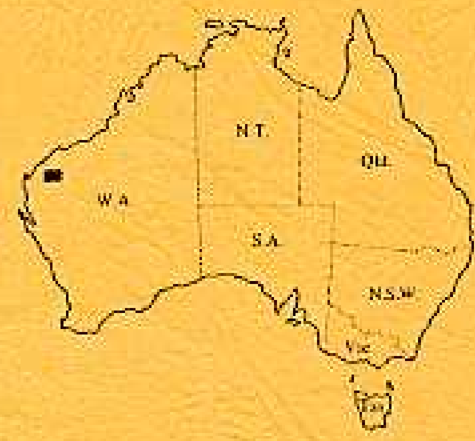
GEOLOGICAL SURVEY OF WESTERN AUSTRALIA
1:250 000 GEOLOGICAL SERIES—EXPLANATORY NOTES

WYLOO

WESTERN AUSTRALIA

SECOND EDITION

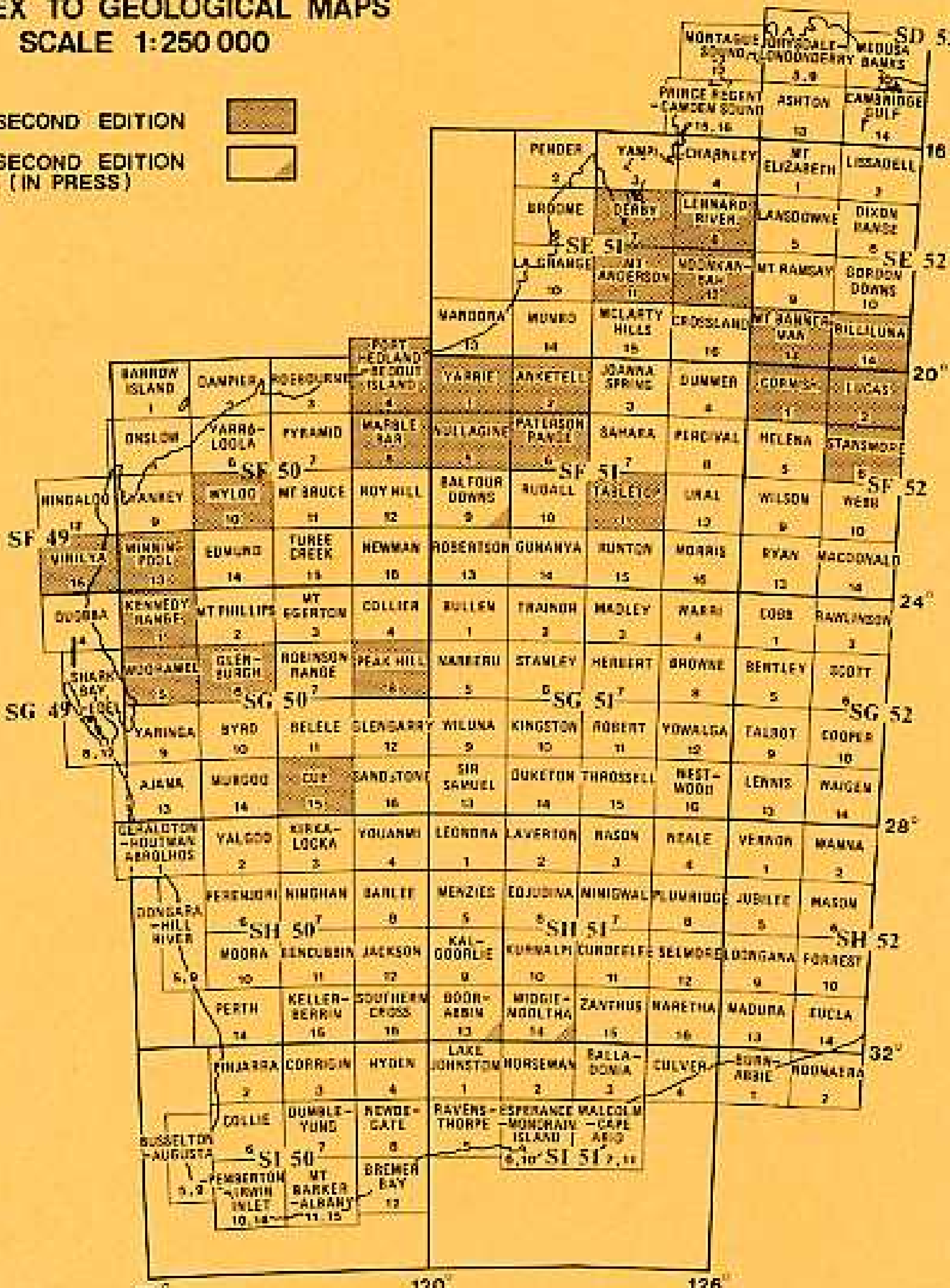


SHEET SF50-10 INTERNATIONAL INDEX

WESTERN AUSTRALIA
INDEX TO GEOLOGICAL MAPS
SCALE 1:250 000

SECOND EDITION

SECOND EDITION (IN PRESS)



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SECOND EDITION

BY D. B. SEYMOUR, A. M.
THORNE, AND D. F. BLIGHT

PERTH, WESTERN AUSTRALIA 1988

60030-1

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ISSN 0729—3720
National Library of Australia Card Number and
ISBN 0 7309 1106 3

Explanatory Notes on the Wyloo Geological Sheet (Second Edition)

By D. B. Seymour, A. M. Thorne, and D. F. Blight

INTRODUCTION

The WYLOO* 1:250 000 area (SF50-10) is bounded by latitudes 22°S and 23°S and by longitudes 115° 30′E and 117°E. It is located in the southwestern part of the Hamersley Range in the North-West Division of Western Australia.

