology

A biotite monzogranite from the Yilgarn Craton on CUNYU (AMG 315191)* has a Sensitive High-Resolution Ion Microprobe (SHRIMP) U–Pb zircon age of 2648 ± 19 Ma (Nelson, 1998). This compares well with an age of 2624 ± 8 Ma obtained from a syenogranite of the Goodin Inlier (GSWA sample 118963; Nelson, 1997), and 2613 ± 13 Ma obtained from a metasandstone from the Jones Creek area, south of CUNYU (GSWA sample 118937; Nelson, 1997). These ages provide evidence for the maximum age of deposition of the Yerrida Group, which rests unconformably on the Yilgarn Craton. Woodhead and Hergt (1997) reported Pb–Pb isochron ages of 2173 ± 80 Ma from stromatolitic carbonates of the Bubble Well Member (Yerrida Group), and 2008 ± 68 and 1946 ± 71 Ma from carbonate rocks of the Yelma Formation at the base of the Earaheedy Group, which overlies the Yerrida Group. Thus, on the basis of the available evidence, the age of the Yerrida Group is about 2100–2200 Ma.

Archaean geology

Greenstones

On CUNYU, greenstones of the Yilgarn Craton are poorly exposed and restricted in extent. The northernmost part of the Yandal greenstone belt straddles the eastern boundary of the area; the southern tip of the Cunyu greenstone belt extends onto CUNYU in the north (Fig. 3). Information on the internal stratigraphy of these belts within the map area is limited. A third greenstone belt, the Wiluna greenstone belt, is not exposed on CUNYU, but is interpreted from aeromagnetic data to extend beneath Quaternary and Proterozoic cover in the southwestern part of the map area.

* Localities are specified by the Australian Map Grid (AMG) standard six-figure reference system whereby the first group of three figures (eastings) and the second group (northings) together uniquely define position, on this sheet, to within 100 m.

Ultramafic rocks (*Au, Aur*)

The distribution of ultramafic rocks on CUNYU has largely been interpreted from aeromagnetic data. The only exposure is a small rubbly outcrop of extremely weathered, talc-bearing rock at the contact between granite and the Yandal greenstone belt on the eastern edge of CUNYU (AMG 503883). However, ultramafic rocks were intersected in several exploration drillholes. These rocks show a range of alteration types and, where petrographic information is not available, were recorded as undivided ultramafic rocks (*Au*).

Well-foliated, medium-grained, tremolite-rich schist (*Aur*) was intersected by several exploration drillholes in the northern part of the Yandal greenstone belt. These rocks typically contain tremolite, chlorite, and minor amounts of opaque minerals. Tremolite commonly forms small acicular grains aligned parallel to the foliation, and larger grains (up to 1 mm in diameter) enclosed by the foliation.

Mafic rocks (*Ab, Aba, Aog, Aogf*)

Mafic rocks are poorly exposed on CUNYU. The outcrops are typically rubbly and extremely weathered, and are mapped as undivided, metamorphosed mafic rocks (*Ab*). An area of weathered, undivided mafic rock outcrops about 7 km east of Cunyu Homestead (Fig. 3 — Locality 1, AMG 184180). This is the only exposure of the Cunyu greenstone belt on CUNYU.

A small exposure of fresh, fine-grained amphibolite (*Aba*) in the Yandal greenstone belt is on the eastern margin of CUNYU (Fig. 3 — Locality 2, AMG 470031). The rock contains plagioclase, amphibole, and small amounts of epidote, sphene, and opaque minerals. It is a foliated rock with a transposition fabric, defined by fine-grained amphibole, enclosing coarser grained amphibole grains up to 0.4 mm in diameter. In addition, there are small spots containing fine-grained, brown biotite and epidote. The outcrop is surrounded by an area of ferruginous rubble, which is probably derived from the weathered mafic rocks.

A small exposure of fresh metagabbro (*Aog*) is located south of Mudjon Bore on the eastern edge of CUNYU (Fig. 3 — Locality 3, AMG 504883). The metagabbro is weakly deformed, fine to medium grained, granular, and contains amphibole, plagioclase, and minor sphene, biotite, quartz, epidote, and opaque minerals. Large amphibole grains (up to 2.5 mm in diameter), which are pseudomorphs after pyroxene, commonly show marginal replacement by fine-grained, acicular amphibole. Plagioclase grains contain abundant fine-grained amphibole and epidote. Small grains of orange-brown

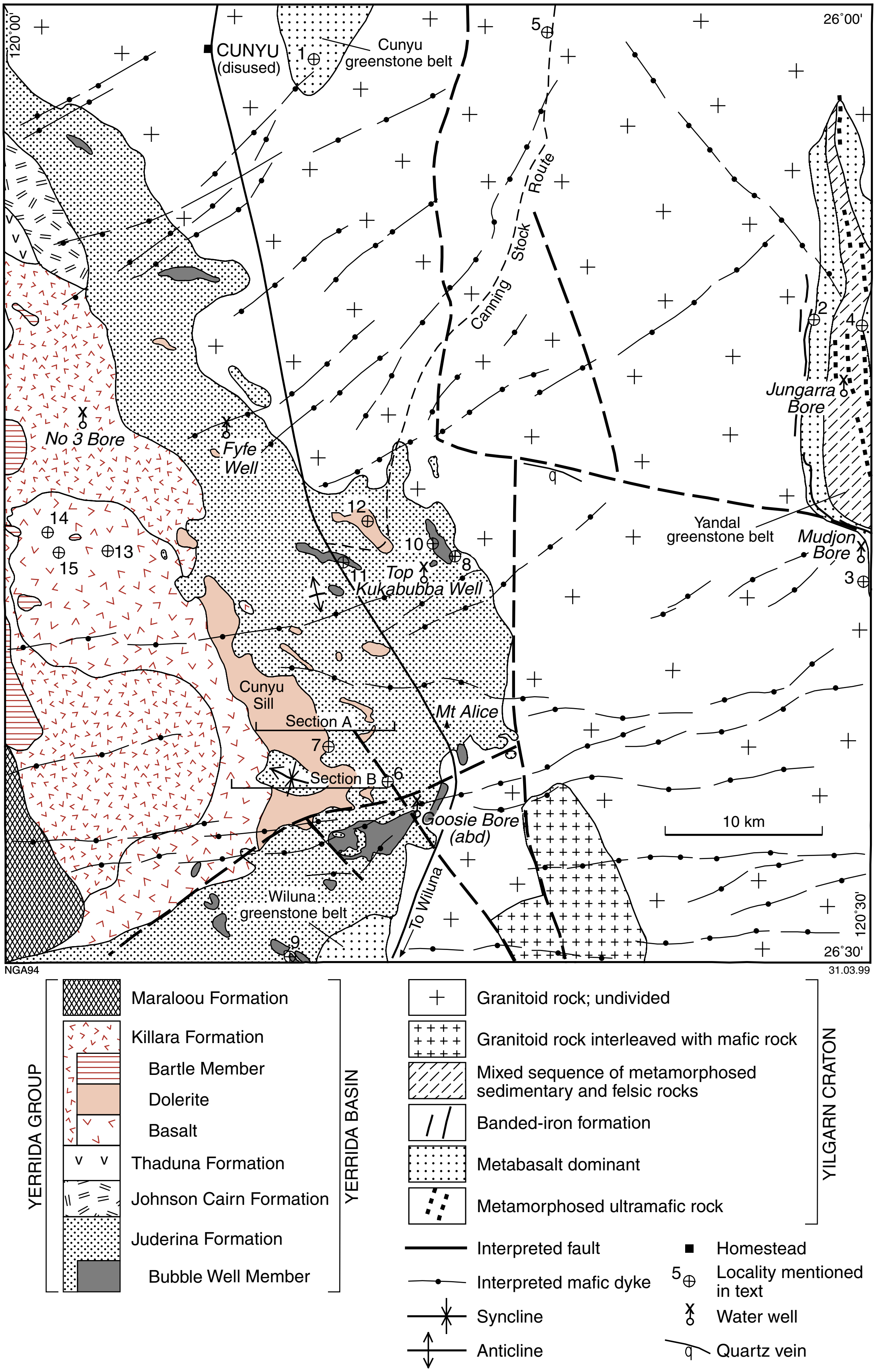

Figure 3. Simplified geology of Cunyu and localities mentioned in text

biotite (less than 0.5 mm in diameter) are scattered throughout the rock.

Foliated metagabbro (*Aogf*) is common north-northeast of Jungarra Bore. This rock type has been observed only in drillhole samples and typically contains porphyroclasts of amphibole, after pyroxene, enclosed by a well-developed, anastomosing foliation.

Felsic rocks (*Af, Afs*)

Felsic rocks are exposed only at one location on CUNYU (Fig. 3 — Locality 4, AMG 496027). About 4 km north-northeast of Jungarra Bore in the Yandal greenstone belt, there is a weathered, rubbly outcrop of foliated, possible felsic volcaniclastic rock (*Af*). Nearby drillholes have intersected plagioclase-phyric felsic rocks, which may be related to the volcaniclastic rocks exposed at the surface.

Felsic schist (*Afs*), containing muscovite, biotite, and relict quartz grains, is widespread in exploration drillholes in the Yandal greenstone belt, north of Jungarra Bore.

Granitoid rocks (*Ag, Agm*)

Granitoid rocks are poorly exposed and intensely weathered on CUNYU. As a consequence, they are commonly mapped as undivided granitoid rocks (*Ag*). In areas of fresh outcrop, such as along the eastern and northern margins of CUNYU, the dominant rock type is biotite monzogranite (*Agm*).

Granitoid rocks close to the Yandal greenstone belt on the east side of CUNYU are strongly deformed. The intensity of deformation is highest at the granite–greenstone contact and decreases rapidly to the west. Exposures within 1 km of the granite–greenstone contact are poor, but in the area near Jungarra Bore they are represented by alternating layers (5–40 cm) of foliated granitoid and quartzofeldspathic gneiss. Further west, the dominant rock type is a fine-grained, weakly deformed, sparsely porphyritic biotite monzogranite that contains some thin, straight pegmatite veins and irregular pegmatite patches. In some areas, there is diffuse compositional layering within the monzogranite, and in others, a later phase of medium-grained monzogranite cuts both the fine-grained monzogranite and the pegmatite veins.

A fresh exposure of biotite monzogranite is also present on the Canning Stock Route, close to the northern boundary of CUNYU (Fig. 3 — Locality 5, AMG 316195). Two phases of monzogranite are present at this location: a fine-grained monzogranite with several pegmatite veins and pods, and a medium-grained porphyritic monzogranite. Both rock types are weakly deformed.

