Department of
Industry and Resources

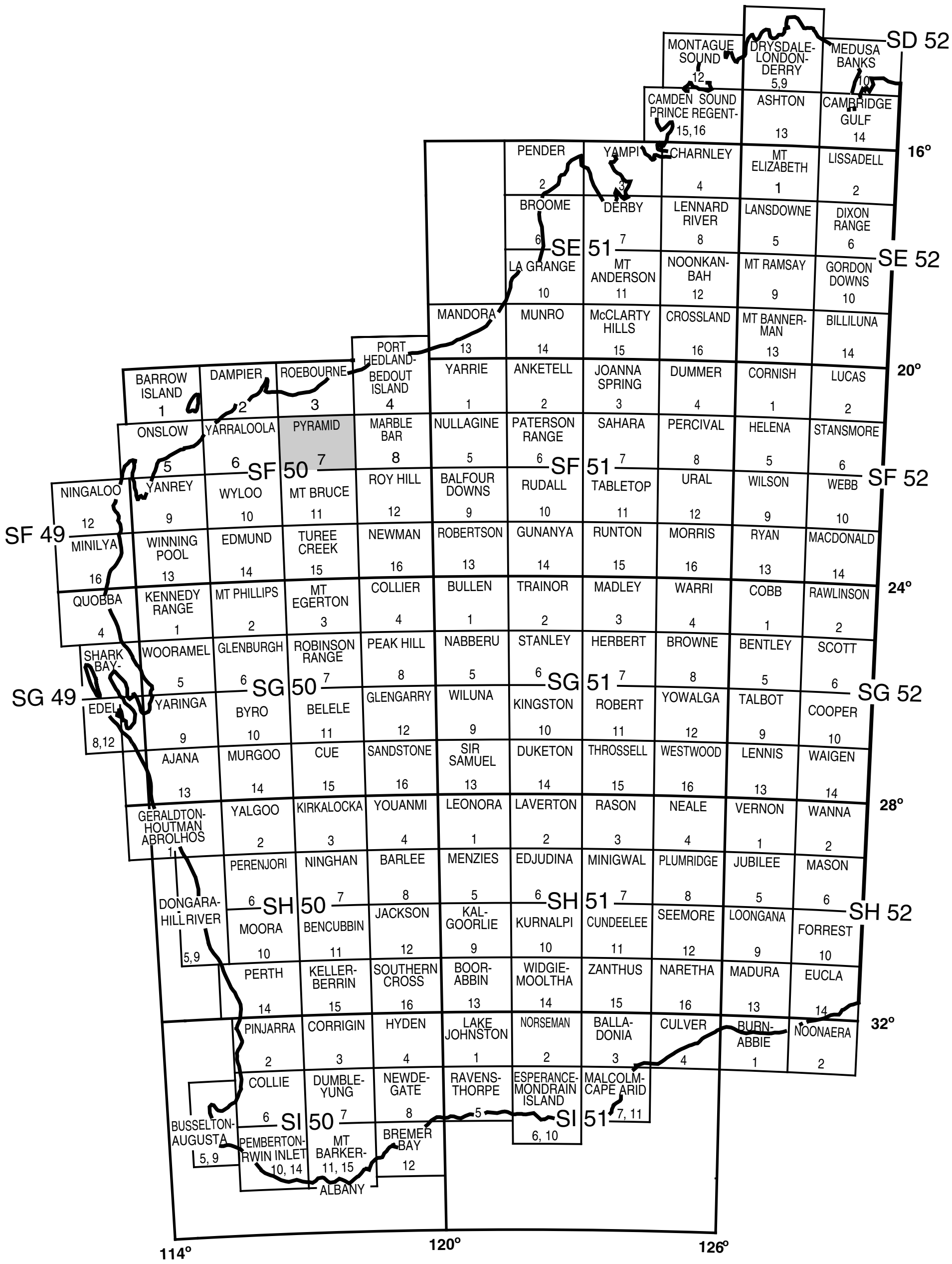
EXPLANATORY NOTES

GEOLOGY OF THE HOOLEY 1:100 000 SHEET

by R. H. Smithies

1:100 000 GEOLOGICAL SERIES

Geological Survey of Western Australia



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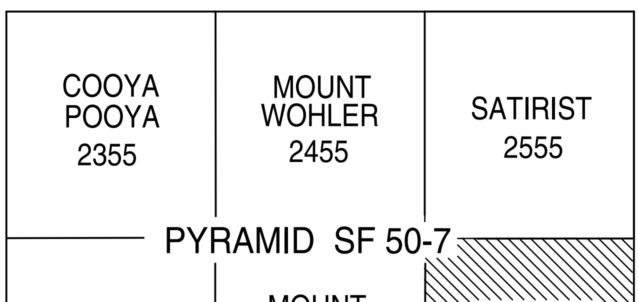

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GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGY OF THE HOOLEY 1:100 000 SHEET

by
R. H. Smithies

Perth 2003

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Cover photograph:
Looking northwest to Mumbillina Bluff where metasedimentary rocks of the Hardey Formation unconformably overlie granite.

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by

R. H. Smithies

Abstract

The HOOLEY 1:100 000 sheet lies in the southwestern part of the Archaean East Pilbara Granite–Greenstone Terrane of the Pilbara Craton. Rocks of the c. 2775–2630 Ma Fortescue Group cover all but the northeastern and southwestern corners of the map sheet. These rocks are mostly shallow dipping, weakly deformed and metamorphosed. A locally angular unconformity separates the Fortescue Group rocks from the Yule Granitoid Complex of the East Pilbara Granite–Greenstone Terrane, which is exposed only in the northeastern part of HOOLEY. The Yule Granitoid Complex consists mainly of c. 2945–2930 Ma granitic rocks but also includes xenoliths and roof-pendants of greenstones belonging to the Pilbara Supergroup. The Punduna greenstone pendant is the largest of these roof pendants. The supercrustal rocks have been metamorphosed to at least lower amphibolite facies, but are now typically strongly retrogressed. Their stratigraphic position within the Pilbara Supergroup is unclear. In the far southwestern corner of HOOLEY, rocks of the Hamersley Group conformably overlie the Fortescue Group.

KEYWORDS: Archaean, Pilbara Craton, Pilbara Supergroup, Fortescue Group, Hamersley Group, East Pilbara Granite–Greenstone Terrane, regional geology, structural geology, metamorphism, granitic rock

Introduction

The HOOLEY* 1:100 000 geological sheet (SF 50-7, 2554) covers the southeastern part of the PYRAMID 1:250 000 map sheet, in the northern Pilbara region (Fig. 1). Bounded by latitudes 21°30'S and 22°00'S, and longitudes 118°00'E and 118°30'E, the map area lies within the West Pilbara Mineral Field.

Exposure is good throughout the sheet area. The northeastern corner of HOOLEY contains outcrops of the East Pilbara Granite–Greenstone Terrane of the Archaean Pilbara Craton. Most of the sheet area, however, is covered by the volcano-sedimentary assemblages that form the lower to middle part of the 2775 to 2400 Ma Hamersley Basin (Arndt et al., 1991). These assemblages include the entire Fortescue Group and the Marra Mamba Iron Formation, the lowest part of the overlying Hamersley Group (see **Interpreted bedrock geology** on main map). The Fortescue Group unconformably overlies the Yule Granitoid Complex of the East Pilbara Granite–Greenstone Terrane.

The area was originally mapped in 1963 as part of the PYRAMID 1:250 000 geological map sheet (Kriewaldt and Ryan, 1967). During 2000 and 2001 the HOOLEY 1:100 000 geological sheet was mapped using both 1:25 000 colour, and 1:50 000 black and white aerial photographs. Relatively easy access to the northeastern corner of the sheet facilitated mapping of that region; however, the rugged topography of the Mungaroona and Chichester Ranges (which rise 500 m above sea level) impeded access to much of HOOLEY. Mapping was restricted to traverses along tracks and to widely spaced sites reached by helicopter. Limited access to large parts of the map sheet have placed significant reliance on Landsat imagery and aerial photographic interpretation.

Access and land use

The unsealed road connecting the towns of Wittenoom and Roebourne passes through the southwest corner of HOOLEY. Intersecting that road, to the south of the map area, is the road to Hooley Homestead (the only currently inhabited homestead), which lies in the south-central part of the sheet (Fig. 2). The only other serviced road is in the far northeast corner of the sheet, and connects the Mugarinya Aboriginal Community on Yandeearra Station to the north (on SATIRIST) to Yandeearra Outstation to the east (on WHITE SPRINGS). There is limited access to areas in the northeast, south, and west of the sheet by four-wheel drive vehicle on unmaintained tracks. Large parts of the sheet area,

* Capitalized names refer to standard 1:100 000 map sheets, unless otherwise indicated.