The sealed North West Coastal Highway crosses the northwestern corner of WYLOO, and the main road from Nanutarra to Wittenoom crosses from the central western side to the southeastern corner. The pastoral stations of Cane River, Duck Creek, Glen Florrie, Kooline, Mount Stuart, Nanutarra, Red Hill, and Wyloo, occupy the lower, less rugged western and southern portions of the area, where generally good access is provided by graded roads and station tracks. Most stations have airstrips suitable for light aircraft.

The area is arid to semi-arid. The average annual rainfall ranges from 350 mm in the north to 270 mm in the south; at Wyloo Station it is 287 mm. The vegetation on Wyloo can be subdivided into tall shrubland with wattle and teatree, and spinifex grassland with scattered trees and shrubs (Beard, 1981). Eucalypts are common along the main drainages.

PHYSIOGRAPHY

The northeastern part of the sheet includes rugged country of the Hamersley Range. The highest point on WYLOO (1 006 m) is in this area, and the local relief ranges up to 500 m. To the southwest, the country is lower and more open; it contains isolated hills and long, narrow ridges, typified by the Parry Range and its southeast continuation through to Mount Florry.

The course of the Ashburton River, an intermittent stream, runs through the southwestern corner of WYLOO. The major tributaries from the north are Duck Creek and the Hardey River, and from the south, the Henry River.

PREVIOUS INVESTIGATIONS

Maitland (1909) crossed the region from Glen Florrie to the Cane River via Mount Stuart in 1907. He investigated the general geology and studied some of the mineral occurrences. In 1918, Talbot (1926) studied the geology in the Hardey River region and westward down the Ashburton valley. The geology of some of the smaller mines in the area has been described by Forman (1938), Finucane (1939), and Finucane, Sullivan, and Telford (1939).

Results of the first 1:250 000 mapping of WYLOO were published in the late 1960's (Daniels and Halligan, 1969), Daniels (1970). More recent accounts describing aspects of the geology are discussed in the text.

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

TERMINOLOGY

Sandstone is classified according to the scheme of Pettijohn (1975) with the following modifications:

(1) The terms *arkosic arenite* and *subarkose* are replaced by *feldspathic arenite* and *subfeldspathic arenite* respectively.

(2) *Wacke* is used to define sandstone containing more than 10% matrix and the term *greywacke* is abandoned.

ARCHAEAN CRYSTALLINE ROCKS

PILBARA SUPERGROUP

The oldest rocks on WYLOO are exposed in the core of the Wyloo Dome (Fig. 1). They are a metamorphosed sequence of mafic volcanics, dolerite, gabbro, and minor chert, and are intruded by the Metawandy Granite. They are generally schistose and are unconformably overlain by rocks of the Fortescue Group. The dolerite and gabbro occur either as individual sills and dykes or as sheeted-dyke complexes. Large enclaves of mafic schist occur in the Metawandy Granite. The mafic rocks are broadly correlated with the Pilbara Supergroup *(Ap)* of the northern Pilbara Block (Hickman, 1983). The obsolete name "Warrawoona Series" used on the first edition map of WYLOO is abandoned.

The area of Archaean mafic rocks on the second edition of WYLOO differs from that on the first in three ways:

(1) In a traverse southwards from the small outcrop of Metawandy Granite near 22° 43′S, 116° 26′ 30″E, no evidence could be found of an unconformity between the Pilbara Supergroup and the overlying Fortescue Group. The boundary between these units is moved closer to the contact with the Metawandy Granite, and separates Pilbara Supergroup mafic volcanics with granitic veins to the north, from similar Fortescue Group rock types, without veins, to the south.

(2) A northwest-trending strip of rocks shown as Warrawoona Series in the centre of the Metawandy Granite in the first edition, map is reinterpreted as a dolerite dyke of probable Fortescue Group age because it could not be distinguished petrographically from dolerite dykes and sills which intrude, and are folded with the Fortescue Group.

(3) A large area of Archaean mafic rocks, running south-southwest past Billeroo Bore, was found west of the tributary of Metawandy Creek.

These relatively minor changes contrast with those of Horwitz (1978), who included a large area of essentially mafic volcanics to the west and south of the Metawandy Granite within a late Archaean unit which he named the Paulsen Volcanics. These rocks are similar to the Mount Roe Basalt (Fortescue Group) and are assigned to that formation; the name Paulsen Volcanics is discarded.