Granitoid rocks in the central and southern parts of CUNYU are extremely weathered, fine to medium grained, and foliated. They contain some thin pegmatite veins (commonly less than 7 cm thick) and are intruded by fine-grained ?monzogranite dykes.

Structure and metamorphism

All the greenstone belts on CUNYU are deformed and metamorphosed. They commonly show evidence for only one phase of deformation, which correlates with D_3 on MILLROSE, east of CUNYU (Farrell and Wyche, in prep.). Rocks of the Yandal greenstone belt typically have a steeply dipping, northerly trending foliation. None of the inferred earlier (pre-D_3) generations of structures have been recognized in outcrop, but microscopic evidence suggests that the foliation is a composite fabric.

Strongly deformed granitoid rocks close to the granite–greenstone contact along the eastern edge of CUNYU have a northerly trending foliation (S_3), as well as a prominent mineral lineation (L_3) defined by the preferred alignment of biotite and aggregates of quartz and feldspar. The granite–greenstone contact is interpreted to be a D_3 fault with possible interleaving of granite and greenstone rocks. Other northerly trending D_3 faults extending onto CUNYU from WILUNA were interpreted from aeromagnetic data.

The interpretation of metamorphic grade on CUNYU is hampered by the lack of fresh outcrop. Metamorphism is thought to have peaked at amphibolite facies adjacent to the granitoids based on the coexistence of Ca-plagioclase and hornblende in mafic rocks. Peak assemblages, which consist of relatively coarse grained and pseudomorphed primary assemblages in igneous rocks, are locally replaced by finer grained assemblages aligned parallel to the foliation (S_3). This suggests that the metamorphic peak probably occurred prior to D_3. In mafic rocks, assemblages defining S_3 consist of amphibole–plagioclase–biotite (–epidote–sphene). The presence of biotite indicates minor K-metasomatism during D_3.

All Archaean structures on CUNYU are cut by a series of easterly trending faults and fracture zones. Many of these faults and fracture zones have a strong magnetic signature, which suggests that they have been infilled by mafic dykes. Others are parallel to large quartz veins. Some of the faults extend for more than 100 km to the east and one, which passes through the centre of CUNYU, displaced the Yandal greenstone belt in a sinistral sense. These structures are thought to be Proterozoic from previous studies in the Eastern Goldfields; for example, Hallberg (1987).

Proterozoic geology

Mafic dykes (*Ed*)

Presumed Proterozoic dykes have been identified in the Archaean basement from aeromagnetic data. The interpreted dykes have an easterly trending direction in the southern part of CUNYU, swinging to a northeasterly direction in the north. The trend of these dykes is similar to that of the post-cratonization dyke suite of Hallberg (1987), which is developed throughout the Yilgarn Craton. The dykes are marked by linear zones of normal or reverse polarity on aeromagnetic maps. No dykes were observed in outcrop and, on the basis of geophysical modelling by

Tucker and Boyd (1987), many of them are situated at some depth below the surface.

Yerrida Group

The Yerrida and Bryah Groups, defined by Pirajno et al. (1996), include rocks that were initially included in the Glengarry Group of Gee and Grey (1993). A major structural discontinuity, the Goodin Fault (Fig. 1), is mapped as the boundary between the Yerrida and Bryah Groups.

The Yerrida Group is subdivided into the Windplain and Mooloogool Subgroups. This subdivision is based on the change from a predominantly shallow-water environment dominated by quartz arenite and stromatolitic units (sag-basin succession; Pirajno et al., 1995) of the Juderina and Johnson Cairn Formations, into a presumably deeper water environment (rift succession) characterized by turbidites (Thaduna and Doolgunna Formations), black shale (Maraloou Formation), and mafic volcanic rocks (Killara Formation). On CUNYU, the Yerrida Group is represented by sedimentary rocks of the Juderina Formation (Windplain Subgroup), with intercalated mafic volcanic rocks of the Killara Formation (Mooloogool Subgroup). The stratigraphy of the Yerrida Group is shown in Table 1.

Windplain Subgroup

Juderina Formation (ⱣYj, ⱣYjf, ⱣYjs, ⱣYjb)

The Juderina Formation (Occhipinti et al., 1997) is a predominantly shallow-water sequence of quartz sandstone, local siltstone, chert breccia, and conglomerate, and forms the base of the Yerrida Group (Table 1). This unit is distributed around the margins of the Yerrida Basin, but is inferred to be present throughout, forming the basin floor. The Juderina Formation is in faulted or unconformable contact with Archaean basement rocks and is conformably overlain by the Johnson Cairn Formation, with the contact defined by the top of the last quartz arenite unit. The thickness of the Juderina Formation varies considerably throughout the Yerrida Basin. At the type locality, 3.5 km north of Juderina Bore on DOOLGUNNA, the formation is only 30 m thick (Gee, 1979). In reference sections on MARYMIA and MOOLOOGOOL, the formation is about 1000 m thick (Occhipinti et al., 1997).

The Juderina Formation outcrops as a broad arc in the western part of CUNYU (Fig. 3) and forms resistant ridges rising up to 60 m above the surrounding plain. The ridges are separated by recessive zones underlain by siltstones. A generalized stratigraphy of the Juderina Formation in the area 5–10 km west and southwest of Mount Alice is shown in Figure 4.

The basal units of the Juderina Formation are commonly represented by beds of mature quartz arenite and subordinate quartz siltstone. These units show sedimentary structures (ripple marks, herring-bone cross laminations) that are indicative of shallow-water sedimentation. These rocks constitute the Finlayson Member (*ⱣYjf*). The Bubble Well Member (*ⱣYjb*) comprises a distinctive unit of stromatolitic chert and chert breccia in the middle of the formation. These units are discussed below. The development of chert breccia units is more pronounced in the southern part of CUNYU than in the north and a turbidite unit has been identified. Furthermore, the formation has been considerably thickened by the intrusion of dolerite sills.

Higher in the sequence, the rocks of the Juderina Formation become increasingly thicker bedded and consist of a predominantly grey quartz arenite (*ⱣYj*), commonly with a purple hematitic surface colouration. Sand grains in the upper quartz arenite are commonly more angular, and cross-bedding and ripple marks are not as well developed as in the basal units. The sandstone is composed of packed aggregates of rounded to subrounded quartz (0.3 – 0.4 mm in diameter) with subordinate interstitial kaolinite and traces of rutile, zircon, and tourmaline. The quartz grains commonly contain trails of fluid inclusions. About 2.5 km northwest of Goosie Bore (Fig. 3 — Locality 6, AMG 229762), sandstone contains nodules up to 10 cm in diameter, or tabular bodies up to 30 cm long with well-developed cubic voids, probably after halite (Fig. 5).

Shale and quartz siltstone (*ⱣYjs*) form a large proportion (up to 30%) of the Juderina Formation, but are commonly recessive and not well represented on CUNYU. This unit is exposed mainly on the side of hills and ridges capped by quartz arenite. The siltstone varies from white to light grey and is commonly fissile and finely laminated. It is locally interbedded with thin chert-textured bands. Siltstone consists of quartz grains (about 0.05 mm in diameter) in a matrix of very poorly crystalline illite and kaolinite group clays. The quartz grains show irregular crystal boundaries and are partly dissolved by the clay matrix. Local white mica is altered along grain margins to clays, which show a preferred orientation parallel to lamination, probably as a result of diagenetic compaction.

A unit of lithic sandstone couplets fining upwards to siltstone–shale (*ⱣYjs*) sits stratigraphically above the quartz sandstone and is interpreted to be a turbidite deposit. Good exposures outcrop along a tributary of the Negrara Creek (Fig. 3 — Locality 7, AMG 193783). This unit is intruded by the Cunyu sill (see **Dolerite** below) and has been assigned to the Juderina Formation based on its stratigraphic position; however, it shows lithological similarities to units of the Johnson Cairn Formation (not exposed on CUNYU; Occhipinti et al., 1997).

The unconformity at the base of the Juderina Formation is not exposed on CUNYU. However, Elias and Bunting (1982) described the unconformity at a locality 2 km west of Lanagan Bore on WILUNA (1:250 000). They reported an 8 m-thick lens of conglomerate and pebbly arenite that passes laterally and vertically into coarse-grained quartz arenite. Pebbles in the conglomerate consist mainly of vein quartz with minor banded chert, probably derived from the Archaean basement. Elsewhere on WILUNA (AMG 173643), the unconformity is marked by a 50 cm band of thinly bedded granule conglomerate