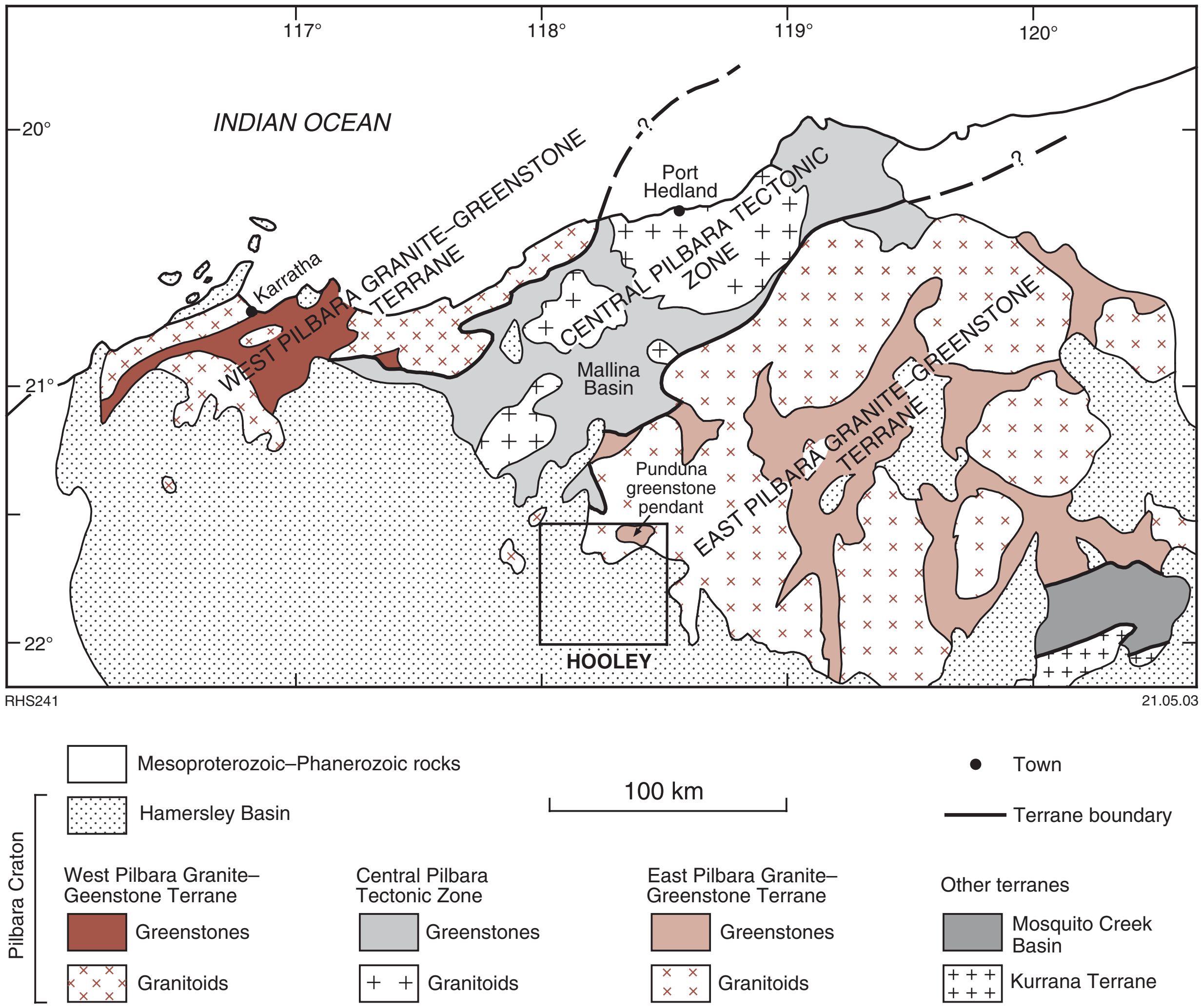

Figure 1. Regional geological setting of Hooley

including most parts of the Mungaroona Range and the Chichester Range, are only accessible on foot or by helicopter.

The Mungaroona Range Nature Reserve occupies a northwest-trending strip through the centre of Hooley. The remaining land is divided between Yandeearra Station (Mugarinya Aboriginal Community) in the northeast, and Hooley Station in the south. Prior permission must be granted by the Mugarinya Aboriginal Community for access to Yandeearra Station. Cattle grazing is the sole agricultural activity. There are no old or active mines.

Climate and vegetation

The climate of Hooley is arid with an average annual rainfall of 405 mm, most of it summer rainfall relating to thunderstorms or decaying tropical cyclones. Mean summer maximum temperatures are in the mid-30s (°C), whereas the winters are mild, with mean minimum July temperatures of around 15°C.

Hooley lies within the Fortescue Botanical District and is broadly divisible into three regimes (Beard, 1975). The Fortescue River, and other major channels and associated floodplains, are lined with riverain Sclerophyll woodlands of River Gum (*Eucalyptus camaldulensis*). The northeast corner of the area consists of a shrub steppe of soft spinifex (*Triodia pungens*) with scattered *Acacia*, *Grevillea*, and *Hakea* species. The third, and largest, regime is a tree steppe of Snappy Gum (*Eucalyptus brevifolia*) with spinifex, and scattered *Acacia*, *Grevillea*, and *Hakea* sp. that grow on the dissected plateau that dominates the sheet area.

Physiography

In the northeast of Hooley, tributaries to the Yule River, including the Pilbaddy Creek, drain northward, whereas the west-draining Fortescue River cuts the southwest corner of the sheet area (Fig. 2). These drainage systems flow mainly during the summer wet season. Physiographic divisions on Hooley match major geological divisions. Rocks of the Fortescue Group typically form a prominent dissected plateau, except in the far southwest of the sheet area, where an alluvial plain marks the Fortescue River floodplain (Fig. 2). The dissected plateau surface

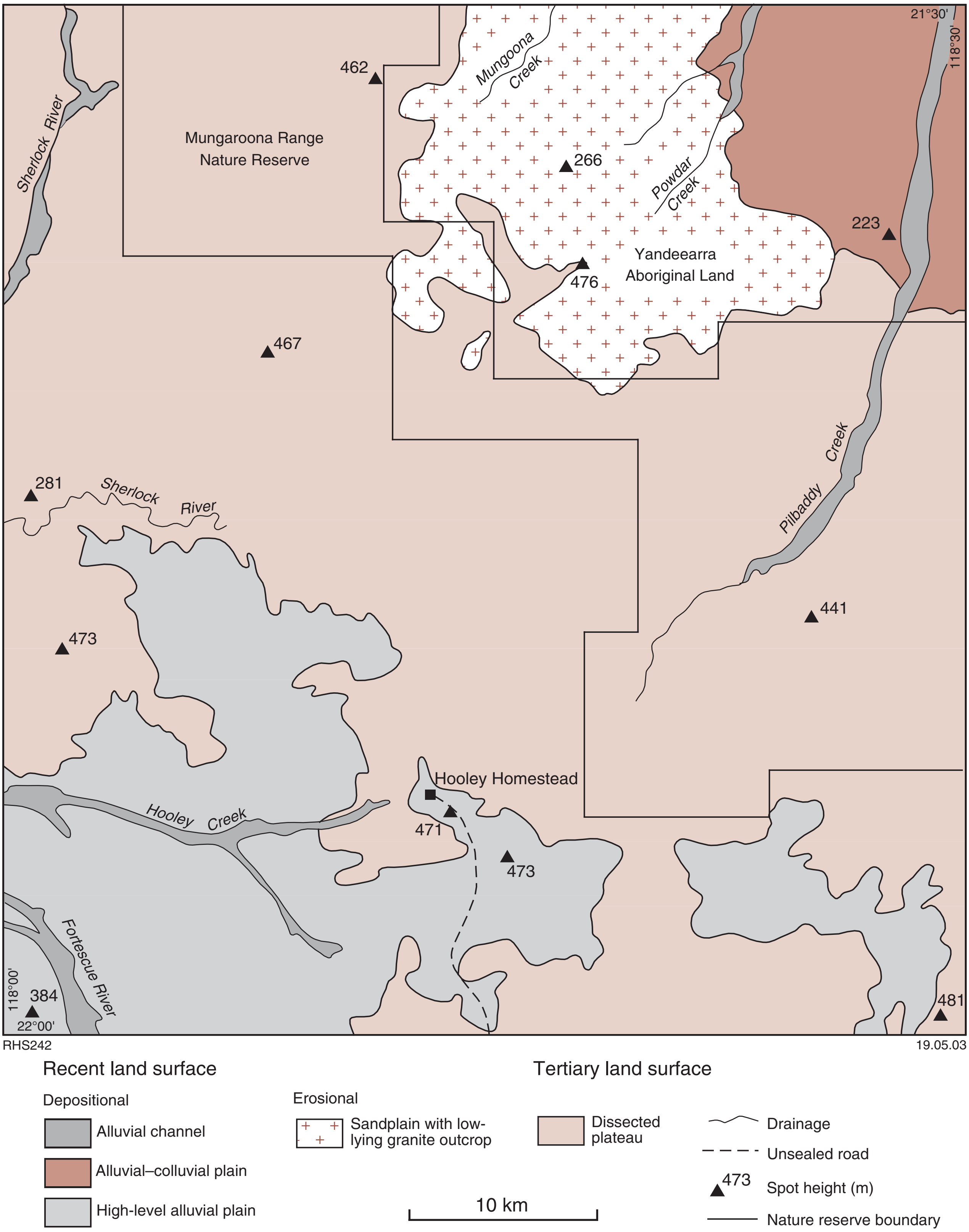

Figure 2. Physiographic features of Hooley

is approximately 500 m above sea level and part of the peneplain that Campana et al. (1964) called the Hamersley Surface. In the far northeast of the sheet area, a sandplain partly covers low-lying granitic outcrop that typically marks the alluvial–colluvial plains division (Fig. 2).

Regional geological setting and previous investigations

The Archaean Pilbara Craton contains some of the oldest exposed crustal elements of Australia. It is divided into two components (Fig. 1) — a granite–greenstone terrane that formed between c. 3600 and c. 2800 Ma (Hickman, 1983, 1990; Barley, 1997), and the unconformably overlying volcano-sedimentary sequences (Mount Bruce Supergroup) of the c. 2775 to 2400 Ma Hamersley Basin (Arndt et al., 1991; Thorne and Trendall, 2001). The granite–greenstone terrane of the Pilbara Craton is exposed mainly in the north and northeast of the craton where erosion has removed all but local remnants of the Mount Bruce Supergroup.

Hickman (1983) provided a comprehensive interpretation of the geological evolution of the granite–greenstone terranes of the Pilbara Craton, and included what was thought to represent a regionally applicable supercrustal stratigraphy — the Pilbara Supergroup. Recently, the recognition of separate lithotectonic elements with distinct lithostratigraphy and history has led to the subdivision of the granite–greenstone terranes into: the East and West Pilbara Granite–Greenstone Terranes, the northeast-trending Central Pilbara Tectonic Zone, the Mosquito Creek Basin, and the Kurrana Terrane (Fig. 1; Hickman, 2000). A detailed description of the subdivision, geological setting, and history of the region is presented by Van Kranendonk et al. (2002).