METAWANDY GRANITE

The Metawandy Granite *(Ag)* (Horwitz, 1978) occurs in the core of the Wyloo Dome. The southwestern margin of the granitoid is tectonized, dips approximately 45° to the southwest, and is concordant with the layering in the adjacent rocks. Offshoots appear to intrude rocks of the Pilbara Supergroup in

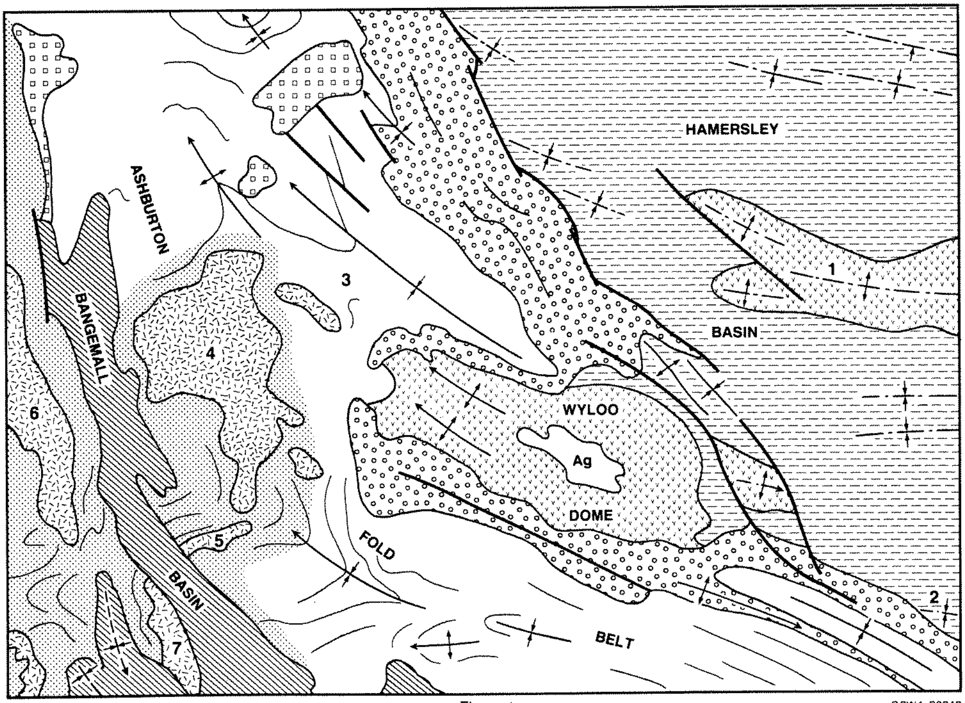

Figure 1 GSWA 23246

WYLOO STRUCTURAL SKETCH MAP

REFERENCE

- Bangemall Group
- Mount Minnie Group
- Post-Wyloo Group granitoid
- Morrissey Metamorphic Suite
- Wyloo Group: Ashburton Formation; Beasley River Quartzite to June Hill Volcanics
- Mount Bruce Supergroup: Hamersley and Turee Creek Groups; Fortescue Group
- Ag Crystalline basement

STRUCTURAL SYMBOLS

- Syncline, Anticline — Pre-Wyloo Group
- Synform, Antiform — Post-Wyloo Group
- Syncline — Post-Bangemall Group
- Fault
- Bedding/Schistosity trend line

0 30 km

1 Jeerinah Anticline
2 Hardey Syncline
3 Duck Creek Syncline
4 Boolaloo Granodiorite
5 Mount Danvers Granodiorite
6 Kilba Granite
7 Wongida Granodiorite

several places (such as at 22° 43′S, 116° 27′E), and Horwitz (1978) noted that the country rocks are hornfelsed. The Metawandy Granite is unconformably overlain by the Fortescue Group.

The Metawandy Granite is an adamellite and, in the least-deformed areas, is medium grained with an allotriomorphic granular texture that is partly recrystallized. Anhedral plagioclase is partly altered to fine sericite and granular epidote. Perthitic microline generally encloses plagioclase poikilitically. Quartz occurs as irregular grains, interstitial to the feldspar and shows undulose extinction. The quartz is partly recrystallized to smaller, weakly oriented grains with sutured margins. Biotite occurs as clusters of ragged grains; and white mica, as an alteration product in fractures and veins and along grain boundaries. Accessory minerals include epidote, iron-titanium oxides, apatite, zircon, and fluorite.

Locally the granitoid is strongly deformed and altered to a quartz-muscovite schist that contains lenticles of strained (or recrystallized) polygonal quartz in a fine-grained lepidoblastic matrix of muscovite and quartz.

MOUNT BRUCE SUPERGROUP

The Mount Bruce Supergroup was established by Halligan and Daniels (1964), and revised by Trendall (1979) to incorporate the Fortescue Group, Hamersley Group, and Turee Creek Group (Table 1).

FORTESCUE GROUP

The Fortescue Group *(F)* is the lowermost unit of the Mount Bruce Supergroup. It unconformably overlies the crystalline Archaean basement and was deposited between 2 750 Ma and 2 490 Ma (Trendall, 1983).

On WYLOO, the Fortescue Group outcrops in the Wyloo Dome and the Jeerinah Anticline (Fig. 1) and has a maximum thickness of 6.5 km. It unconformably overlies the crystalline Archaean basement and is conformably overlain by the Hamersley Group. The succession consists mainly of mafic lavas and pyroclastics, but includes some felsic volcanics, conglomerate, sandstone, BIF, chert, dolerite and mudstone.

The Fortescue Group is subdivided (in ascending order) into the Mount Roe Basalt, Hardey Sandstone, Mount Jope Volcanics, and Jeerinah Formation.