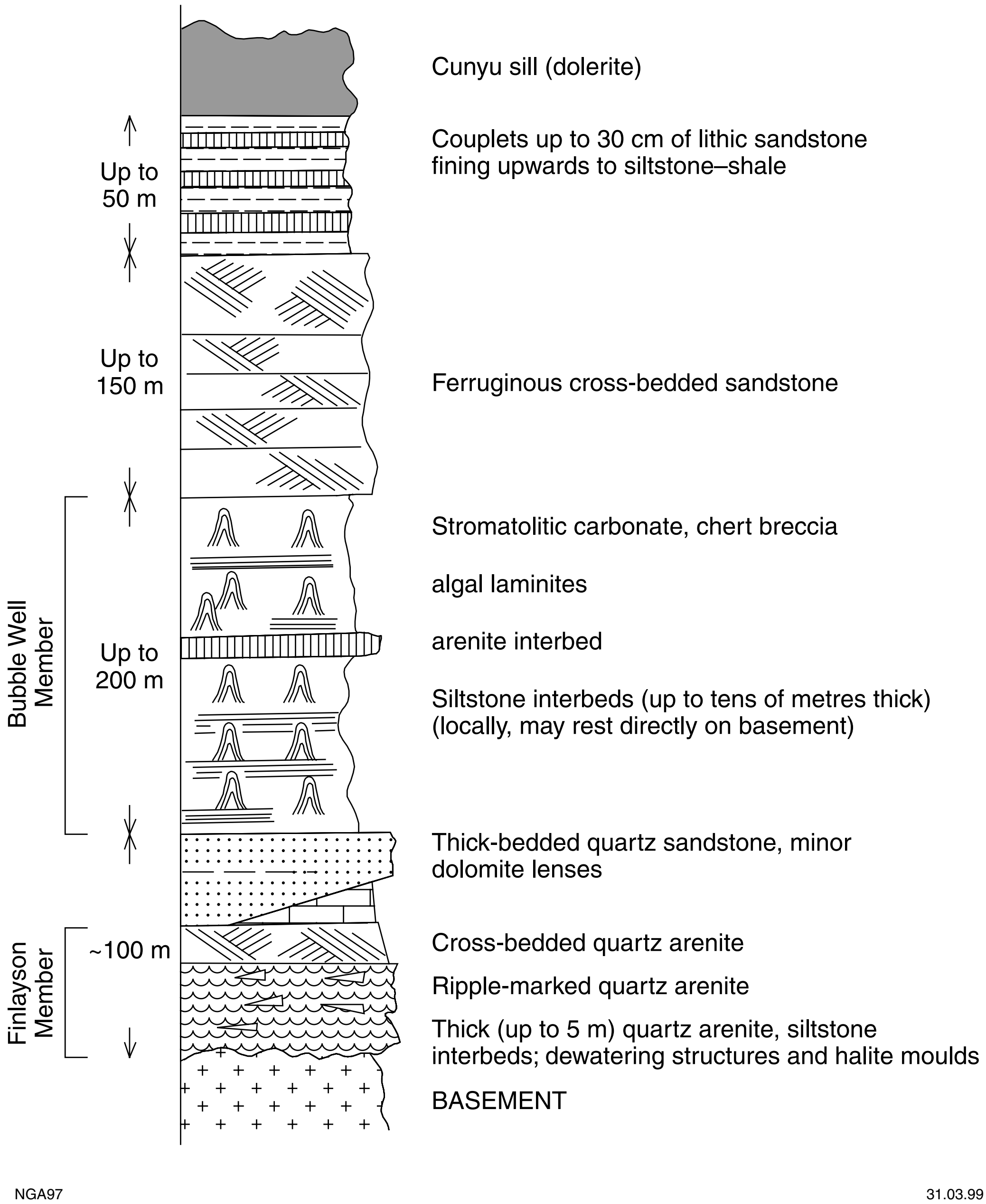

Figure 4. Simplified stratigraphy of the Juderina Formation in the area west of Mount Alice

(Langford and Liu, 1997). Clasts consist of quartz and jasper set in a matrix of poorly sorted and weakly kaolinitic quartz sandstone. The basal arenite units are flaggy bedded and ripple marked.

Finlayson Member (ĿYjf)

Outcrops of the Finlayson Member (*ĿYjf*) are commonly confined to the base of the Juderina Formation, close to the unconformity with the Archaean basement. The basal units are exposed 3 km northeast of Top Kukabubba Well and consist of off white, silica-cemented, parallel-laminated quartz arenite locally with brown diagenetic (?carbonate) spotting (Fig. 6). The arenite forms beds from a few centimetres to 1 m thick. Both symmetrical and asymmetrical ripple marks are present. Ripple crests are straight, although sinusoidal forms are also present. Wavelengths vary widely from a few centimetres to tens of centimetres. Small-scale ripples with flat tops (Fig. 6) suggest very shallow water or even emergent conditions. Nodular chert concretions and halite moulds are locally developed. Brown spotting is widespread and varies from a few millimetres to several centimetres in diameter, and in some cases results in a blotchy appearance (Figs 6 and 7).

Zones of bleaching are present in the quartz arenite 2.5 km northeast of Top Kukabubba Well (Fig. 3 — Locality 8, AMG 267892). These zones consist of irregular areas that vary widely from 1 cm to over a metre across. The bleaching is fracture controlled, pervasive, and overprints the diagenetic carbonate spotting (Fig. 7).

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Figure 5. Halite pseudomorphs in chert nodules within sandstone of the Juderina Formation, 2.5 km northwest of Goosie Bore

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Figure 6. Small-scale ripple marks on carbonate-spotted quartz arenite, Finlayson Member, 4.1 km northwest of Top Kukabubba Well

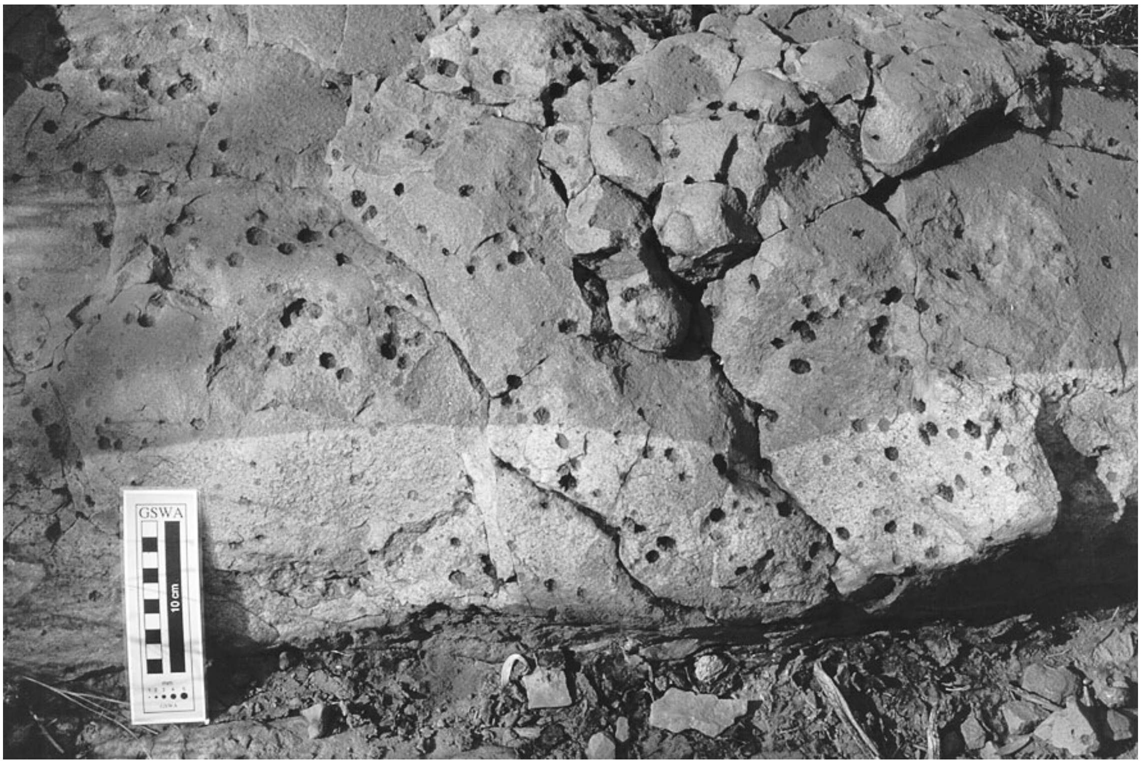

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Figure 7. Zone of bleaching in carbonate-spotted quartz arenite, Finlayson Member, 2.4 km northeast of Top Kukabubba Well

Quartz arenites of the Finlayson Member are characterized by very well sorted and well-rounded quartz grains 0.2 – 0.5 mm in diameter. Grain boundaries are commonly defined by fine impurities. The grains are mostly monocrystalline and undulose with crystallographically continuous overgrowths. Heavy-mineral concentrates from this unit consist mainly of subhedral zircon and tourmaline associated with rounded, brown biotite and rutile. Well-rounded, heavy-mineral phases are subordinate, which suggests that the basal quartz arenite was mainly derived from the protracted peneplanation of the granite basement, with most of the heavy-mineral population being of first-cycle derivation.

Bubble Well Member (ⱣYjb)

The Bubble Well Member (*ⱣYjb*) was defined by Occhipinti et al. (1997) as a unit (estimated to be 160 m thick) of chertified carbonate and evaporitic sedimentary rocks. The member is best developed in the southeastern parts of the Yerrida Basin. The type section is at Eagle Roost on WILUNA (1:250 000; Gee and Grey, 1993) and is considered to be in vertical continuity with outcrops on western CUNYU (Occhipinti et al., 1997). Gee and Grey (1993) carried out detailed studies of evaporitic and stromatolitic features in this unit.

On CUNYU, the Bubble Well Member is present as lenticular outcrops commonly between the basal arenite of the Finlayson Member and overlying thick-bedded arenites. As this unit does not occupy a unique stratigraphic position, it must represent a facies of the Juderina Formation.

The Bubble Well Member overlies granitic basement around Goosie Bore, but commonly overlies either the Finlayson Member or quartz sandstone units (*ⱣYj*; Fig. 4). At the southern boundary of CUNYU (Fig. 3 — Locality 9, AMG 177656), the basal units of the Juderina Formation consist of brown, impure, kaolinitic quartz sandstone overlain by chert and chert breccia of the Bubble Well Member. The cherts show both well-bedded facies with subrounded forms (?biohermal), and chaotic breccia facies with intervening thin, semi-continuous chert bands. Stromatolitic bioherms are widespread in the cherts and diagenetic chert nodules are abundant. The cherts are, in turn, underlain by off white, ripple-marked quartz arenite close to the basal contact. An underlying chert breccia shows well-developed pseudomorphs of evaporitic minerals, probably gypsum. These associations highlight the interfingering relationship between the quartz arenite units of the Finlayson Member and the chert breccia units of the Bubble Well Member.