HOOLEY lies in the southeastern part of the East Pilbara Granite–Greenstone Terrane (EPGGT; Fig. 1). Regionally, the terrane consists of large ovoid granitic-gneiss complexes partially surrounded by belts of tightly folded and near-vertically dipping volcanic rocks and sedimentary rocks typically metamorphosed to greenschist facies. The oldest dated greenstones in the EPGGT are the c. 3515–3498 Ma Coonterunah Group (Table 1; Buick et al., 1995; Van Kranendonk, 1998; Nelson, 2002). Protoliths to the greenstone successions accumulated until c. 2940 Ma, although the majority were deposited before c. 3240 Ma. Felsic magmatism was also periodically active between c. 3600 and c. 2830 Ma, with the majority of granitic rocks in the eastern part of the EPGGT intruded before c. 3240 Ma. In contrast, granitic rocks dated between c. 2945 and 2930 Ma form a volumetrically significant, and locally dominant, component of granitic complexes in the western part of the terrane, including the majority of the Yule Granitoid Complex (Table 1). Champion and Smithies (1998) interpreted these c. 2945–2930 Ma granitoids as the products of the remelting of older-than-3240 Ma felsic crust, associated with tectonic activity in the Central Pilbara Tectonic Zone.

The boundary between the EPGGT and the Central Pilbara Tectonic Zone is a fault, which locally may be a faulted disconformity, between the Mallina Basin and the underlying granite–greenstone sequences. The youngest component of the basement to the Mallina Basin includes a c. 3015 Ma chert assigned to the Cleaverville Formation of the Gorge Creek Group (Smithies et al., 1999).

The Mount Bruce Supergroup is the early (Neoarchaean to Palaeoproterozoic) component of the Hamersley Basin. The supergroup is a cover sequence of dominantly basaltic and sedimentary rocks, of very low metamorphic grade, which unconformably overlie the

Table 1. Summary of the geological history of HOOLEY

Age (Ma)	*Events*
<3515 – >2945	Deposition of greenstone sequences (Pilbara Supergroup), and formation of c. 3060 Ma protolith to the Cockeraga Leucogranite
c. 3420	Intrusion of protolith to the gneissic rocks of the Yule Granitoid Complex
c. 3240	Amphibolite-facies metamorphism associated with granitic magmatism interpreted from TAMBOURAH (Van Kranendonk, 2003) and WHITE SPRINGS (Smithies, in prep.)
<3240 – >2945	Deformation of granite/gneiss and greenstone sequences; 110–160° trending fabric. Age inferred from relationships on TAMBOURAH (Van Kranendonk, 2003)
<3060 – 2945	Amphibolite-facies metamorphism, including generation of the Cockeraga Leucogranite from a c. 3060 Ma source region
c. 2945 – 2930	Voluminous granitic magmatism in the Yule Granitoid Complex, including intrusion of the Powdar Monzogranite
c. 2945 – 2930	Development of northeast-trending foliation throughout the Yule Granitoid Complex
c. 2930 – 2775	Erosion
c. 2775 – 2630	Deposition of volcanic and sedimentary rocks of the Fortescue Group
2770 and younger	Dip-slip faulting along major northeasterly trending faults
c. 2600 – 2500	Deposition of lower Hamersley Group
<2600	Intrusion of dolerite dykes; east-northeast faulting

Table 2. Precise U–Pb zircon geochronology (SHRIMP[a]) relevant to units on Hooley

Age (Ma)	Lithology	Formation/Group/Complex	Sample	Reference
2561 ± 8	Crystal-rich tuff	Wittenoom Formation, Hamersley Group	120044	Trendall et al. (1998)
2597 ± 5	Mount Newman Member	Marra Mamba Iron Formation, Hamersley Group	120046	Trendall et al. (1998)
2763 ± 13	Lapilli tuff	Mount Roe Basalt, Fortescue Group	94792	Arndt et al. (1991)
2775 ± 10	Felsic volcanic rock	Mount Roe Basalt, Fortescue Group	86738	Arndt et al. (1991)
2715 ± 6	Pillingini Tuff	Tumbiana Formation, Fortescue Group	94775	Arndt et al. (1991)
2719 ± 6	Volcaniclastic sandstone	Tumbiana Formation, Fortescue Group	168935	Nelson (2001)
2717 ± 2	Dacite	Maddina Formation, Fortescue Group	144993	Nelson (1998)
2684 ± 6	Tuffaceous sandstone	Jeerinah Formation, Fortescue Group	94776	Arndt et al. (1991)
2690 ± 16	Tuffaceous sandstone	Jeerinah Formation, Fortescue Group	103225	Arndt et al. (1991)
2935 ± 3	Powdar Monzogranite	Yule Granitoid Complex	142937	Nelson (2000)
2945 ± 5	Mungaroona Granodiorite	Yule Granitoid Complex	142938	Nelson (2000)
<3068 ± 22	Cockeraga Leucogranite	Yule Granitoid Complex	169014	Nelson (2002)
<3066 ± 4	Cockeraga Leucogranite	Yule Granitoid Complex	169016	Nelson (2002)

NOTE: (a) Sensitive high-resolution ion microprobe

granite–greenstone terranes. The supergroup has been described in detail by Hickman (1983), Blake (1993), and Thorne and Trendall (2001). The lowest stratigraphic component is the Fortescue Group that was deposited between c. 2775 and 2630 Ma (Arndt et al., 1991; Nelson, 1997; Wingate, 1999: Thorne and Trendall, 2001; Table 2).

According to Arndt et al. (2001), Fortescue Group volcanism is the result of lithospheric melting during three successive phases of mantle plume activity. Thorne and Trendall (2001), however, cited the lithological diversity of the group and the long duration of volcanism (around 140 million years) as evidence against this hypothesis, and described the tectonic setting of the Fortescue Group in terms of a single, protracted rifting event. Blake (1993) also suggested that the lower parts of the Mount Bruce Supergroup record a period of late Archaean west-northwest crustal extension, followed by south-southwest rifting of the southern margin of the Pilbara Craton.

Archaean rocks

The Archaean geology and geological history of Hooley is summarized on **Interpreted bedrock geology** (see main map) and in Table 1. Geochronological data relevant to Hooley and surrounding areas is presented in Table 2.

Approximately 70% of the EPGGT in the northeastern part of Hooley is granitic rock, all of which belongs to the Yule Granitoid Complex. Seriate-textured to K-feldspar-porphyritic monzogranites of the c. 2935 Ma (Nelson, 2000) Powdar Monzogranite (Smithies and Farrell, 2000) dominate outcrop, particularly to the west of the large area of greenstones referred to here as the Punduna greenstone pendant. North of the Punduna greenstone pendant, the Powdar Monzogranite includes large xenoliths, up to 2 km long, of gneissic monzogranite. These belong to the Cheearra Monzogranite, which forms a major component of the Yule Granitoid Complex on Satirist. To the east and south of the Punduna greenstone pendant, schlieric biotite granitic rocks of the Cockeraga Leucogranite dominate outcrop. These granitic rocks contain gneissic xenoliths, and locally abundant greenstone xenoliths, interpreted as derived from the greenstone pendant into which the leucogranite has intruded. The Cockeraga Leucogranite has a maximum age of c. 3065 Ma (Nelson, 2002), but is likely to be younger than this (Smithies, in prep.). A hornblende–biotite tonalite forms a discrete, approximately 10 km-long, body close to the southern unconformity with the Fortescue Group. This tonalite is intruded by the Powdar Monzogranite, but contact relationships with the Cockeraga Leucogranite, which is exposed to the southeast, could not be determined. The tonalite is petrographically and geochemically similar — unpublished geochemical data from Geological Survey of Western Australia (GSWA) and Geoscience Australia (GA) — to the Mungaroona Granodiorite, which is exposed on Satirist (Smithies and Farrell, 2000) and which has an age of c. 2940 Ma (Nelson, 2000).

Greenstones on Hooley are restricted to xenoliths in, and roof-pendants on, granitic rocks of the Yule Granitoid Complex. Due to sparse outcrop and lack of continuity with formally recognized stratigraphic components, these greenstones cannot be confidently assigned to groups or formations within the Pilbara Supergroup. The 12 km-long, east-trending Punduna greenstone pendant forms the largest outcrop of greenstone. The consistent west-northwest strike of the stratigraphy suggests that this pendant can be correlated to the Cheearra greenstone belt in the southern part of Satirist (Smithies and Farrell, 2000). The rocks of the pendant are metamorphosed to amphibolite facies and are largely derived from mafic volcanic rocks, although interleaved rocks of sedimentary and ultramafic protolith are locally abundant. Rocks of sedimentary or ultramafic protolith form local, discrete mappable units. Relict olivine-spinifex textures indicate that some of the ultramafic rocks are metamorphosed komatiites.

The Neoarchaean to Palaeoproterozoic Hamersley Basin contains a volcanic and sedimentary succession — the Mount Bruce Supergroup — that is up to 10 km thick and covers approximately 100 000 km^2 (Trendall, 1990). This succession is subdivided into three lithostratigraphic groups — Fortescue, Hamersley, and Turee Creek. Only the lower two groups are preserved on HOOLEY, with the Fortescue Group dominating outcrop.

On HOOLEY, rocks of the c. 2775–2630 Ma Fortescue Group (Arndt et al., 1991; Nelson et al., 1999; Wingate, 1999; Thorne and Trendall, 2001), and the lowest part of the Hamersley Group typically dip to the south or southwest at less than 10°, and are only very weakly metamorphosed. An unconformity is well developed between the Fortescue Group and the underlying granite–greenstone terrane. On the map area, all recognized formations of the Fortescue Group are preserved; however, regional topographic variations at the time the group was deposited have resulted in locally incomplete development of the lower units. The Mount Roe Basalt is only developed in the northwest of the sheet. Elsewhere on HOOLEY the Hardey and Kylena Formations form the base of the Fortescue Group. In the southwest corner, the contact between the Jeerinah Formation and the overlying Marra Mamba Iron Formation marks the boundary between the Fortescue and Hamersley Groups (Thorne and Trendall, 2001). There is no evidence on the map area of an unconformity between these groups. Rather, carbonaceous mudstones and siltstones of the Jeerinah Formation pass conformably upwards into the ferruginous mudstones of the Marra Mamba Iron Formation. The Wittenoom Formation that conformably overlies the Marra Mamba Iron Formation is not exposed on HOOLEY, but is interpreted to underlie Cainozoic calcrete deposits in the far southwest of the sheet area.