TABLE 1. STRATIGRAPHY OF WYLOO SHEET

	Map Symbol	Formation or member and thickness (m)	Lithology	Stratigraphic relations	Remarks
CAINOZOIC	*Qa*		Gravel, sand, silt, and clay.	Superficial veneer.	Alluvial, good aquifer.
	Qc		Unconsolidated sand and gravel.	Superficial veneer.	Colluvium, good aquifer.
	Qs		Sand, fine-to medium-grained.	Superficial veneer.	Eolian.
	Tc		Partially consolidated sand and gravel.	Superficial veneer.	Colluvium.
	To		Calcrete.	Superficial veneer.	Calcareous deposit formed in soil profile.
	Tp	Robe Pisolite (15-45)	Limonitic and hematitic pisoliths; and a slight terrigenous detritus, plant fragments.	Unconformable on Precambrian units.	Occurs along old drainage lines.

TABLE 1. (Continued)

	Map Symbol	Formation or member and thickness (m)	Lithology	Stratigraphic relations	Remarks
CAINOZOIC	*Ts*		Silcrete and variable amounts of calcrete.	Superficial veneer.	Weathering product; well-developed on dolomites of the Precambrian Bangemall Group.
			UNCONFORMITY		
MESOZOIC	*Kn*	Yarraloola Conglomerate and Nanutarra Formation	Conglomerate, siltstone, some fissile mudstone.	Unconformable on Precambrian Mount Minnie Group.	Confined to northwest of WYLOO.
			UNCONFORMITY		
BANGEMALL GROUP	*Mk*	Kiangi Creek Formation (240)	Silicified quartzitic sandstone.	Conformable on Irregully Formation.	Forms prominent capping to Mount Florry.
BANGEMALL GROUP — IRREGULLY FORMATION	*Ma*	Revels Corner Sandstone Member (330+)	Thin-bedded sandstone.	Conformable on Warrada Dolomite Member.	Not present south of the Ashburton River.
	Mil	Warrada Dolomite Member (640)	Massive, cream-weathering dolomite in lower half; upper half, well-bedded edgewise conglomerate and silicified horizons.	Conformable on Gooragoora sandstone.	Not present south of the Ashburton River.
	Miu	Wannery Member (335)	Mudstone, and thin bed of sandstone	Conformable on Gooragoora Sandstone.	Not present north of Ashburton River.
	Mie	Yeelingee Member (210)	Finely laminated mudstone, sandstone, and thin dolomite.	Conformable on Weewoddie Dolomite Member.	Lateral equivalent of Wannery Member near Mount Florry.
	Mio	Weewoddie Dolomite Member (150)	Black-weathering dolomite and rare, thin beds of sandstone.	Conformable on Chubilyer Member.	Lateral equivalent of Wannery Member near Mount Florry.
	Mih	Chubilyer Member (180)	Mudstone and thin sandstone.	Conformably overlies Gooragoora Sandstone.	Lateral equivalent of Wannery Member near Mount Florry.

TABLE 1. (Continued)

	Map Symbol	Formation or member and thickness (m)	Lithology	Stratigraphic relations	Remarks
BANGEMALL GROUP IRREGULLY FORMATION	*Mid*	Gooragoora Sandstone Member (300)	Thin-bedded, cross-stratified sandstone containing small iron oxide pseudomorphs after pyrite; mud-stone dominant in south of Parry Range.	Conformable on Wongida Dolomite Member.	
	Mi	Wongida Dolomite Member (650)	Massive white-weathering dolomite overlain by well-bedded dolomite with edgewise conglomerate, chert and abundant silicified stromatolites.	Conformable on Yilgatherra Member or unconformable on Mount Minnie Group, Wongida Creek Granodiorite, Morrissey Metamorphic Suite, and Ashburton Formation.	Contains penecontemporaneous breccia horizons near Mount Price.
	Mis	Yilgatherra Member (300)	Sandstone, often silicified, and quartz pebble conglomerate.	Unconformable on Morrissey Metamorphic Suite.	Thins rapidly to the northwest from Warrada Creek Well.
			UNCONFORMITY		
MOUNT MINNIE GROUP	*Ia*	Warramboo Sandstone (400 min.)	Thin-medium bedded, fine to coarse sandstone and minor mudstone; sandstone often cross-stratified, current ripples and small scale slumps.	Conformable on Wabco Shale.	Braided fluvial to shallow-marine.
	Iw	Wabco Shale (500)	Mudstone and thin beds of sandstone.	Conformable on Brodagee Sandstone.	Marine shelf deposits.
	Ib	Brodagee Sandstone (750)	Silicified, thick-bedded sandstone with laterally restricted basal conglomerate; sandstones often occur in upward fining sets, pebbly at base, with trough cross stratification.	Unconformable on Ashburton Formation.	Fluvial with localized alluvial-fan deposits.
	I	Undifferentiated Mount Minnie Group		Unconformable on Ashburton Formation.	
			UNCONFORMITY		

TABLE 1. (Continued)