The Bubble Well Member typically consists of layers of chert breccia, chert with wavy laminations — all derived from dolomitic microbial laminites — and chert-replaced stromatolitic dolomite. The member commonly forms rusty weathered chert and chert breccia with diffuse grey banding. Rounded nodules, probably diagenetic, are widespread, and delicate, wavy microbial laminations formed in some facies. Species of the stromatolite *Wilunella glengarrica* (Grey, K., 1997,

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Figure 8. Stromatolite *Wilunella glengarrica,* Bubble Well Member, 2.2 km north-northeast of Top Kukabubba Well

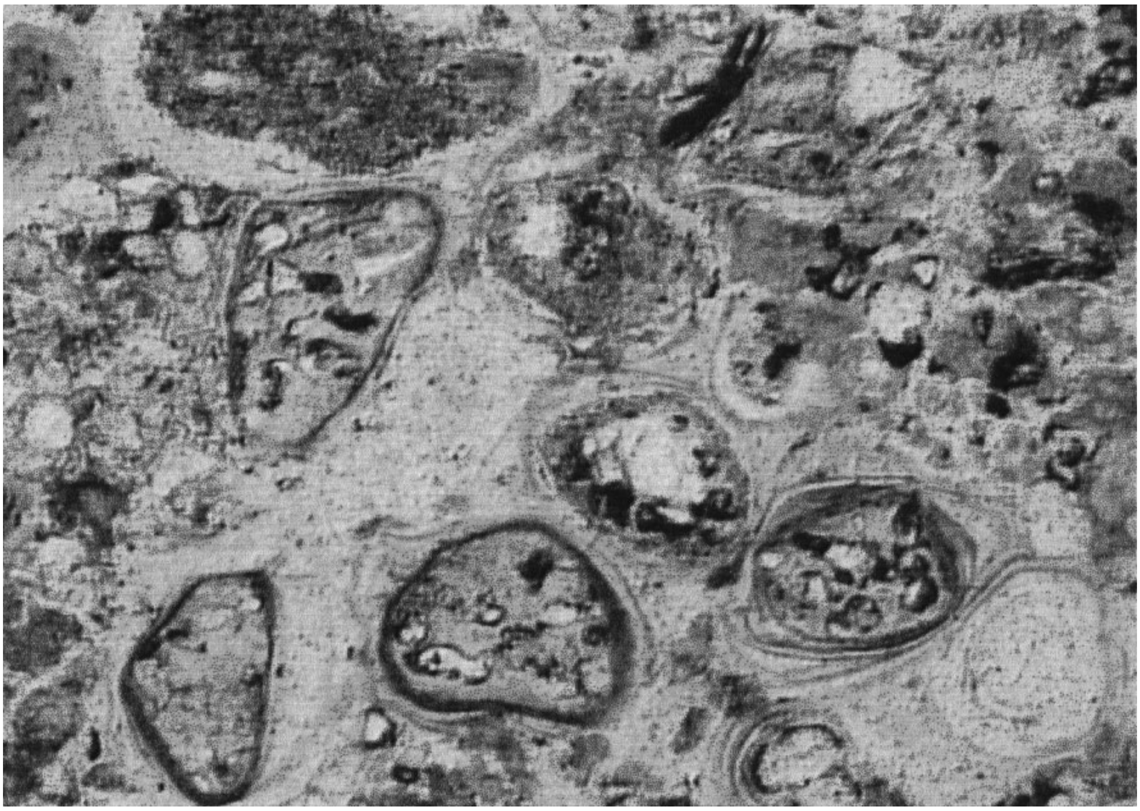

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Figure 9. Peloidal rock composed of coated grains, probably of carbonate origin, pseudomorphed by chalcedony, together with detrital quartz, enclosed in a cherty matrix. Locality 3 km northeast of No 2 Well. GSWA sample 133221, plane-polarized light, field of view is 1.07 mm

pers. comm.; Fig. 8) were identified in outcrop 2 km north of Top Kukabubba Well (Fig. 3 — Locality 10, AMG 252898). Along strike from this outcrop, dolarenite units are interbedded with cross-laminated quartz arenite. The dolarenite units, which are too small to show on the geological map, consist of peloidal or locally oolitic forms. The peloids average 0.4 mm in diameter (Fig. 9) and are commonly elliptical and set in a weakly iron stained, cherty matrix. Quartz grains are intermixed with the peloids and locally form the cores of oolites. The presence of these units indicates a shallow-water, high-energy environment (Davies et al., 1978).

Breccia bands are locally interbedded with subordinate, weakly ferruginous, well-sorted sandstone. Ripple-marked quartz arenite 4.9 km west-northwest of Top Kukabubba Well (Fig. 3 — Locality 11, AMG 203891), is overlain by a thick sequence of chert and chert breccia, locally with evaporitic minerals (now elongate pseudomorphs) and stromatolitic laminations. Cherty bands up to 2 cm thick formed in some facies alternating with finely laminated chert of probable microbial origin.

The lithological associations described above suggest a shallow-water, probably intertidal, environment with interfingering relationships between carbonate units (now represented by chert breccia) and quartz sandstone, and the local development of evaporitic minerals and stromatolites. Gee (1987) and Gee and Grey (1993) interpreted these relationships to be indicative of a sabkha-type environment.

Johnson Cairn Formation (ⱣYc)

The Johnson Cairn Formation (Johnson Cairn Shale; Gee, 1987) is not exposed on CUNYU. However, the formation is inferred from the adjacent MOUNT BARTLE to underlie part of the northwestern edge of CUNYU. At the type area 13 km northeast of THADUNA, the formation rests conformably on the Juderina Formation and is represented by laminated, varicoloured, iron-rich shale interbedded with minor carbonate. The formation may be up to 1250 m thick and is conformably overlain by the Thaduna Formation of the Mooloogool Subgroup (Bagas, 1998). On MOUNT BARTLE, it is described as a sequence of laminated, purple- to cream-coloured siltstones and is considerably thinner, probably less than 100 m thick (Dawes and Pirajno, 1998).

Mooloogool Subgroup

Thaduna Formation (ⱣYt)

The Thaduna Formation, originally named Thaduna Greywacke by Gee (1979), is not exposed on CUNYU but interpreted from MOUNT BARTLE to underlie part of the northwest edge of CUNYU. The contact with the underlying Johnson Cairn Formation is inferred to be conformable.

At the type locality around Thaduna mine, the Thaduna Formation is estimated to be up to 5 km thick and represented by a sequence of lithic sandstone and hematitic shale. The sequence is interpreted to be proximal turbidites, with rain-pitted surfaces suggesting periodic emergence (Blockley, 1968). Clasts in the sandstone include basaltic rock, albitized plagioclase, and epidote. These components may have been derived from mineralogically similar metavolcanic rocks of the Archaean greenstone belts; however, contributions from the Killara Formation of the Yerrida Group (see **Killara Formation**), or from the Narracoota Formation (Bryah Group), can not be discounted (Bagas, 1998).

On MOUNT BARTLE, the Thaduna Formation is represented by a thick sequence of litharenite, feldspathic litharenite, and interbedded shale. The formation is thickest in the northwestern part of MOUNT BARTLE, and thins considerably to the east at the boundary with CUNYU.

Killara Formation (ⱣYk, ⱣYkb, ⱣYkd, ⱣYkc)

The Killara Formation (*ⱣYk*; Occhipinti et al., 1997) consists of dolerite intrusions and basalt flows with minor cherty bands. The formation covers extensive areas south and east of the Goodin Inlier and shows interfingering relationships with most units of the Yerrida Group. East of the Goodin Inlier (Fig. 1), units of the Killara Formation interfinger with the Johnson Cairn, Doolgunna, and Thaduna Formations. The formation also interfingers with the base of, and is overlain by, the Maraloou Formation. The Killara Formation represents continental volcanism associated with the rifting of the Yerrida Basin. Details of the geology, petrography, and geochemistry of the Killara Formation on the adjacent MOUNT BARTLE are documented by Dawes and Pirajno (1998) and Pirajno et al. (1998).

On CUNYU, outcrops of the Killara Formation are largely represented by dolerite sills (*ⱣYkd*), which intrude the arenite units of the Juderina Formation. In the upper parts of the formation, fine-grained basaltic flow units (*ⱣYkb*) predominate. The top of the Killara Formation consists of chertified microbial laminites and is termed the Bartle Member (*ⱣYkc*; Occhipinti et al., 1997).

Dolerite (ⱣYkd)

Dolerite (*ⱣYkd*) forms thick sills (up to 150 m) at three stratigraphic levels in the Juderina Formation. The distribution of the dolerite sills is partly controlled by the presence of siltstone units, with intrusion preferentially taking place along their contact with the more competent quartz arenite beds.

Dolerite is dark grey to black with blocky to spheroidal weathering and typically forms resistant ridges. Micropegmatitic segregations are present in places and the rock is locally veined by a quartz–epidote assemblage. Dolerite is locally microporphyritic and consists of fresh clinopyroxene, commonly with polysynthetic twinning, and plagioclase, which locally has normal igneous zoning. The composition of the plagioclase ranges from andesine to labradorite. Two types of pyroxene are locally present: weakly pleochroic, commonly serpentinized orthopyroxene; and fresh, colourless ?augite. Interstitial granophyric intergrowths of quartz and feldspar are well developed. The opaque mineral in the dolerite is titanomagnetite, which is variably altered to leucoxene and shows trellis-type exsolution lamellae of ilmenite.

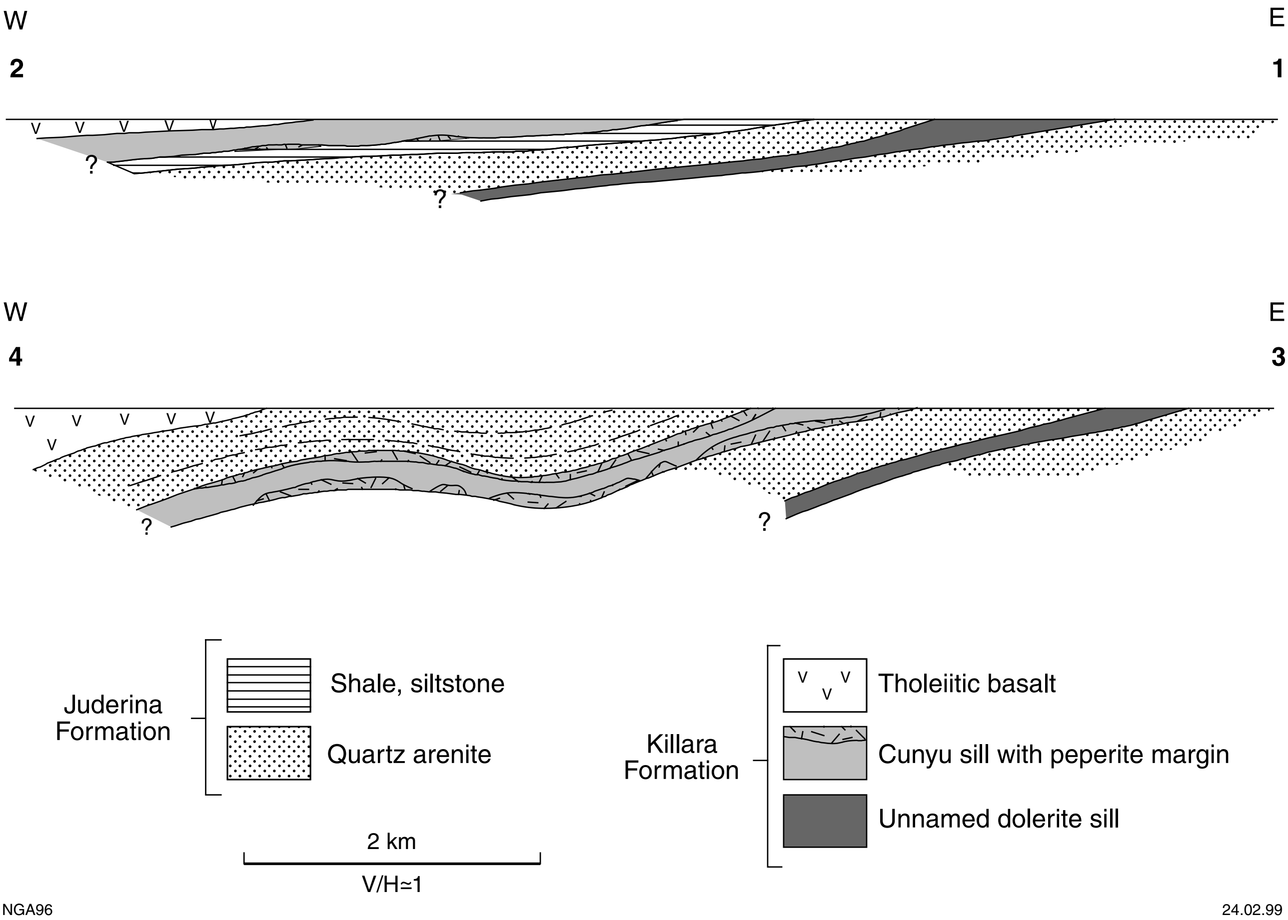

Figure 10. Cross sections through the Cunyu sill based on field observations. Positions of sections are shown in Figure 3