Unassigned greenstone units

Ultramafic rocks (*Au*, *Auk*, *Aur*)

Outcrops of metamorphosed ultramafic rock that are weathered or strongly deformed have mainly been mapped as undivided ultramafic rock (*Au*). In areas of better exposure, the ultramafic rocks have been subdivided into metamorphosed peridotitic komatiite (*Auk*) and tremolite-rich schist (*Aur*).

Undivided ultramafic rock (*Au*) includes serpentine schist, tremolite schist, and talc–tremolite–chlorite schist. These are exposed in the Punduna greenstone pendant and also form isolated xenoliths within rocks of the Yule Granitoid Complex.

Serpentine–talc–tremolite rock (*Auk*) locally preserves olivine-spinifex textures and is metamorphosed peridotitic komatiite. It forms a prominent outcrop along the southern margin of the Punduna greenstone pendant, and also forms minor xenoliths within rocks of the Yule Granitoid Complex (e.g. MGA 642000E 7605500N).

Tremolite-rich schist (*Aur*) is the most abundant ultramafic rock type. It is typically fine grained and well foliated, and comprises acicular or fibrous tremolite, with subordinate amounts of chlorite, talc, and fine-grained opaque minerals.

Mafic rocks (*Aba*, *Abal*, *Abag*, *Abas*, *Abu*, *Abuq*)

Most of the unassigned greenstone units on HOOLEY comprise metamorphosed mafic rock. The dominant rock type is fine- to medium-grained, massive to strongly foliated amphibolite-facies mafic rock (*Aba*). This comprises a typically granoblastic assemblage of hornblende, plagioclase, and quartz, and locally clinopyroxene, or less commonly orthopyroxene. The rocks are typically melanocratic to mesocratic. Leucocratic amphibolite (*Abal*), with less than 20% hornblende, is mapped separately along the southern part of the Punduna greenstone pendant. Similar rock is well exposed in the foothills of the Mungaroona Range (e.g. MGA 648000E 7606800N).

Within the Punduna greenstone pendant, medium-grained amphibolite locally contains abundant layers, veins, and irregular patches of tonalite (*Abag*; e.g. MGA 645000E 7615400N). Where tonalite is abundant the rocks resemble components of the heterogeneous Cockeraga Leucogranite (*AgYco*).

Amphibolite is partially retrogressed, with variable alteration of hornblende to actinolite and chlorite, and of plagioclase to sericite and epidote. Where metamorphic retrogression is associated with deformation, the rocks are transitional to mafic schist and comprise interleaved amphibolite and actinolite schist (*Abas*).

Mafic and ultramafic rocks that are stratigraphically interleaved at metre scale (*Abu*) outcrop west of the Punduna greenstone pendant (MGA 634000E 7621700N), and form the southern extension of the Cheearra greenstone belt exposed on SATIRIST. The mafic component of these rocks can be either amphibolite or actinolite–chlorite schist. The ultramafic component is typically tremolite schist. A similar unit dominates the northern half of the Punduna greenstone pendant, where the mafic and ultramafic rocks are also interleaved with quartz–muscovite schist and quartzite (*Abuq*).

Sedimentary rocks (*Asq, Asqn*)

Quartz–muscovite schist and quartzite (*Asq*), after subarkose, outcrop to the west of the Punduna greenstone pendant (at MGA 635500E 7621700N), in association with interleaved mafic and ultramafic rocks (*Abu*) of the Cheearra greenstone belt. The quartz–muscovite schist and quartzite unit, which is an important component of the Cheearra greenstone belt on SATIRIST (Smithies and Farrell, 2000), contains between 70 and 95% quartz. Less quartz-rich components of this unit are locally well layered, with layering defined by feldspar-rich layers, a prominent schistosity produced by alignment of muscovite, or a combination of both. The more quartz-rich rocks are typically massive and comprise a granoblastic assemblage of quartz–plagioclase (now epidote and sericite), and rare microcline and clinopyroxene. Actinolite is a late-crystallizing acicular mineral. Within the Punduna greenstone pendant quartzite is interleaved with locally layered quartz and quartz–feldspar–amphibole paragneiss (*Asqn*; e.g. MGA 643000E 7620500N, and MGA 647000E

7613500N). Layering is defined by 10 cm- to 1 m-thick layers rich in amphibole, interpreted to be original sedimentary bedding.

Quartz–muscovite schist and quartzite (*Asq*) is also faulted against rocks of the Fortescue Group, in the northwestern corner of HOOLEY (e.g. MGA 607000E 7612000N). Here, metamorphic grade is notably lower than in the Punduna greenstone pendant. The unit also includes interbeds of fine-grained tuff as well as pebble conglomerate (Van Kranendonk, M. J., 2002, written comm.). It is not clear whether this outcrop belongs to the Pilbara Supergroup or to the Fortescue Group.

Yule Granitoid Complex

Cheearra Monzogranite (*AgYchn*)

Outcrops of gneissic monzogranite to granodiorite (*AgYchn*) in the far northeast of HOOLEY (MGA 645500E 7621000N) are interpreted as xenoliths in both the seriate-textured Powdar Monzogranite (*AgYpos*) and the Cockeraga Leucogranite (*AgYco*). The gneissic unit includes hornblende-rich granodioritic and tonalitic varieties. It is mineralogically identical to, and texturally transitional from, a moderately to strongly foliated monzogranite (*AgYchm*) that outcrops to the north on SATIRIST (Smithies and Farrell, 2000). Mesocratic and leucocratic bands are locally well developed with stromatic banding in some outcrops.

Cockeraga Leucogranite (*AgYco, AgYcor, AgYcorx*)

The Cockeraga Leucogranite outcrops sporadically near the northeastern boundary of HOOLEY. The unit comprises leucocratic biotite(–hornblende) tonalite or granodiorite, with subordinate monzogranite (*AgYco*). These rocks commonly show a distinctive, well developed, schlieric banding (*AgYcor*), and locally also contain abundant xenoliths of greenstone and gneiss (*AgYcorx*). The precise age of the leucogranite has not been determined. The youngest population of zircons from two samples collected on WHITE SPRINGS (GSWA 169014 and 169016, both at MGA 675720E 7595740N) provided a U–Pb sensitive high-resolution ion microprobe (SHRIMP) age of c. 3065 Ma (Nelson, 2002). While this may be the crystallization age of the rocks, geochemical data (GSWA–GA unpublished data) suggests that these rocks are the result of disequilibrium melting, and might still contain abundant restite. Accordingly, the preferred interpretation is that the age obtained (c. 3065 Ma) represents the minimum age of the source and the maximum age of the leucogranite, which may be as young as c. 2940 Ma, the age of voluminous granite magmatism in the region.

The Cockeraga Leucogranite ranges from medium- to coarse-grained tonalite or granodiorite. It is compositionally and texturally highly variable at outcrop scale, comprising an accumulation of individual sheets and veins, readily identified by abrupt changes in grain size and mineralogy. Inclusions range from pea-sized clots up to kilometre-scale blocks, and are sourced from metasedimentary, granite, and mafic to ultramafic igneous protolith. Schlieren typically represent variably disaggregated xenolithic material, which in some cases is demonstrably of local origin. In thicker leucogranite units, schlieren are typically strongly attenuated, but become more common and angular towards contacts with greenstone country-rock or xenoliths. The greenstone country-rock or xenoliths are themselves metamorphosed to at least lower amphibolite facies, and become increasingly invaded (net-veined), or swamped and disaggregated by leucogranite, close to leucogranite sheets. Biotite is the predominant mafic mineral in schlieren, but is accompanied by hornblende where the leucogranite has intruded mafic xenoliths. A flow foliation is particularly well defined in the schlieren-rich rocks. It locally wraps around xenoliths and shows irregular ‘swirls’ that do not conform to regional structural trends.

Hornblende–biotite tonalite (*AgYt*)

Coarse-grained and massive, this hornblende–biotite tonalite (*AgYt*) forms a discrete, approximately 10 km-long body, to the south of Punduna Pool (e.g. MGA 645000E 7608000N). This mesocratic rock has locally well developed 10 cm to metre-scale layering that parallels the strike of greenstone units within the Punduna greenstone pendant. The layering is defined by variations in the combined abundance of mafic minerals (Fig. 3) and almost certainly reflects emplacement of at least parts of the tonalite body via sheeted intrusion. The tonalite is undeformed, and so is younger than the greenstones and gneissic rocks, but older than the c. 2935 Ma (Nelson, 2000) porphyritic monzogranite of the Powdar Monzogranite (*AgYpos*), which intrudes it. Mineralogically, the tonalite differs from the Mungaroona Granodiorite (*AgYmux*) only in containing a relatively higher proportion of plagioclase; however, the two rocks are geochemically very similar (GSWA–GA, unpublished data). Accordingly, it is speculated that the tonalite is similar in age to the c. 2945 Ma Mungaroona Granodiorite (Nelson, 2000).