Map Symbol	Formation or member and thickness (m)	Lithology	Stratigraphic relations	Remarks
Pgbr	Boolaloo Granodiorite, Mount Danvers Granodiorite, Wongida Creek Granodiorite.	Biotite granodiorite, mainly coarse-grained, contains mafic xenoliths.	Intrudes Ashburton Formation and Morrissey Metamorphic Suite.	Probable igneous source rocks, crustal origin.
Pgmb	Kilba Granite	Muscovite-biotite (-tourmaline) adamellite and granite; most phases homogenous i.e. xenoliths of schist.	Intrudes Morrissey Metamorphic Suite.	Probably derived by anatexis of Morrissey Metamorphic Suite.
Pgml	Kilba Granite (Marginal Phase)	Porphyritic, muscovite-biotite granite.	Intrudes Morrissey Metamorphic Suite; forms pluton margins.	
Pgs		Gneissic, biotite (-hornblende) granodiorite.	Intrudes Morrissey Metamorphic Suite.	Early, mantled gneiss granitoid.
MORRISSEY METAMORPHIC SUITE				
x	Mudong Metamorphics (undifferentiated)	Schist, amphibolite, marble, skarn, quartzite, and pelite.		Previously Mudong Member (1st Edition WYLOO 1:250,000).
xq		Quartzite.	Forms unit within Mudong	
np		Medium-grained microgneiss and schist.	Metamorphic; probable metamorphosed Ashburton Formation.	np is probably a higher grade equivalent to lm.
nm		Marble.		
na		Amphibolite.		
mb		Paragneiss migmatite.		
lm		Low- to medium-grade schist, fine- to coarse-grained.	Metamorphosed Ashburton Formation.	
cm		Contact-metamorphosed gneiss and schist.	Metamorphosed Ashburton Formation.	Developed in proximity to eastern margin of Boolaloo Granodiorite.

TABLE 1. (Continued)

	Map Symbol	Formation or member and thickness (m)	Lithology	Stratigraphic relations	Remarks
	Wa	Ashburton Formation (500-10 000)	Conglomerate, wacke, mudstone, ferruginous mudstone, minor chert.	Conformable on Duck Creek Dolomite or disconformable on June Hill Volcanics.	Submarine-fan and associated basin-plain sediments.
	Wai		Banded iron-formation, mudstone, chert.	Occurs close to base of Ashburton Formation.	Outcrop confined to north of the Wyloo Dome.
	Wj	June Hill Volcanics (120)	Predominantly mafic lavas, tuffs, and pillow breccias; minor dolomite, sandstone, and mudstone.	Conformable on Duck Creek Dolomite.	Confined to area north of the Wyloo Dome.
WYLOO GROUP	*Wd*	Duck Creek Dolomite (1 000)	Thin to thick-bedded, locally stromatolitic dolomite with minor chert and mudstone; contains relic evaporite textures and dolomitic breccias.	Conformable on Mount McGrath Formation.	Shallow-shelf and slope carbonates.
	Wm	Mount McGrath Formation (900)	Conglomerate, arenite, wacke, mudstone, dolomitic mudstone, dolomite.	Disconformable on Cheela Springs Basalt, or with local angular unconformity on Wooly Dolomite.	Predominantly deltaic and shallow-marine shelf deposits.
	Ww	Wooly Dolomite (325)	Thin- to thick-bedded, locally stromatolitic dolomite (may contain intraclasts); dolomitic mudstone and minor chert; pebbly arenite at base.		Confined to southeast of WYLOO; quiet-water to high-energy shelf carbonates.
	Wb	Cheela Springs Basalt (2 000)	Vesicular and amygdaloidal basalt with minor tuff and chert; some dolerite sills.	Conformable upon Beasley River Quartzite. Localized erosion unconformity.	Thins to nothing away from type locality.

TABLE 1. (Continued)

	Map Symbol	Formation or member and thickness (m)	Lithology	Stratigraphic relations	Remarks
WYLOO GROUP	*Wq*	Beasley River Quartzite (360)	Conglomerate, sandstone, mudstone and dolomite, with some dolerite sills; locally includes the Three Corner Conglomerate Member, (a lithic conglomerate with minor sandstone and mudstone).	Unconformable on Fortescue, Hamersley, and Turee Creek Groups.	Predominantly shallow-marine shelf deposits, with localized alluvial-fan sediments at the base.
			UNCONFORMITY		
TUREE CREEK GROUP	*Tk*	(4000)	Conglomerate, lithic and quartzitic arenites, wacke, mudstone, pebble-cobble mudstone, dolomite, basalt; intruded by dolerite sills.	Conformable on Boolgeeda Iron Formation	Includes Kungarrra Formation; Group represents shallowing marine to fluvial succession.
HAMERSLEY GROUP	*Ho*	Boolgeeda Iron Formation (300)	Laminated grey-brown to black BIF with chert and mudstone.	Conformable on Woongarra Volcanics.	BIF units are locally magnetic.
	Hw	Woongarra Volcanics (550)	Porphyritic and non-porphyritic rhyolites and dacites, thin stratified tuffs plus minor BIF and dolerite.	Concordant with overlying Boolgeeda Iron Formation and underlying Weeli Wolli Formation.	Contains both intrusive and extrusive phases.
	Hj	Weeli Wolli Formation (480)	BIF, often including red or white laminated cherts; mudstones and numerous dolerite sills.	Conformable on Brockman Iron Formation.	Dolerite sills constitute over half the formation thickness.
	Hb	Brockman Iron Formation (650)	Banded iron-formation and mudstone.	Conformable on Mount McRae Shale.	Subdivided into Dales Gorge, Whaleback Shale, Joffre, and Yandicoogina Shale Members.