The largest of the dolerite sills is the Cunyu sill in the southern part of CUNYU. The sill extends in a northwesterly direction for 18 km and is 30–150 m thick. Cross sections through the intrusion are shown in Figure 10. The upper and lower contacts between the sill rocks of the Juderina Formation are marked by peperite. Peperite, a fine mixture of glass and sediment, is a product of quench fragmentation by the intrusion of magma into wet sediments (Cas and Wright, 1988). Peperitic dolerite is distinguished by a high content of country rock fragments, hydrothermal alteration, interstitial devitrified glass, quench textures, and weak disseminations of sulfide mineralization (mainly pyrrhotite and pyrite). In these zones, pyrrhotite commonly fills cavities and is rimmed by zeolite minerals and calcite. The Cunyu sill has a higher magnetic susceptibility at its upper and lower contacts relative to its central parts. These variations are attributed to the effects of hydrothermal alteration during peperite development.

The Cunyu sill typically contains augite and cloudy plagioclase laths (labradorite) with prehnite, pumpellyite, calcite, palagonite, zeolite, and chlorite as alteration minerals, disseminated skeletal ilmenite, leucoxene, and sulfides. The sulfides tend to form small (<0.01 – 0.02 mm in diameter), irregular blebs and include pyrite, hexagonal pyrrhotite (non-magnetic; Fig. 11), smythite ($(Fe,Ni)_9S_{11}$), and, less commonly, chalcopyrite. A highly reflective sulfide (probably a lead arsenide) is present as submicroscopic inclusions in pyrrhotite.

Very fine grained, laminated, pale-green and locally spotted chert-like rocks form narrow (5–100 cm wide) subparallel bands up to 50–60 m long within the dolerite. Within these zones, dolerite is fractured and veined with the chert-like rocks. Good exposures of these cherty bands are present near the junction of the Wiluna North road with the Canning Stock Route (Fig. 3 — Locality 12, AMG 214911). These rocks consist of a mosaic of lobate quartz and prismatic clinozoisite with a distinct granular texture. Disseminated epidote porphyroblasts (?pistacite) give the rock a spotted appearance; cross-cutting veinlets of quartz and clinozoisite are also present. These rocks are classed as epidosite and represent either a thermally metamorphosed volcaniclastic layer, or sites of hydrothermal reaction zones where seawater, heated from underlying mafic melts, has reacted with the surrounding rocks to form epidote and quartz at the expense of Ca-plagioclase.

Basalt (ȺYkb)

Outcrops of basalt (*ȺYkb*) occupy an arcuate belt in the western part of CUNYU. Basalt is either weathered to a nodular or pisolitic laterite (*Czl*), or covered by ferruginous rubble and colluvium (*Czf*). There are small subcrops

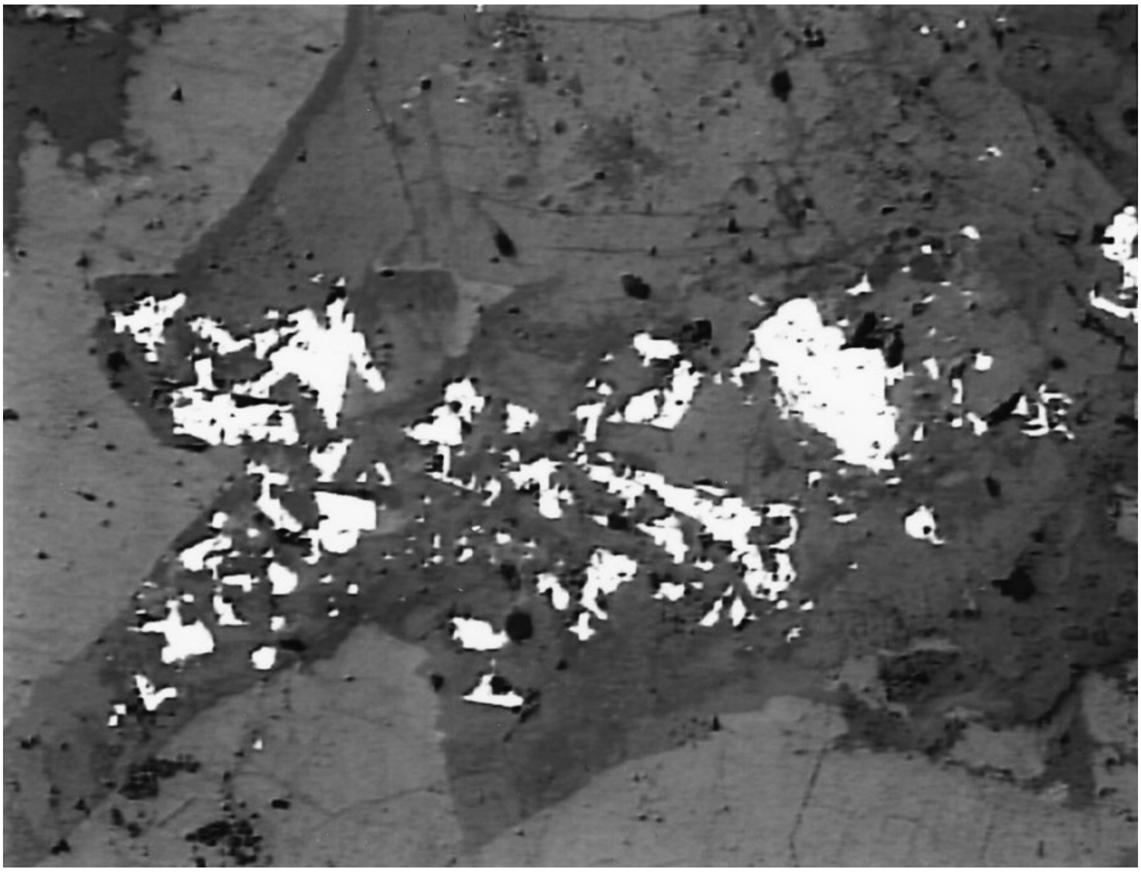

Figure 11. Pyrrhotite blebs in altered plagioclase crystals in a peperite zone developed at the contact between dolerite of the Killara Formation and sandstone of the Juderina Formation; GSWA sample 119417, 500 m east of a microwave repeater station. Reflected light, parallel polars, field of view is 1.07 mm

of comparatively fresh material that can not be represented at the map scale. However, large outcrops of fresh, fine-grained basalt are located between Gum and Negrara creeks in the south, with more extensive outcrops in the area north of No 1 Bore on the western edge of CUNYU. The transition from basalt to the overlying Bartle Member is marked by the development of thin-bedded morphology in the basalt and the presence of cherty, interflow sedimentary units. Forms resembling flattened pillows are locally exposed.

Basalt is distinguished from dolerite by poorly developed columnar jointing and a finer grain size. Spheroidal weathering is common and the basalt shows varying degrees of vesicularity. Quartz is a common fracture-filling mineral, both in the form of veins of coarse-crystalline material and as banded chalcedonic varieties (agate). In the upper parts of the sequence (Fig. 3 — Locality 13, AMG 063893), photogeological trends reflect alternating spheroidal and blocky weathered basalt, which suggests sequential eruption of lavas of slightly different character.

Textures in the basalt vary from holocrystalline to microporphyritic or intersertal. Fine-grained holocrystalline basalt consists of euhedral plagioclase and anhedral clinopyroxene, the latter commonly interstitial to plagioclase. Both plagioclase and pyroxene are mostly fresh with minor alteration limited to fractures. Chlorite, titanite, secondary quartz, and prehnite are the main alteration products. The formation of titanite is linked to the alteration of titanomagnetite, with the latter commonly altered to leucoxene, which encloses minute specks of euhedral chalcopyrite.

Bartle Member (ƁYkc)

The Bartle Member (*ƁYkc*) is a thin and laterally discontinuous unit containing chert, tuffaceous lithologies, chertified sedimentary rocks, and thin lava flows. This unit was defined by Occhipinti et al. (1997) and contains rocks that were previously included in the Maraloou Formation by Elias and Bunting (1982), and in the Narracoota Formation by Gee and Grey (1993). The unit is well developed on MOUNT BARTLE, west of CUNYU. A detailed description of the member is provided by Pirajno and Grey (1997) and Dawes and Pirajno (1998), who argued for deposition in a playa-type environment with associated hot springs. These authors suggested that the Bartle Member was formed in an environment similar to the modern-day Afar region of northeast Africa.

On CUNYU, the Bartle Member caps volcanic units of the Killara Formation. The maximum thickness of the member (about 10 m) is rarely exposed. The unit consists largely of chert, which varies from white to grey, and is locally banded. Cherty siltstone and brown hematitic and limonitic ironstone, locally with a spherulitic texture, are present. The chert is veined by coarse-grained quartz. Outcrops of vuggy goethitic ironstone with boxworks, probably after sulfides, are locally present; for example, in the area 6.5 km south-southwest of No 3 Bore (Fig. 3 — Locality 14, AMG 028904).