Mungaroona Granodiorite (*AgYmux*)

A small outcrop of the Mungaroona Granodiorite, locally containing abundant greenstone xenoliths and rafts (*AgYmux*), in the northwest of HOOLEY (MGA 611600E 7622100N), is fault-bounded against rocks of the Fortescue Group. The rock is typically a medium- to coarse-grained and mostly equigranular hornblende–(biotite) granodiorite or (rarely) biotite monzogranite. A sample of Mungaroona Granodiorite from SATIRIST was dated at c. 2945 Ma (Nelson, 2000)

Powdar Monzogranite (*AgYpop, AgYpos*)

On SATIRIST, the Powdar Monzogranite (*AgYpo*) includes four distinct mineralogical and textural varieties, but on HOOLEY only a porphyritic monzogranite (*AgYpop*) and seriate-textured monzogranite (*AgYpos*) are exposed, differing only in the abundance of K-feldspar phenocrysts.

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Figure 3. Layering in hornblende–biotite tonalite defined by variations in the relative proportions of hornblende and plagioclase (typically on a 10–50 cm scale). Mafic xenoliths (left of lens cap) are rounded cognate inclusions of diorite and gabbro

These rocks are typically leucocratic with biotite, the sole mafic silicate mineral (now mostly chlorite), comprising less than 5% of the rock. The rocks are commonly massive to weakly deformed, but locally have a strong foliation defined by flow alignment of K-feldspar phenocrysts. A sample of the Powdar Monzogranite (GSWA 142937) from SATIRIST was dated at c. 2935 Ma (Nelson, 2000).

Unassigned granitoid (*AgY*)

Surrounded by outcrop of the lower parts of the Fortescue Group, this strongly weathered granitic rock is of uncertain age and relationship to other granitic rocks of the Yule Granitoid Complex (*AgY*; e.g. MGA 629000E 7603000N). It is interpreted to have formed topographic highs at the time of early Fortescue Group deposition.

Metamorphism

Most rocks of the EPGGT are metamorphosed to low- to middle-greenschist facies, characterized by the presence of chlorite–actinolite–albite(–epidote) in mafic rocks, and albite–biotite(–white mica – chlorite) in pelitic metasedimentary rocks. Amphibolite-facies assemblages are locally developed close to contacts with granitic rocks, and particularly to larger bodies of tonalitic to granodioritic composition. Metamorphic temperatures in the northwestern part of the EPGGT (e.g. SATIRIST), and in the Mallina Basin region, peaked at c. 2950 Ma, approximately coincident with voluminous magmatism (Smithies and Farrell, 2000).

All greenstone assemblages (in xenoliths and roof pendants) on HOOLEY have been metamorphosed to at least lower-amphibolite facies. Although the mineralogy of most rocks reflects extensive retrogression, preservation of the peak metamorphic assemblage, hornblende–plagioclase(–clinopyroxene), is widespread. Smithies and Farrell (2000) noted that on SATIRIST the metamorphic mineral assemblages in the pre-metamorphic component of the Cheearra Monzogranite (*AgYch*), and in the Cheearra greenstone belt, show a progressive southerly increase in metamorphic grade. It appears that this trend continues onto HOOLEY as evidenced by the prevalence of amphibolite-facies mineral assemblages in rocks of the Punduna greenstone pendant. It is not clear if this metamorphic trend is related to local intrusion of granitic rocks or is more regional in nature, reflecting a northerly decrease in structural depth.

Furthermore, structures defined by amphibolite-facies assemblages of the Western Shaw greenstone belt on

TAMBOURAH can be related to an earlier c. 3240 Ma phase of deformation (Wijbrams and McDougall, 1987; Van Kranendonk, 2003). Hence, the metamorphic history of the EPGGT in the HOOLEY region may have been long and complex.

Structure

All phases of the Yule Granitoid Complex on HOOLEY show a weak east-northeasterly trending foliation (S_3), and except for foliations developed adjacent to late faults, this is the only deformational fabric developed in the c. 2945 to 2930 Ma granitic rocks that dominate the complex.

In the greenstones, this late east-northeasterly trending foliation overprints a strongly developed foliation. In the Punduna greenstone pendant, the greenstones are folded with steep east-southeasterly trending axial planes (Fig. 4), with a strongly developed axial-planar foliation (S_2). The age of this early foliation is unknown, but a similarly oriented fabric developed in greenstone xenoliths in the eastern part of WHITE SPRINGS (Fig. 4) overprints a fabric (S_1) that Van Kranendonk (2003) related to a c. 3240 Ma phase of deformation. On this evidence, the age of the east-southeast fabric is constrained between c. 3240 and 2945 Ma, as there is no other known phase of deformation during that period in the EPGGT (Van Kranendonk et al., 2002).

Hamersley Basin

Fortescue Group

The Fortescue Group is a c. 2775–2630 Ma (see Table 2; Arndt et al., 1991; Nelson et al., 1999; Wingate, 1999; Thorne and Trendall, 2001) succession of dominantly basaltic rocks that extends across much of the Pilbara Craton. An angular unconformity defines its contact with the granite–greenstone terrane. Polymictic conglomerate containing subrounded clasts derived from the underlying granite–greenstone terrane, and a medium- to coarse-grained, poorly sorted sandstone, locally mark the base of the group on HOOLEY. These units are generally too thin and irregular to be represented at 1:100 000 scale. Rocks of the Fortescue Group typically dip shallowly southward with a resultant gradual southerly progression to higher stratigraphic levels. All recognized formations of the Fortescue Group are preserved.

Mount Roe Basalt (AFr)

The Mount Roe Basalt (*AFr*) forms the basal unit of the Fortescue Group. It comprises both subaerial and subaqueous lava facies, but no reliable indicators were observed on HOOLEY to establish the local environment of deposition.

This unit is only preserved in the far northwest corner of the sheet area. Much of the Mount Roe Basalt is composed of either massive, vesicular or glomeroporphyritic basalt. The vesicular basalt contains rare, squat, subhedral phenocrysts of plagioclase and clinopyroxene in a plagioclase-rich groundmass that also includes interstitial chlorite and epidote (after mafic phases and glass). The glomeroporphyritic rocks differ from the vesicular variety only in that they contain abundant aggregates of plagioclase up to 2 cm in size. Both the vesicular and glomeroporphyritic basalt are locally pillowed.

Hardey Formation (AFh, AFhu)

Regionally, the Hardey Formation (*AFh*) includes a wide range of sedimentary and volcanic rocks deposited in various alluvial (including fan), fluvial, lacustrine, deltaic, and shoreline environments (Thorne and Trendall, 2001). It overlies the Mount Roe Basalt in northwestern HOOLEY, but in the central-northern part of the sheet it unconformably overlies the EPGGT. This unit was originally referred to as the Hardey Sandstone, but was later renamed by Thorne et al. (1991). On HOOLEY the Hardey Formation comprises medium- to coarse-grained, poorly sorted subarkose, with locally developed conglomerate, well-laminated siltstone, shale, and felsic tuff. It is, however, dominated by a sequence of poorly sorted, medium- to coarse-grained, volcanolithic sandstone, interbedded with well-laminated siltstone, fine-grained tuffaceous sedimentary rock, and conglomerate (*AFhu*).

Kylena Formation (AFk, AFkbi, AFkh)

The Kylena Formation (*AFk*), previously the Kylena Basalt (Kojan and Hickman, 1998), conformably or disconformably overlies the Hardey Formation in the northwestern part of HOOLEY. Farther to the southeast it forms the basal unit of the Fortescue Group, in direct contact with basement rocks of the EPGGT. The unit typically comprises flows of massive to amygdaloidal basalt and basaltic andesite, and is known regionally to contain minor intercalations of high-Mg basalt, dacite, and rhyolite (Kojan and Hickman, 1998). Layers in which basaltic andesite, with minor basalt and andesite (*AFkbi*) are dominant were mapped separately. Basalt and basaltic volcaniclastic rocks, including breccia, locally contain sericite and pyrophyllite alteration along epithermal veins and bedding planes (*AFkh*). This hydrothermal alteration produces bleached zones that are readily identifiable on aerial photography (e.g. MGA 646000E 7601300N) and is interpreted as syn- to late-volcanic, epithermal-style alteration.

Tumbiana Formation (AFt, AFtsv, AFtc, AFtsvs, AFtsvb)

On HOOLEY, the Tumbiana Formation (*AFt*) is a thin (<200 m) unit comprising mainly coastal and nearshore shelf facies, clastic and volcaniclastic rocks. It includes a distinctive stromatolitic carbonate horizon and a minor mafic lava component (Thorne and Trendall, 2001) that becomes a locally volumetrically significant component on HOOLEY, and further east on WHITE SPRINGS. The contact between the Tumbiana Formation and Kylena Formation has been regarded as a conformity, as it appears on HOOLEY; however, Hickman (in prep.) documented a locally unconformable relationship between these two units on COOYA POOYA, in the West Pilbara Granite–Greenstone Terrane.