TABLE 1. (Continued)

Group	Map Symbol	Formation or member and thickness (m)	Lithology	Stratigraphic relations	Remarks
HAMERSLEY GROUP	*Hs*	Mount McRae Shale (90)	Laminated mudstones; minor chert plus dolerite.	Conformable on Mount Silvia Formation.	
HAMERSLEY GROUP	*Hs*	Mount Sylvia Formation (30)	Three, thin BIF units separated by mudstone with minor chert and dolomite.	Conformable on Wittenoom dolomite.	Grouped together on the accompanying WYLOO map.
HAMERSLEY GROUP	*Hd*	Wittenoom Dolomite (150)	Thin-to medium-bedded dolomite with mudstone, chert, and minor BIF.	Conformable on Marra Mamba Iron Formation.	Dolomites may contain small-scale slump structures.
HAMERSLEY GROUP	*Hm*	Marra Mamba Iron Formation (230)	BIF with chert, podded chert, mudstone, and dolomite.	Conformable on Jeerinah Formation of Fortescue Group.	
FORTESCUE GROUP	*Fd*		Dolerite sills.	Concordant sills and feeder dykes.	
FORTESCUE GROUP	*Fj*	Jeerinah Formation (940)	Mudstone, chert, banded iron-formation, and basalt.	Conformable on Mount Jope Volcanics.	Intruded by numerous dolerite sills.
FORTESCUE GROUP, MOUNT JOPE VOLCANICS	*Fbf*	Felsic volcanics	Lapilli tuff and quartz feldspar porphyry.		
FORTESCUE GROUP, MOUNT JOPE VOLCANICS	*Fbs*	Sandstone	Medium- to coarse-grained arenite.		
FORTESCUE GROUP, MOUNT JOPE VOLCANICS	*Fbu*	Bunjinah Pillow Lava Member	Basalt with some well-developed pillows.		Schistose in southwestern half of Wyloo Dome.
FORTESCUE GROUP, MOUNT JOPE VOLCANICS	*Fbp*	Pyradie Pyroclastic Member (3 500)	Aggolomerate and tuff; intruded by abundant dolerite sills.		
FORTESCUE GROUP, MOUNT JOPE VOLCANICS	*Fbo*	Boongal Pillow Lava Member	Basalt; some pillow lava development.		
FORTESCUE GROUP, MOUNT JOPE VOLCANICS	*Fb*	Undifferentiated	Basaltic pillow lavas; some pyroclastics.	Conformable on Hardey Sandstone.	
FORTESCUE GROUP, MOUNT ROE BASALT	*Fh*	Hardey Sandstone (550 max)	Felspathic, lithic, and quartzitic sandstones, minor mudstones.	Conformable on Mount Roe Basalt.	

TABLE 1. (Continued)

	Map Symbol	Formation or member and thickness (m)	Lithology	Stratigraphic relations	Remarks
FORTESCUE GROUP MOUNT ROE BASALT	*Frf*	Felsic volcanics	Layered ashfall tuff, dacitic accretionary lapilli tuff, quartz feldspar porphyry.		Schistose in southwestern half of the Wyloo Dome.
	Frs	Sedimentary (1500)	Cobble mudstone and conglomerate (clasts may be granitic), sandstone and mudstone.		
	Fr	Undifferentiated	Vesicular basalt and basaltic agglomerate.		
			UNCONFORMITY		
PILBARA SUPERGROUP	*Ag*	Metawandy Granite	Sericitized adamellite, cataclastically deormed in part; mafic xenoliths locally abundant.		
	Ap		Mafic volcanics, intruded by dolerite.		

Mount Roe Basalt

The Mount Roe Basalt (*Fr*) is 1 500 m thick on the northeastern flank of the Wyloo Dome; but on the southwestern flank, it is thinner, strongly deformed, and shows a pronounced penetrative cleavage. It consists of basalt, basaltic agglomerate, felsic to intermediate tuff, and small amounts of sedimentary rock.

At 22° 37′ 30″S, 116° 23′E, the lowest unit of the Mount Roe Basalt consists of several metres of coarse lithic sandstone with locally developed trough cross-stratification and pebble horizons. A gradational, unconformable contact separates the sandstone from the underlying adamellite. The sandstone ranges from lithic wacke and arenite to sublitharenite or feldspathic arenite. Clasts comprise recrystallized quartz, plagioclase, microcline and quartz-feldspar, all showing evidence of strain. The matrix consists of clay minerals, chlorite, quartz, and granular sphene.

Coarser grained basal sedimentary rocks occur adjacent to the Metawandy Granite at 22° 41′S, 116° 27′ 30″E. An ancient regolith showing a transition from solid adamellite bedrock through angular cobble-boulder breccia with lithic wacke matrix into more rounded pebble- or cobble-bearing lithic wacke is preserved. Most fragments are locally derived.

Much of the overlying Mount Roe Basalt is of vesicular or amygdaloidal metabasalt and contains altered plagioclase phenocrysts in a chloritized and epidotized matrix. The distinctive amygdales are filled with carbonate, quartz, and feldspar, and survive even in strongly foliated rocks.

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Basaltic agglomerates in the lower part of the Mount Roe Basalt locally contain large autolithic fragments, spindle-shaped and bread-crust bombs, and exotic lithic fragments, including granite at 22° 39′ 30″S, 116° 27′ 25″E.