An outcrop of grey chert 7.5 km north of No 1 Bore (Fig. 3 — Locality 15, AMG 033894) shows contorted laminae, which suggests that there was some syn-depositional deformation. Cavities in the chert are coated with botryoidal hematite. Radiating spherulitic forms are present in the body of the chert. Samples from this unit contain abundant globular structures, 20–50 µm in diameter, composed of iron hydroxides. Associated with these features are rosettes of radially arranged, rhomb-shaped crystals (probably dolomite, now replaced by quartz) with interstices filled with radiating chalcedony. These features suggest silicification of a carbonate rock. Chalcedonic quartz forms spherulites, which contain submicroscopic spheroids ~10 µm in diameter. Similar spheroids have been described from outcrops on MOUNT BARTLE (Pirajno and Grey, 1997; Dawes and Pirajno, 1998) and the term microdubiofossils was applied due to their uncertain biological origin. An alternative explanation of the origin of these spheroids is by flocculation of colloids from hydrothermal solutions (Pirajno, 1992). Siliceous rocks are spatially associated with the cherts and consist of a mixture of silica and fibrous goethite (Fig. 12). These lithological associations suggest a shallow-water environment where carbonate, chert, and iron hydroxides were precipitated. The iron is probably related to the volcanic activity associated with the emplacement of the Killara Formation.

Maraloou Formation

The Maraloou Formation is a sequence of argillaceous sedimentary rocks, black shale, marl, dolostone, and minor chert, and forms the uppermost unit of the Yerrida Group (Occhipinti et al., 1997). The formation interfingers with the Killara Formation on MOUNT BARTLE (Dawes and Pirajno, 1998), although unconformable contacts with the Doolgunna Formation were noted during recent mapping on THADUNA (Pirajno and Adamides, 1997). On CUNYU, the Maraloou Formation is not exposed; however, it is interpreted from the adjacent MOUNT BARTLE to underlie part of the southwest corner of CUNYU.

Structure and metamorphism

Sedimentary units on CUNYU show only minor deformation in the form of gentle dips and local open, west-northwesterly plunging folding. The quartz grains in the arenite units retain their original detrital shape with no indication of suturing or recrystallization. In the southern

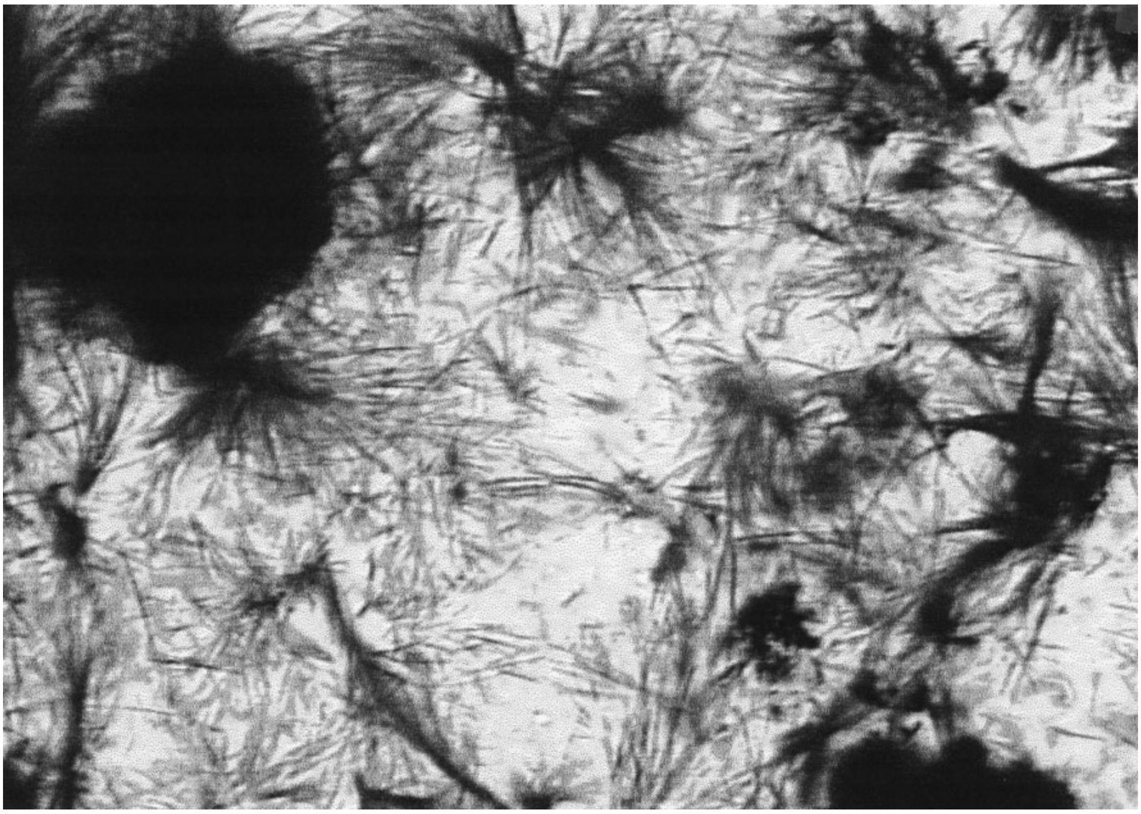

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Figure 12. Mixture of silica and fibrous goethite. This assemblage probably crystallized in a hot-spring environment. Bartle Member, GSWA sample 133246, 12.4 km southwest of Fyfe Well. Plane-polarized light, field of view is 0.54 mm

part of CUNYU, the contact between the Killara and Juderina Formations is abrupt and well defined with no mafic rocks identified southeast of the discontinuity. The orientation of the discontinuity, which extends in a west-southwesterly direction from Little Kukabubba Well to the southern edge of the map, is parallel to major aeromagnetic lineaments, which are probably occupied by mafic dykes. The discontinuity (not shown on the geological map but plotted on Fig. 3) is mapped as a fault by Myers and Hocking (1988). Exposure on CUNYU is insufficient to establish the nature of the discontinuity, but it may have played a role in the deposition of the Killara Formation.

Very low-grade metamorphism in the Juderina Formation, which corresponds to anchimetamorphism (Kisch, 1987), is typified by the incipient development of illite, but the general preservation of original detrital clays. This very low metamorphic grade is confirmed by the preservation of primary mineral assemblages in mafic units. Alteration in these rocks is predominantly in the form of vein infillings of quartz and epidote, and partial fracture-controlled alteration of silicates. Alteration of titanomagnetite to leucoxene, and the association of this alteration with traces of sulfide, suggests incipient hydrothermal metamorphism (probably under auto-metasomatic conditions) and does not reflect general metamorphic conditions in the surrounding rocks.

Rocks of the Juderina Formation adjacent to the dolerite sills have a contact metamorphic assemblage of chlorite–carbonate–titanite–albite. The chlorite is faintly pleochroic with first-order grey birefringence and closely associated with carbonate. Euhedral crystals of pyrite within the carbonate are clearly related to the alteration assemblage. Fresh albite is interstitial to quartz. Carbonate rocks, proximal to dolerite, are patchily recrystallized to a coarser grained aggregate and locally contain a quartz–kaolinite assemblage infilling voids.

Cainozoic geology

Cainozoic deposits cover most of CUNYU and are subdivided into several units depending on their position on the land surface and composition. Areas of outcrop are commonly fringed by scree slopes composed of an unsorted mixture of rock fragments, lateritic rubble, sand, and silt (*Czc*). At lower topographic levels, this material is reworked by periodic flooding and results in a pattern of vegetation groves, which is particularly obvious on aerial photographs. This reworked material, or sheetwash (*Cza*), commonly fringes areas of alluvium in active drainage channels (*Qa*). The alluvium is composed of gravel mixed with finer sand and silt material. Claypans (*Qac*), composed of fine silt, have a distinctive high-reflectivity response on Landsat images and form at the terminations of internal drainage on low-lying areas.

Laterite (*Czl*) commonly overlies mafic volcanic rocks of the Killara Formation. The laterite forms a layer, up to 10 m thick, of nodular and pisolitic material and associated debris, which represents the products of deep weathering of mafic rocks during a period of warm and wet climatic conditions, probably in the early Tertiary (Elias and Bunting, 1982). The laterite grades downwards into a saprolitic zone, then into the underlying weathered bedrock. Overlying the laterite, and derived from it, is a mixture of ferruginous pisolites and nodules, ferruginized rock, ironstone rubble, and soil (*Czf*).

Areas of granitoid are commonly covered by a thick layer of orange-brown, subangular-textured sand (*Czs*), which is the result of initial lateritization of the granite and subsequent degradation. The sand is locally arranged into predominantly northerly trending dunes that reflect the prevailing winds. Locally, granitoid outcrops are capped by silcrete (*Czz*), a hard siliceous material containing unsorted, angular quartz grains.

Calcrete (*Czk*), a mixture of carbonate and opaline silica commonly lining the main drainages, is particularly well developed near the abandoned Cunyu Homestead. The calcrete reaches a thickness of 10–30 m and is commonly a good aquifer, yielding water suitable for livestock. The formation of calcrete is linked to precipitation below the watertable under conditions of low rainfall and high evaporation (Hocking and Cockbain, 1990).

Economic geology

Minor sulfide mineralization, in the form of veinlets and disseminations of pyrite and chalcopyrite, is locally evident in the dolerite of the Killara Formation. Chalcopyrite is spatially associated with magnetite, now altered to leucoxene. Pyrite veinlets follow boundaries between plagioclase and clinopyroxene. This mineralization, in association with the development of a quartz–epidote vein assemblage, suggests limited hydrothermal activity. Elsewhere, the rocks of the Bartle Member were reported to be locally anomalous in gold with a maximum value of 66 ppb from MOUNT BARTLE (Dawes and Pirajno, 1998).

A listing of exploration reports on open file as of 30 October 1998 is presented in Appendix 2. Rocks exposed on CUNYU, particularly the stromatolitic chert breccia of the Bubble Well Member, are prospective for base metal (Mississippi Valley-type) deposits; consequently, the area has been included in regional exploration programs. Exploration for Witwatersrand-type gold in the coarser facies of the Juderina Formation was described by Drummond (1983). Exploration by Amax for nickel sulfide mineralization in Archaean ultramafic rocks between 1966 and 1973 (Item 1928, Appendix 2) resulted in the identification of areas of lateritic nickel mineralization, locally grading above 1% Ni and 0.1% Co.