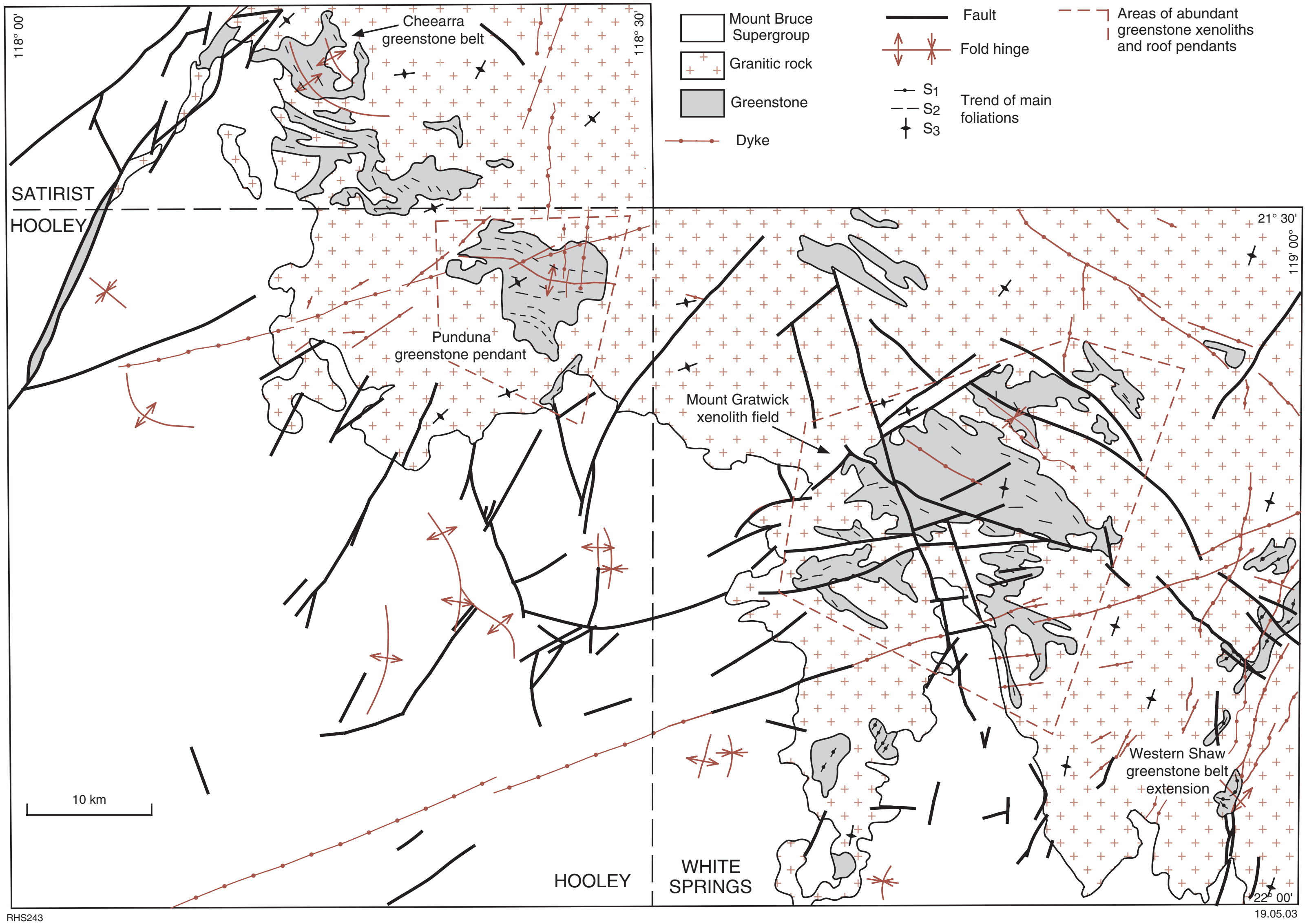

Figure 4. Structural overview of Hooley and adjacent 1:100 000 map areas. Also shown are major greenstone outcrops, and in boxes, areas of abundant greenstone xenoliths and pendants

Four subdivisions of this formation are recognized on HOOLEY. The dominant and locally basal package comprises metre- to tens of metre-scale interbeds of volcaniclastic sandstone, carbonate-rich tuff, and volcaniclastic mudstone and siltstone (*AFtsv*). This lower package also includes distinct layers of dark-grey, siliceous stromatolitic dolomite and limestone. Where these carbonate units are abundant or dominant, they were mapped as the Meentheena Carbonate Member (*AFtc*).

The upper part of the Tumbiana Formation on HOOLEY comprises fine- to coarse-grained volcaniclastic sandstone, tuff, and fine-to medium-grained clastic sedimentary rock (*AFtsvs*), with rare carbonate-rich interbeds. This unit appears to combine parts or all of the upper units, as mapped to the northwest on COOYA POOYA (Hickman, in prep.). These include sandstone and siltstone (*AFtss*), tuff, and tuffaceous siltstone, commonly with accretionary lapilli (*AFtt*), and arenaceous siltstone and tuff (*AFtsl*).

In the area around Wonga Well, in the central part of HOOLEY, the volcaniclastic sandstone, tuff, and clastic sedimentary rock unit (*AFtsvs*) contains abundant basalt sheets and dykes (*AFtsvb*). Contacts between basalt and sedimentary rocks are locally peperitic, evidence of synchronous clastic sedimentation and mafic volcanism.

Maddina Formation (AFm, AFmk, AFmx)

The Maddina Formation (*AFm*) outcrops over much of the southwestern quarter of HOOLEY. Regionally, the formation consists mainly of basalt flows, pillow lavas, and fine- to coarse-grained mafic volcaniclastic rocks. Subordinate dacite, rhyolite, and non-volcanic sedimentary rock, including stromatolitic carbonate and quartz sandstone are present (Thorne and Trendall, 2001).

On HOOLEY, the Maddina Formation typically consists of massive, vesicular, and amydaloidal basalt, and basaltic andesite (*AFm*). Included is a distinct layer of mafic volcanicalstic sandstone, mudstone, chert, and dolomite called the Kuruna Member (*AFmk*), which Thorne and Trendall (2001) interpreted to have accumulated in a low-energy shallow coastal setting. In the southeast corner of the sheet, the Maddina Formation includes extensive deposits of basaltic volcaniclastic breccia (*AFmx*) consisting of angular basalt fragments, up to 30 cm across, with a chlorite- and carbonate-rich mafic matrix.

Jeerinah Formation (AFjslg, AFjo, AFjsl, AFjkd)

Outcrop of the Jeerinah Formation is confined to the southwest corner of HOOLEY. Regionally, this formation includes argillite, sandstone, dolomite, chert, and a variety of volcanic rocks including basalt flows, as well as mafic to felsic volcaniclastic rocks (Thorne and Trendall, 2001).

On HOOLEY the basal unit of the formation — the Woodiana Member (*AFjo*) — appears to conformably overly the Maddina Formation. It comprises quartz-rich sandstone interbedded with subordinate chert, chert breccia, mudstone, and volcanogenic lithic sandstone, and is locally well preserved (e.g. MGA 606000E 7584000N). According to Thorne and Trendall (2001), the Woodiana Member reflects deposition in a nearshore shelf environment, whereas the middle and upper parts of the Jeerinah Formation reflect deposition within an offshore shelf environment. On HOOLEY, rocks characteristic of the latter facies include variegated, light-coloured mudstone and siltstone (*AFjsl*), and an overlying unit comprising carbonaceous mudstone and siltstone, chert, and local dolomite beds (*AFjslg*). Within this carbonaceous mudstone and siltstone unit, dolomite and dolomitic shale (*AFjkd*) form local mappable layers (e.g. MGA 607800E 7577000N).

Hamersley Group

Marra Mamba Iron Formation (AHm)

Outcrop of the Hamersley Group on HOOLEY is restricted to the far southwest corner of the sheet. The group typically comprises poorly outcropping interbeds of chert, banded iron-formation, mudstone, and siltstone of the Marra Mamba Iron Formation (*AHm*). No evidence is preserved of an unconformity between this unit and the underlying Jeerinah Formation, although there are significant changes from north to south in the thickness of units within the latter formation (particularly in *AFjslg*).

Structure and metamorphism

For both the Fortescue and Hamersley Groups, bedding surfaces typically dip at a shallow angle, predominantly southwards. The rocks show gentle folding (Fig. 4) and broad domal features are locally present (MGA 604500E 7612000N). North-northeasterly trending faults show a dip-slip component that has locally juxtaposed quartz–muscovite schist and quartzite (*Asq*), in the northwestern part of HOOLEY, against rocks of the Tumbiana Formation (MGA 606600E 7611000N), and has uplifted a wedge of Mount Roe Basalt. These faults typically do not affect the Maddina Formation, and it is likely that fault movement pre-dates deposition of that formation.

Northeast-trending faults are a common and significant feature throughout HOOLEY, and for many of these the latest phase of movement probably post-dated deposition of the Fortescue Group. These faults contain evidence of both strike-slip and dip-slip displacements; however, only the latter appears to typify displacement after deposition of the Fortescue Group.

The rocks of the Fortescue and Hamersley Groups have been subject to low-grade metamorphism, characterized in mafic rocks by an assemblage containing chlorite and epidote.

Dolerite dykes (*d*)

Dolerite dykes (*d*), of undetermined age are recognized in the southern and northern parts of HOOLEY. They typically trend either east-northeast or north, and are associated with a late phase of faulting (e.g. MGA 647500E 7577500N).

Cainozoic deposits

Residual deposits (*Czru, Czrk, Czrfb*)

Massive, grey, siliceous caprock over ultramafic rock (*Czru*) is associated with altered outcrop of tremolite-rich schist (*Aur*) in the northern part of HOOLEY (MGA 643000E 7619400N).

Massive, nodular, and cavernous limestone of residual origin (*Czrk*) in the far northeast corner of the map area is developed over rocks of the EPGGT. The deposit is more extensively developed in the southwestern part of the sheet, mainly over mafic rocks of the Maddina Formation.

Ferruginous caprock (*Czrfb*), developed over basalt, forms small exposures in the northwestern part of HOOLEY (MGA 615000E 7622000N), is more extensively developed to the north, on SATIRIST. It forms laterite platforms that are slightly elevated compared to adjacent colluvial deposits developed over basaltic rocks of the Fortescue Group.

Colluvium (*Czc, Czcb*)

Dissected and consolidated colluvium (*Czc*) forms outwash fans, flanking elevated outcrop in the northeastern and southwestern parts of the sheet. These deposits consist of clay- or silica-cemented, poorly stratified silt, sand, and gravel, typically with a high proportion of mafic (chloritic) detritus, except where derived from granitic rocks. In the southwest part of HOOLEY, a gilgai surface has locally developed over colluvial deposits (*Czcb*). Gilgai is a clay-rich silt or sand deposit characterized by the development of numerous cracks and sinkholes. The clay expands and contracts according to water content, and in dry conditions produces an irregular 'crabhole' surface.

Alluvial deposits (*Czaf, Czag, Czak*)

Alluvial deposits dissected by recent drainage are a minor component on HOOLEY. Pisolitic limonite deposits (*Czaf*) form two small mesas 1–2 km to the southeast of Hooley Homestead. Alluvial gravel (*Czag*) is only in the northeastern part of the map, where it overlies rocks of the EPGGT, particularly adjacent to the present channel of Pilbaddy Creek. Alluvial calcrete (*Czak*) is exposed along the southwestern bank of the Fortescue River, in the far southwest corner of the sheet, where it is interpreted to overlie the Wittenoom Formation of the Hamersley Group.