Most felsic volcanics, commonly crystal-lithic vitric tuffs, occur in thin lenses. Many contain accretionary lapilli (10 mm in diameter) set in a fine tuffaceous groundmass containing relic shards. Some tuffs show coarse fragmental texture and/or eutaxitic structure, and probably represent ashflow deposits. Samples of felsic tuff taken from 22° 40′S, 116° 28′E give a Rb-Sr whole-rock isochron of 2 032 ± 148 Ma (de Laeter and others, 1985). These workers attribute the anomalously young age to isotopic resetting during a subsequent metamorphic event.

Sedimentary rocks, in addition to those occurring at the base of the Mount Roe Basalt, are conglomerate, cobble sandstone, feldspathic or lithic sandstone, and (rarely) mudstone. At 22° 44'S, 116° 26'E, a 400 m-thick matrix-supported conglomerate extends along strike for 6.5 km. It contains rounded granitic cobbles (up to 15 cm diameter) and occasional basalt and felsic-volcanic clasts, set in a foliated sandy matrix.

Lateral discontinuity of units, together with the presence of coarse pyroclastics and immature sedimentary rocks, suggests that deposition took place in a complex volcanic environment. A rugged topography where sedimentary rocks were deposited in restricted basins, in an essentially terrestrial environment, is envisaged.

Hardey Sandstone

A sequence of thin- to thick-bedded lithic and feldspathic sandstones and ferruginous mudstones conformably overlies the Mount Roe Basalt. It is correlated with the Hardey Sandstone (*Fh*), which has its type area in the Rocklea Dome east of WYLOO (de la Hunty, 1965). On WYLOO, the Hardey Sandstone occurs only as discontinuous outcrops in the central part of the Wyloo Dome. It is up to 550 m in thick, compared to the maximum thickness of 1 200 m in the type area. In the latter region, Blight (1985) described a basal conglomerate that contains large angular blocks of the underlying Mount Roe Basalt, but no such feature was seen on WYLOO. Blight (1985) interprets the Hardey Sandstone as an alluvial braidplain deposit of which the Wyloo Dome sequence represents a distal facies.

Mount Jope Volcanics

The Mount Jope Volcanics (*Fb*) conformably overlie the Hardey Sandstone. They comprise a 3 500 m sequence of basaltic lava, pillow lava, pillow breccia, fine- to coarse-grained pyroclastics, and minor fine-grained sedimentary rocks. On the northeastern flank of the Wyloo Dome, the pillow lavas are well exposed and show chilled margins and concentric zones of radially oriented vesicles. At the type locality (MOUNT BRUCE), de la Hunty (1965) subdivided the formation into three members. In ascending order these are the Boongal Pillow Lava Member, the Pyradie Pyroclastic Member, and the Bunjinah Pillow Lava Member. the same three-fold subdivision is recognized around the northeastern flank of the Wyloo Dome. Here, the topographic expression of the middle member is mainly due to numerous dolerite sills. It has not been possible to extend this subdivision to the more deformed southern and western parts of the Wyloo Dome.

The Mount Jope Volcanics are considered to have been laid down in a marine environment.

Jeerinah Formation

The Jeerinah Formation (*Fj*) conformably overlies the Mount Jope Volcanics in the Wyloo Dome and forms a large outcrop in the Jeerinah Anticline (Fig. 1). It is apparently absent from most of the northwestern part of the Wyloo Dome. The formation consists of thin-bedded mudstone, chert, BIF, and basalt, intruded by numerous dolerite sills. Those sills may comprise up to 60% of the formation's 940 m maximum thickness. The Jeerinah Formation is interpreted as a marine sequence. It is transitional upwards into the Marra Mamba Iron Formation of the Hamersley Group, and contact with the latter is generally conformable; but locally, there is a high-angle unconformity between thin, slump-folded cherts within the Jeerinah Formation and the basal Marra Mamba Iron Formation (Horwitz, 1978). The great lateral extent of the Jeerinah Formation indicates more affinity with the Hamersley Group than with the Fortescue Group (Trendall and Blockley, 1970).

HAMERSLEY GROUP

The Hamersley Group (*H*) (MacLeod and others, 1963; Trendall and Blockley, 1970), conformably overlies the Fortescue Group and is conformably overlain by the Turee Creek Group. It is approximately 2.5 km thick and consists of five important iron-formations separated by mudstones, carbonates, dolerites, and felsic igneous rocks. The age of the Hamersley Group is approximately 2.5 Ga (Trendall, 1983).

The Hamersley Group outcrops over much of the northeastern part of WYLOO. It is subdivided, in ascending order, into: Marra Mamba Iron Formation; Wittenoom Dolomite; Mount Sylvia Formation; Mount McCrae Shale; Brockman Iron Formation; Weeli Wolli Formation; Woongarra Volcanics; and Boolgeeda Iron Formation.

Marra Mamba Iron Formation

The lowermost unit of the Hamersley Group is the 185–230 m thick Marra Mamba Iron Formation (*Hm*). Trendall and Blockley (1970) informaly subdivided this formation into, a lower BIF containing podded chert and dolomite, a middle shaly unit with minor amounts of BIF, and an upper, BIF-dominated unit. The BIF's are characterized by thick chert mesobands with poorly defined fine lamination, which alternates with minnesotaite mesobands and laminated chert. In addition, chert pods are abundant in thin beds of black shale, calcareous shale, and carbonate. This threefold subdivision is generally recognized on WYLOO; however, the middle shale unit does not always occur on the northeastern flank of the Wyloo Dome.