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Appendix 1

Gazetteer of localities mentioned in text

Locality[(a)]	*Latitude (S)*	*Longitude (E)*	*AMG coordinates*	
			Easting	*Northing*
Canning Stock Route	26°10'53"	120°14'55"	225000	7101300
Cunyu Homestead	26°01'25"	120°06'55"	211300	7118500
Eagle Roost[(b)]	26°34'40"	119°55'30"	291360	7057000
Finlayson Range	26°28'45"	120°06'40"	212000	7068000
Fyfe Well	26°13'27"	120°07'50"	213300	7096300
Goodin Inlier[(b)]	25°56'21"	119°18'24"	731000	7129000
Goosie Bore	26°25'23"	120°14'31"	224900	7074500
Gum Creek	26°27'02"	120°02'30"	205000	7071000
Jones Creek	27°26'41"	120°33'33"	258760	6961940
Juderina Bore[(b)]	25°52'53"	119°12'03"	720500	7135600
Jungarra Bore	26°12'10"	120°28'56"	248400	7099400
Lanagan Bore	26°42'23"	120°00'50"	202900	7042600
Little Kukabubba Well	26°22'36"	120°19'01"	232300	7079800
Mount Alice	26°22'42"	120°15'28"	226400	7079500
Mudjon Bore	26°17'23"	120°29'46"	250000	7089800
Negrara Creek	26°28'03"	120°09'42"	217000	7069400
New Springs Homestead	25°49'28"	120°00'02"	299300	7140300
No 1 Bore	26°21'31"	120°02'13"	204300	7081200
No 2 Well	26°17'04"	120°12'22"	221000	7089800
No 3 Bore	26°13'06"	120°02'40"	204700	7096750
Thaduna	25°30'29"	119°42'40"	772500	7176000
Top Kukabubba Well	26°18'11"	120°14'44"	225000	7087800
Wiluna	26°35'39"	120°13'25"	223500	7055500

NOTES: (a) Localities are within Australian Map Grid (AMG) Zone 51 unless specified otherwise
(b) Locality within AMG Zone 50

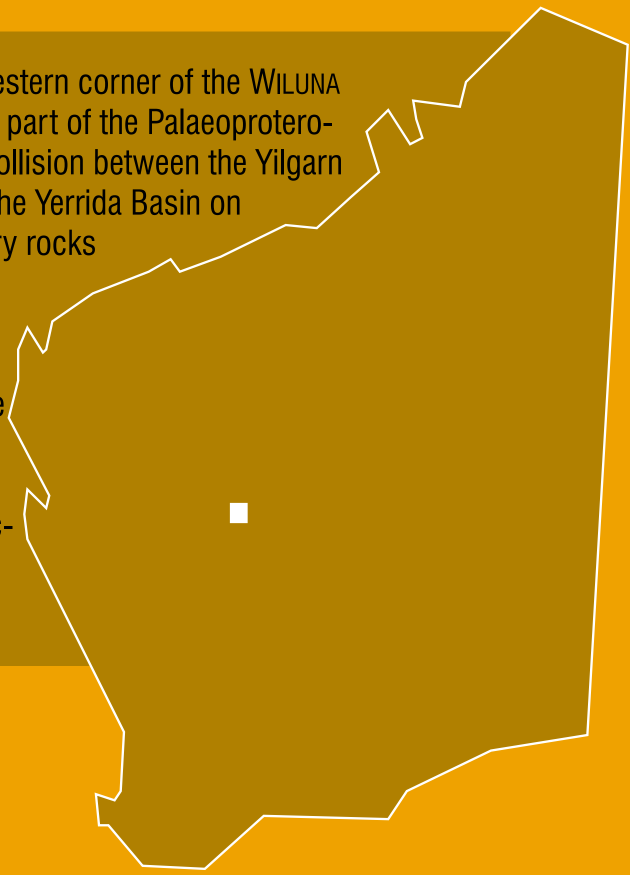
Appendix 2

Projects on open file in the Western Australian Mineral Exploration database (WAMEX) as of 30 October 1998

GSWA WAMEX item number [(a)]	*Reports*	*Duration*	*Title*	*Company*
1928	8	1966–73	Wiluna nickel–copper/gold exploration	Vam Limited
3004	1	1976–79	Twelve Mile Pool copper–lead–zinc exploration	Samantha Mines
1100	1	1979–80	Johnch Bore uranium exploration	Chevron Exploration Corporation
3101	4	1982–86	Paroo copper–lead–zinc/gold exploration	Jarrahmond Holdings
2684	1	1982–84	Quartermaine Well copper–uranium exploration	Amoco Minerals Australia Company
3223	1	1986–87	Cunyu Woolshed/Davis Well gold exploration	BHP Minerals
5577	2	1987–89	Wiluna North gold exploration	Eon Metals
3800	1	1986–88	Finlayson Range copper–zinc exploration	Mitchell Exploration Company
5413	3	1987–91	Jundee gold exploration	Western Mining Corporation
3871	1	1987–88	Jonch Bore gold exploration	BHP Minerals
8044	2	1991–94	Moilers Find/Jundee exploration	Eagle Mining Corporation
6077	1	1990–91	Terabubba gold exploration	Western Mining Corporation
7323	1	1991–94	Wiluna diamond exploration	Stockdale Prospecting
8490	1	1991–95	Wiluna nickel exploration	CRA Exploration
7855	1	1991–94	Negrara Creek gold exploration	Eagle Mining Corporation
8585	1	1992–95	Yandil base metals/gold exploration	RGC Exploration
8781	2	1992–96	Yandil base metals/gold exploration	RGC Exploration
8892	4	1992–95	Paroo base metals/gold and diamond exploration	RGC Exploration
8511	1	1991–95	Merrie Range gold/diamond exploration	Marymia Exploration
9165	1	1991–96	Cunyu gold/diamond exploration	Cyprus Gold Australia Corporation
7858	3	1991–94	Bundel Well gold exploration	Eagle Mining Corporation, Orpheus Geoscience
7740	1	1992–94	Glengarry diamond exploration	Marymia Exploration

NOTE: (a) Information available from the Geological Survey of Western Australia Library, Mineral House, 100 Plain Street, W.A., 6004.

The CUNYU 1:100 000 map sheet covers the northwestern corner of the WILUNA 1:250 000 sheet. The sheet covers the southeastern part of the Palaeoproterozoic Yerrida Basin, which formed as a result of the collision between the Yilgarn and Pilbara Cratons during the Capricorn Orogeny. The Yerrida Basin on CUNYU includes siliciclastic and chemical sedimentary rocks (Juderina Formation), intercalated with mafic rocks (dolerite and basalt) of the Killara Formation. The sedimentary rocks rest unconformably on Archaean basement (Yilgarn Craton). Parts of three greenstone belts (Agnew–Wiluna, Cunyu, and Yandal) are present within the sheet area. CUNYU is prospective for greenstone-related gold mineralization, ultramafic-hosted nickel deposits, and sediment-hosted base metal deposits.



Further details of geological publications and maps produced by the Geological Survey of Western Australia can be obtained by contacting:

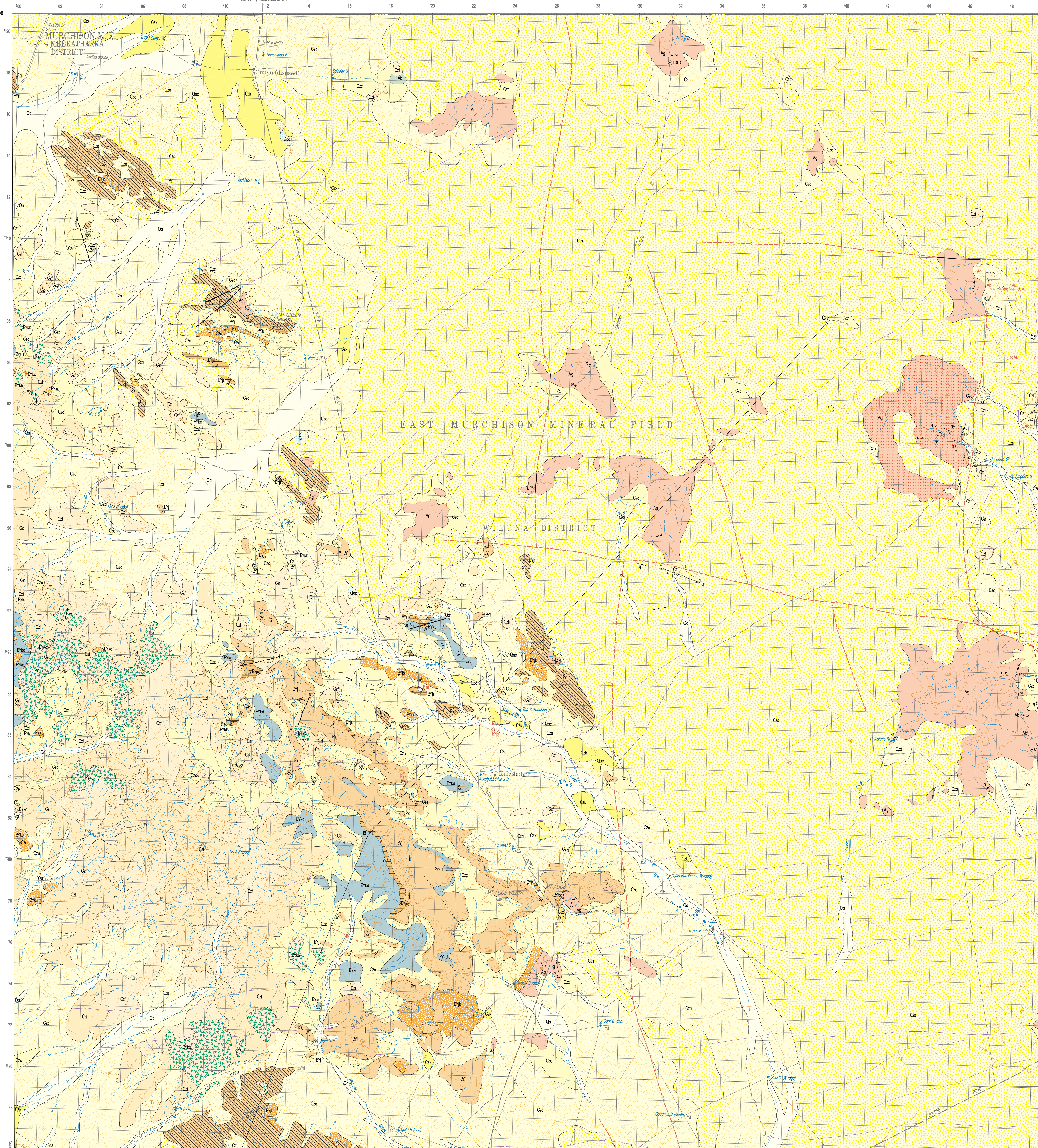
Information Centre
Department of Minerals and Energy
100 Plain Street
East Perth WA 6004
Phone: (08) 9222 3459   Fax: (08) 9222 3444
www.dme.wa.gov.au