Quaternary colluvium and sheetwash deposits (*Qc, Qw*)

Colluvium, consisting of sand, silt, and gravel, is locally derived from elevated outcrops and deposited on outwash fans, and talus slopes (*Qc*). In more distal regions, sheetwash deposits (*Qw*) of silt, sand, and pebbles are deposited on outwash fans. Locally reworked by wind action, sand deposits have generally been stabilized by extensive grass and shrub cover.

Quaternary alluvial deposits (*Qaa, Qao, Qab*)

Present-day drainage channels contain alluvial clay, silt, and sand in channels on floodplains, or sand and gravel in rivers and creeks (*Qaa*). Alluvial clay, silt, and sand form overbank deposits on floodplains (*Qao*) and locally include gilgai (*Qab*).

Economic geology

There are no known gold occurrences on HOOLEY, nor are there any currently working mines or prospects. In the past the late (c. 2935 Ma) granitic rocks of the Yule Granitoid Complex (*AgYpos*) have been prospected for pegmatite-hosted beryl (MGA 636900E 7612300N); alluvial corundum has been found in Corung Creek (MGA 647500E 7609810N; Kriewaldt and Ryan, 1967), and iron-rich regolith deposits have been investigated over rocks of the Marra Mamba Iron Formation, in the southwest of HOOLEY (MGA 604200E 7575800N; Ruddock, 1999). For a detailed description of the mineral occurrences and exploration potential of the EPGGT see Ruddock (1999).

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Appendix 1

Gazetteer of localities

Place name	*MGA coordinates*	
	Easting	*Northing*
Grimms Bore	643600	7575000
Hooley Homestead	626300	7579600
Punduna Pool	642000	7612700
Wonga Well	624100	7592700

The HOOLEY 1:100 000 sheet covers the southeast corner of the PYRAMID 1:250 000 sheet. These Notes describe the stratigraphy, structure, and mineralization of the area, which lies in the central part of the Archaean Pilbara Craton. The Yule Granitoid Complex (2945-2930 Ma) is a major feature of the East Pilbara Granite–Greenstone Terrane on HOOLEY, and contains unassigned greenstones as xenoliths or roof pendants. The Fortescue Group (2775-2630 Ma), and the Marra Mamba Iron Formation of the Hamersley Group unconformably overlie these rocks as part of the Hamersley Basin. They dip shallowly south-southwest with the Fortescue Group dominating outcrop on HOOLEY as a plateau. Pegmatite-hosted beryl, iron-rich regolith, and alluvial corundum have previously been of economic interest on the map area.

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

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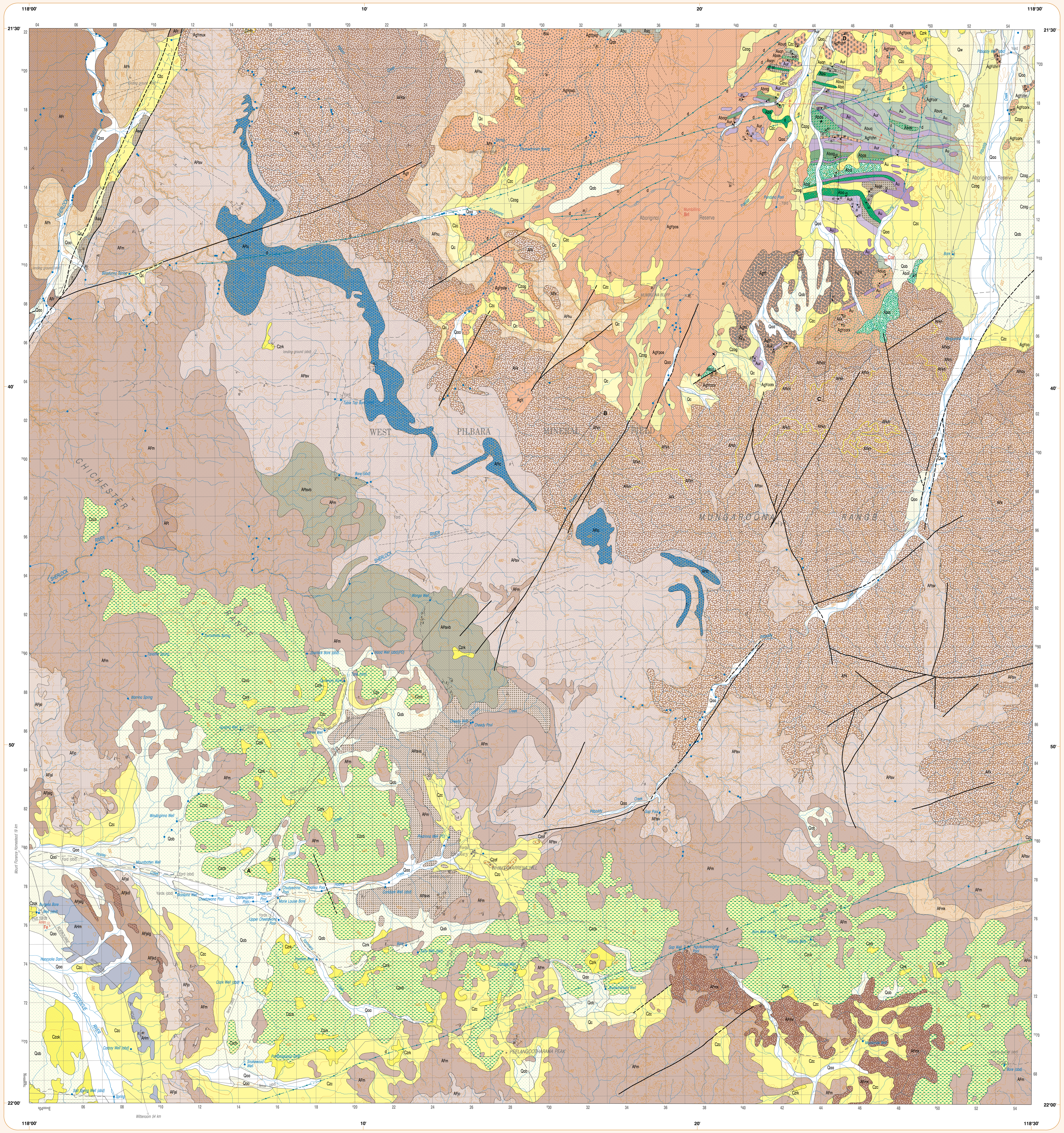
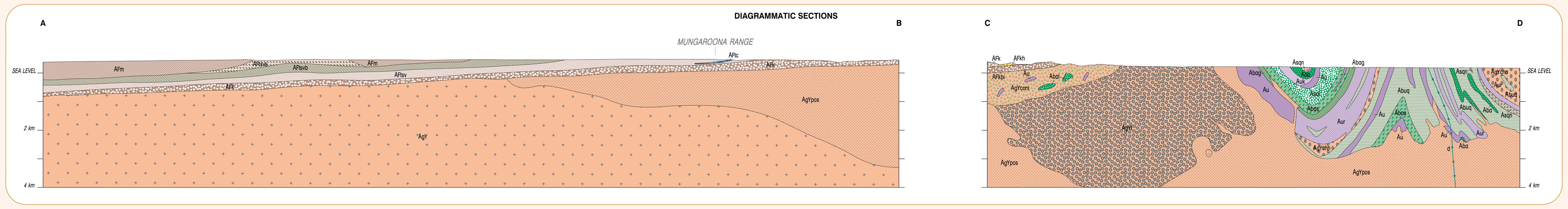
HOOLEY

AUSTRALIA 1 : 100 000 GEOLOGICAL SERIES — GEOLOGICAL SURVEY OF WESTERN AUSTRALIA — SHEET 2554



DIAGRAMMATIC SECTIONS



QUATERNARY / CAINOZOIC / PHANEROZOIC

Qaa Alluvial sand and gravel in rivers and creeks; clay, silt, and sand in channels on floodplains
Qao Overbank deposits; alluvial sand, silt, and clay in floodplains adjacent to main drainage channels
Qab Alluvial sand, silt, and clay in floodplains, with gilgai surface in areas of expansive clay
Qw Sheetwash deposits — silt, sand, and pebbles in distal outwash fans; no defined drainage
Qc Colluvium — sand, silt, and gravel on outwash fans; scree and talus

Czaf Pisolitic limonite deposits, developed along palaeodrainage lines; dissected by recent drainage
Czag Alluvial gravel, unrelated to recent drainage; variably consolidated; dissected by recent drainage
Czak Alluvial calcrete; massive, nodular, and cavernous limestone; variably silicified and dissected
Czc Colluvium — sand, silt, and gravel on outwash fans; scree and talus
Czcb Colluvium with gilgai surface in areas of expansive clay; dissected by recent drainage
Czrfb Ferruginous caprock over basalt
Czrk Residual calcrete; massive, nodular, and cavernous limestone; mainly silicified
Czru Siliceous caprock over ultramafic rock

d Dolerite dyke; interpreted from aeromagnetic data where dashed

ARCHAEAN — PILBARA CRATON — HAMERSLEY BASIN

Mount Bruce Supergroup — Hamersley Group

c. 2595 Ma[1] AHm **MARRA MAMBA IRON FORMATION:** chert, banded iron-formation, mudstone, and siltstone

Fortescue Group

JEERINAH FORMATION

c. 2686–2629 Ma[2,3] AFjslg Carbonaceous mudstone and siltstone, chert, and local dolomite beds
AFjkd Dolomite and dolomitic shale
AFjsl Variegated, light-coloured mudstone and siltstone
AFjo **Woodiana Member:** quartz-rich sandstone, chert, chert breccia, and mudstone; locally includes volcanogenic lithic sandstone

c. 2717 Ma[4] AFm **MADDINA FORMATION:** massive, vesicular, and amygdaloidal basalt and basaltic andesite
AFmx Basaltic volcaniclastic breccia
AFmk **Kuruna Member:** basaltic to andesitic volcaniclastic sandstone, mudstone, chert, and dolomite

c. 2719 Ma[5] AFt **TUMBIANA FORMATION:** mafic to felsic volcaniclastic sandstone, tuff, and fine- to medium-grained clastic sedimentary rock; minor basalt, chert, dolomite, and limestone
AFtsvs Volcaniclastic sandstone, tuff, and fine- to medium-grained clastic sedimentary rock
AFtsvb Volcaniclastic sandstone, tuff, and clastic sedimentary rock with locally abundant basalt sheets and dykes with peperitic margins
AFtsv Volcaniclastic sandstone, carbonate-rich tuff, and volcaniclastic mudstone, and siltstone; locally abundant layers of dark grey siliceous stromatolitic dolomite and limestone
AFtc **Meentheena Carbonate Member:** dark grey stromatolitic dolomite and limestone, carbonate-rich tuff, mudstone, and siltstone

AFk **KYLENA FORMATION:** massive and amygdaloidal basalt, basaltic andesite, and dacite; local high-Mg basalt and rhyolite
AFkh Massive and amygdaloidal basalt, and mafic volcaniclastic rocks with sericite and pyrophyllite (hydrothermal) alteration along epithermal veins and bedding planes
AFkbi Basaltic andesite with minor basalt and andesite

c. 2760 Ma[2,6] AFh **HARDEY FORMATION:** sandstone, conglomerate, siltstone, shale, and felsic tuff
AFhu Felsic tuff, tuffaceous sandstone, siltstone, and shale; interbedded; locally conglomerate

c. 2770 Ma[2,7] AFr **MOUNT ROE BASALT:** massive, vesicular, and glomeroporphyritic basalt

YULE GRANITOID COMPLEX

AgY Granitoid rock, unassigned; age uncertain; typically strongly weathered; metamorphosed

2935 Ma[8] **POWDAR MONZOGRANITE**
AgYpop Porphyritic monzogranite
AgYpos Seriate-textured monzogranite

MUNGAROONA GRANODIORITE
AgYmux Hornblende(–biotite)-bearing granodiorite and monzogranite with greenstone and granitoid gneiss rafts and xenoliths
AgYt Hornblende–biotite tonalite
AgYco **COCKERAGA LEUCOGRANITE:** leucocratic biotite(–hornblende) tonalite and granodiorite and subordinate monzogranite; locally abundant pegmatite, and greenstone and granitoid gneiss xenoliths; weakly metamorphosed
AgYcor Leucocratic biotite(–hornblende) tonalite and granodiorite and subordinate monzogranite with well-developed schlieric banding; locally abundant granitoid gneiss xenoliths
AgYcorx Leucocratic biotite(–hornblende) tonalite and granodiorite and subordinate monzogranite with well-developed schlieric banding and locally abundant greenstone and granitoid gneiss xenoliths

CHEEARA MONZOGRANITE
AgYchn Gneissic monzogranite to granodiorite

Pilbara Supergroup (no stratigraphic subdivision)

Asq Quartz–muscovite schist and quartzite
Asqn Quartzite with locall banded quartz and quartz–feldspar–amphibole paragneiss

Aba Amphibolite; fine to medium grained; massive to strongly foliated
Abag Medium-grained amphibolite with abundant layers, veins, and irregular patches of tonalite; massive to strongly foliated
Abal Leucocratic amphibolite; medium grained; massive to strongly foliated
Abas Amphibolite and actinolitic schist
Abu Interleaved mafic and ultramafic rocks; metamorphosed
Abuq Interleaved mafic and ultramafic rocks, quartz–muscovite schist, and quartzite

Au Ultramafic rock, undivided; metamorphosed
Auk Metamorphosed peridotitic komatiite; olivine spinifex texture; serpentine–talc–tremolite rock
Aur Tremolite-rich schist; after ultramafic rock

Symbols

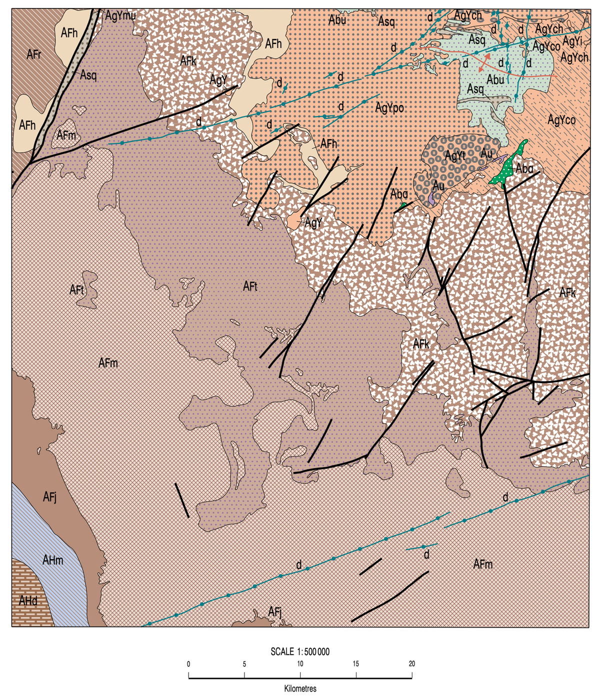
Geological boundary
exposed
Fault
exposed
concealed
Fold, showing axial trace
antiform; exposed, concealed
Small-scale fold axis, showing strike and dip
syncline
Z-vergence
Bedding, showing strike and dip
inclined
vertical
overturned
strike and dip estimated from aerial photography
5–15°
15–45°
Igneous layering, showing strike and dip
inclined
Igneous flow banding, showing strike and dip
inclined
Metamorphic foliation, showing strike and dip
inclined
vertical
Gneissic banding, showing strike and dip
inclined
Cleavage, showing strike and dip
inclined
vertical
Crenulation cleavage, showing strike and dip
inclined
Airphoto lineament
fracture pattern

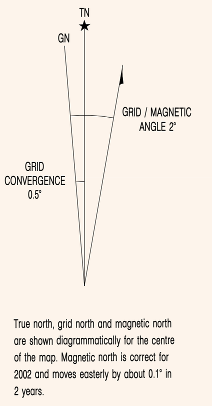
Formed road
Major track
Track
Fence, generally with track
Homestead — Hooley
Building
Yard — Yard
Reserve boundary
Breakaway
Contour line, 20 metre interval — 220

Watercourse with ephemeral pool or waterhole
Pool — Pool
Spring — Spring
Bore, well — Bore, Well
Windpump
Dam, tank — Dam, Tank
Abandoned — (abd)
Position doubtful — (PD)

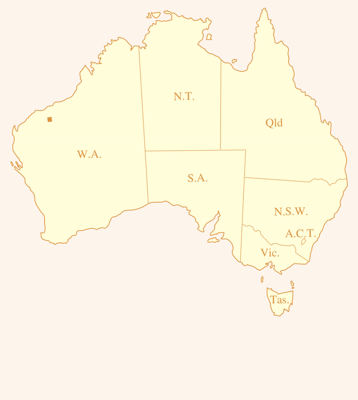
Mineral deposit
Prospect — Mumbillina
Mineral exploration drillhole, showing subsurface data — AHm
Mineral occurrence
Mineral and rock commodities
Beryl — Brl
Corundum — Cor
Iron — Fe

INTERPRETED BEDROCK GEOLOGY





True north, grid north and magnetic north are shown diagrammatically for the centre of the map. Magnetic north is correct for 2002 and moves easterly by about 0.1° in 2 years.



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Geochronology by:
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(8) D. R. Nelson, 2000, GSWA Record 2000/2, p. 82–85.

Edited by C. Strong and G. Loan

Cartography by S. Coldicutt, G. Wright, and B. Williams

Topography from the Department of Land Administration Sheet SF 50-7, 2554, with modifications from geological field survey

Mineralization and rock commodity information from non-confidential data held in the WAMIN database, GSWA, at 15 May 2002

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SMITHIES, R. H., 2002, Hooley, W.A. Sheet 2554: Western Australia Geological Survey, 1:100 000 Geological Series.

SHEET INDEX

COOYA POOYA 2355	MOUNT WOHLER 2455 (PYRAMID)	SATIRIST 2555	WODGINA 2655	NORTH SHAW 2755 (MARBLE BAR)	MARBLE BAR 2855
MILLSTREAM 2354	SF 50-7 MOUNT BILLROTH 2454	HOOLEY 2554	WHITE SPRINGS 2654	SF 50-8 TAMBOURAH 2754	SPLIT ROCK 2854
JEERINAH 2353	McRAE 2453 (MOUNT BRUCE)	WITTENOOM 2553	MOUNT GEORGE 2653	MOUNT MARSH 2753 (ROY HILL)	WARRIE 2853
ROCKLEA 2352	SF 50-11 MOUNT LIONEL 2452	MOUNT BRUCE 2552	MUNJINA 2652	SF 50-12 WEELI WOLLI 2752	ROY HILL 2852

1:100 000 maps shown in black
1:250 000 maps shown in brown

Department of Mineral and Petroleum Resources — Geological Survey of Western Australia

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GEOSCIENCE AUSTRALIA
NGA PRODUCT OF THE NATIONAL GEOSCIENCE AGREEMENT

SCALE 1:100 000
1000 Metres 0 1 2 3 4 5 6 7 8 9 10 Kilometres

UNIVERSAL TRANSVERSE MERCATOR PROJECTION
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUSTRALIA 1994
VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM

Grid lines indicate 1000 metre interval of the Map Grid Australia Zone 50

The Map Grid Australia (MGA) is based on the Geocentric Datum of Australia 1994 (GDA94)
GDA94 positions are compatible within one metre of the datum WGS84 positions

HOOLEY

SHEET 2554 **FIRST EDITION 2002**
Version 1 – June 2002