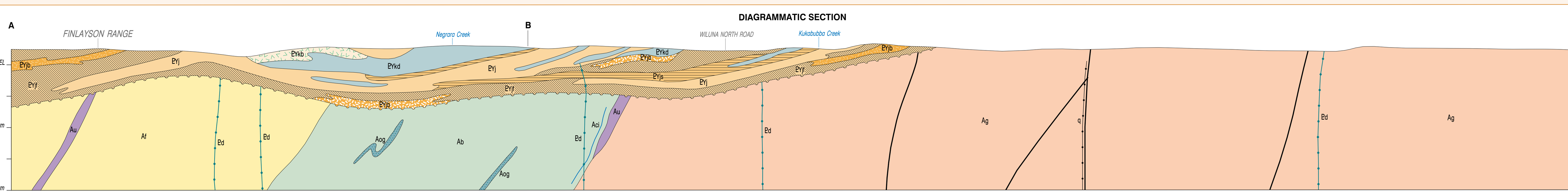
CUNYU

AUSTRALIA 1:100 000 GEOLOGICAL SERIES

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SHEET 2945





Legend

PHANEROZOIC — CAINOZOIC — QUATERNARY

- Qa — Alluvial deposits—sand and silt in discrete channels and floodplains
- Qac — Clay and silt in claypans

CAINOZOIC

- Cza — Sheetwash deposits—ferruginous clay, silt, and sand as extensive fans
- Czc — Colluvium—disaggregated bedrock, locally mixed with gravel, sand, and silt as scree
- Czk — Calcrete
- Czs — Sandplain deposits—unconsolidated sand; minor silt and clay; includes low, vegetated dunes
- Czz — Silcrete
- Czf — Ferruginized rubble and colluvium—dominantly ferruginized pisolites and nodules, ferruginized rock, and ironstone rubble; degraded lateritic duricrust
- Czl — Lateritic deposits—nodular and pisolitic laterite, and associated debris

PROTEROZOIC

- Ꝑd — Mafic dyke; interpreted from aeromagnetic data (section only)

YERRIDA BASIN — Yerrida Group

Mooloogool Subgroup

- ꝐYk — KILLARA FORMATION: undivided mafic intrusive and extrusive rocks (simplified geology only)
- ꝐYkc — Bartle Member: chertified microbial laminites with barite and anhydrite nodules
- ꝐYkd — Medium- to coarse-grained dolerite dykes and sills
- ꝐYkb — Aphyric tholeiitic basalt

Windplain Subgroup

- ꝐYj — JUDERINA FORMATION: quartz sandstone; local siltstone, chert breccia, and conglomerate
- ꝐYjb — Bubble Well Member: stromatolitic chert and chert breccia; minor dolomite
- ꝐYjs — Shale and siltstone
- ꝐYjf — Finlayson Member: quartz arenite and subordinate siltstone; planar-bedded or cross-stratified; commonly ripple-marked

- q — Quartz vein

ARCHAEAN — YILGARN CRATON

- Ag — Granitoid rock, undivided
- Agm — Biotite monzogranite
- Aci — Banded iron-formation; metamorphosed (section only)
- Af — Metamorphosed felsic rock, undivided
- Afs — Felsic schist, commonly quartz-phyric (subsurface only)
- Aog — Gabbro, generally fine- to medium-grained; metamorphosed
- Aogf — Gabbro, strongly foliated; metamorphosed (subsurface only)
- Ab — Metamorphosed mafic rock, undivided
- Aba — Amphibolite
- Au — Metamorphosed ultramafic rock, undivided
- Aur — Tremolite schist, probably after ultramafic rock or high-Mg basalt (subsurface only)

Symbols

Geological boundary
- exposed
- concealed

Fault, showing dip of fault plane
- exposed
- concealed
- concealed, interpreted from aeromagnetic data

Fold, showing trend and plunge direction
- anticline; exposed
- syncline; exposed, concealed

Bedding, showing strike and dip
- inclined
- horizontal
- strike and dip interpreted from aerial photographs
  - 0—15°
- trend

Metamorphic foliation, showing strike and dip
- inclined
- showing mineral lineation

Fracture or joint, showing strike and dip
- inclined
- vertical

Airphoto lineament

Aeromagnetic lineament

Isotopic age determination site with GSWA identification number — 142816

Formed road

Track

Fence, generally with track

Homestead — Cunyu

Building

Yard — Yd

Microwave repeater station

Horizontal control, minor

Breakaway

Sand dune

Contour line, 20 metre interval — 580

Watercourse, ephemeral; pool — P

Rockhole — RH

Soak — Sk

Spring — S

Bore — B

Well — W

Windpump

Tank — T

Abandoned — (abd)

Position doubtful — (PD)

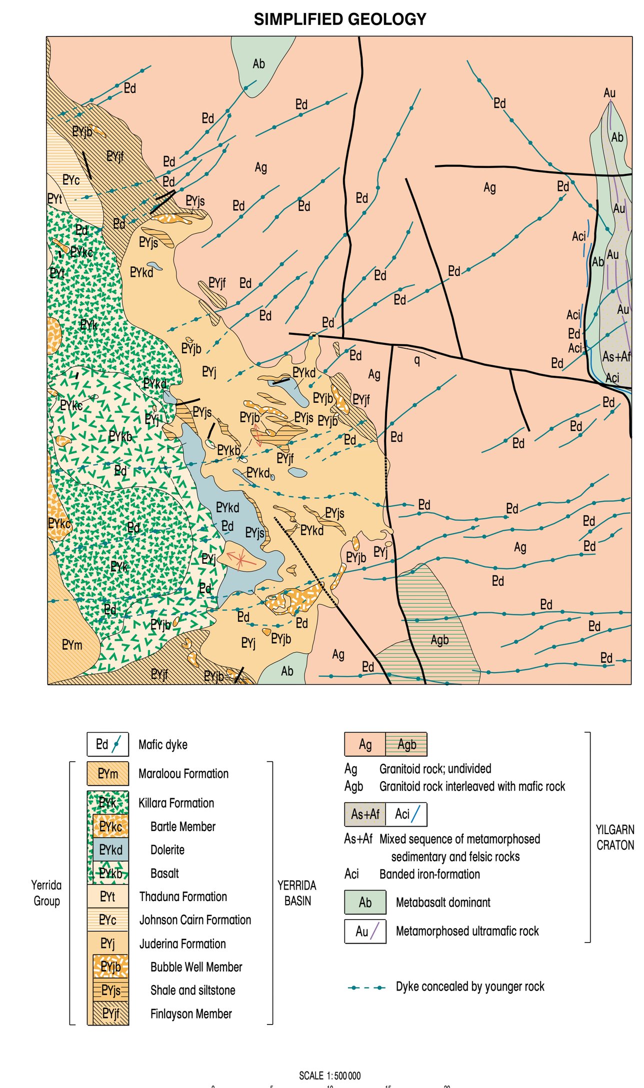
Mineral field boundary

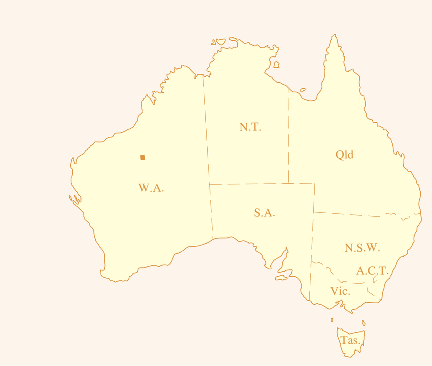
Quarry or pit

Mineral exploration drillhole, showing subsurface data — Aogf

Mineral occurrence
- Road metal — Rm

SIMPLIFIED GEOLOGY





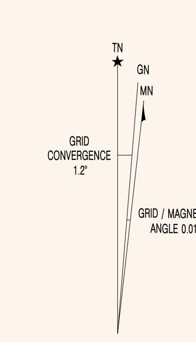
SHEET INDEX

JAMINDI 2647	THREE RIVERS 2747	MARYMIA 2847	FAIRBAIRN 2947	METHWIN 3047	RHODES 3147
BRYAH 2646	DOOLGUNNA 2746	THADUNA 2846	MERRIE 2946	NABBERU 3046	GRANITE PEAK 3146
GLENGARRY 2645	MOOLOOGOOL 2745	MOUNT BARTLE 2845	CUNYU 2945	MILLROSE 3045	BALLIMORE 3145
GABANINTHA 2644	YAGANOO 2744	MEREWETHER 2844	WILUNA 2944	LAKE VIOLET 3044	SANDALWOOD 3144

PEAK HILL SG 50-8; NABBERU SG 51-5; GLENGARRY SG 50-12; WILUNA SG 51-9

1:100 000 maps shown in black

1:250 000 maps shown in brown



True north, grid north and magnetic north are shown diagrammatically for the centre of the map. Magnetic north is correct for 1997 and moves easterly by about 0.1° in 2 years.

GOVERNMENT OF WESTERN AUSTRALIA
HON. NORMAN MOORE, M.L.C.
MINISTER FOR MINES

DEPARTMENT OF MINERALS AND ENERGY
L. C. RANFORD, DIRECTOR GENERAL

NGMA
PRODUCT OF THE NATIONAL GEOSCIENCE MAPPING ACCORD

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA
DAVID BLIGHT, DIRECTOR

Geology by N. G. Adamides, T. R. Farrell, and F. Pirajno 1996

Edited by D. Ferdinando and G. Loan

Cartography by P. Taylor, K. Greenberg and M. Ward

Topography from the Department of Land Administration Sheet SG 51-9, 2945, with modifications from geological field survey

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SCALE 1:100 000

1000 Metres 0 1 2 3 4 5 6 7 8 9 10 Kilometres

TRANSVERSE MERCATOR PROJECTION
HORIZONTAL DATUM: AUSTRALIAN GEODETIC DATUM 1984
VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM

Grid lines indicate 1000 metre interval of the Map Grid Australia Zone 51

CUNYU

SHEET 2945 FIRST EDITION 1998