Wittenoom Dolomite

The Wittenoom Dolomite (*Hd*) conformably overlies the Marra Mamba Iron Formation. It is 150 m thick on the southern limb of the Jeerinah anticline (22° 28′S, 116° 40′E). The formation is subdivided into two units. A lower unit consists of thin- to medium-bedded dolomite intercalated with thin beds of chert and mudstone. The dolomites are parallel-laminated or, rarely, ripple cross laminated. The upper unit consists of thin-bedded, parallel-laminated dolomite with small slump folds. These carbonates are interbedded with mudstone, chert, and BIF, which are most abundant in the upper part of the unit.

Mount Sylvia Formation

The Mount Sylvia Formation (*Hs*) conformably overlies the Wittenoom Dolomite and consists of the three prominent, but thin, BIF units separated by parallel-laminated mudstone and minor chert and dolomite. The two lowermost BIF's are banded ferruginous chert; whereas, the uppermost BIF (Bruno's Band) comprises thin mesobands of finely laminated chert and ferruginous chert. As the Mount Sylvia Fomation on WYLOO is only 30 m thick, it is grouped with the Mount McRae Shale on WYLOO.

Mount McRae Shale

The Mount McRae Shale (*Hs*) conformably overlies the Mount Sylvia Formation. It is a 90 m thick sequence of thin-bedded, laminated mudstone containing small amounts of chert, dolomite, and BIF, which become more abundant towards the top of the formation. A 4 m thick chert forms a prominent marker bed near the middle of the formation in the northeastern part of WYLOO.

Brockman Iron Formation

The Brockman Iron Formation (*Hb*) (650 m) conformably overlies the Mount McRae Shale. Trendall and Blockley (1970) subdivided the formation into Dales Gorge, Whaleback Shale, Joffre, and Yandicoogina Shale Members. These units are present over much of northeastern WYLOO. The Dales Gorge Member consists of BIF and shale macrobands; the BIF's are further subdivided into chert and chert matrix mesobands. The latter constitute 20% of the total volume of BIF. The Joffre Member lacks a regular macrobanding and contains thin stilpnomelane-bearing shales. The Whaleback and Yandicoogina Shale Members are black, laminated mudstone and contain subordinate chert and carbonate.

Weeli Wolli Formation

The Weeli Wolli Formation (*Hj*) (480 m maximum) conformably overlies the Brockman Iron Formation. It consists of BIF interlayered with thick beds of shale and numerous dolerite sills. There are two distinct types of BIF. One is a dark, red-brown rock whose 2–5 mm layers are composed of very finely laminated hematite-rich chert. The other includes, in addition, distinctive beds of red or white laminated chert.

Woongarra Volcanics

The 550 m thick Woongarra Volcanics (*Hw*) conformably overlies the Weeli Wolli Formation. The formation consists of porphyritic and non-porphyritic rhyolites, dacites, and thin tuffs; these are interbedded subordinate BIF and dolerite. The rhyolites and dacites occur as flows and as sills. The former are most abundant in the lower and middle levels of the formation, and contain accretionary lapilli, relic shards, and fiamme. The latter occur throughout the Woongarra Volcanics and range from a few metres to over 100 m thick. In the southeast of WYLOO, Horwitz (1978) noted that the upper part of the formation consists of a porphyry sill which contains rafts of BIF hundreds of metres long. Near Duck Creek homestead (22° 31'S, 116° 35'E), rhyodacite sills show flow banding, auto-brecciation, and columnar jointing. In addition to the sills, an intrusive plug of porphyritic, spherulitic rhyodacite occurs at 22° 02′ 40″S, 116° 13′ 30″E.

Boolgeeda Iron Formation

The Boolgeeda Iron Formation (*Ho*) (<300 m thick) conformably overlies the Woongarra Volcanics. It consists of laminated, grey-brown to black, locally magnetite-bearing BIF, interbedded with chert and mudstone. BIF is less abundant in the middle of the formation.

Summary of Hamersley Group sedimentation

Detailed interpretations of the depositional environment of the Hamersley Group are given by Trendall and Blockley (1970) and Trendall (1983). On the basis of isopachs on the Dales Gorge Member, which are considered to reflect basin shape, they envisaged an almost completely closed basin of about 150 000 km^2. A limited connection to the open sea is proposed to explain the lack of desiccation features. BIF deposition took place in a tranquil subaqueous environment by precipitation from marine water rather than from extrabasinal dust (cf. Carey, 1976). Volcaniclastic detritus in shale horizons suggests that these may have formed during periods when BIF sedimentation was retarded or diluted by an influx of volcanic debris.

Ewers and Morris (1981) interpreted the BIF microbands and mesobands as resulting from variations in depositional environment. Trendall and Blockley (1970), however, regarded the mesobanding as the result of diagenetic differentiation. Ewers and Morris (1981) envisaged the depositional environment of the Dales Gorge Member as a shelf rather than a barred basin. An alternative view was put by Morris and Horwitz (1983), who suggested that the Hamersley Group was deposited on a submarine platform analogous to the present-day Bahamas Platform.

TUREE CREEK GROUP

The "Turee Creek Formation", which rests conformably upon the Boolgeeda Iron Formation, was raised to group status (*TK*) by Trendall (1979). Outcrop is confined to the northeastern and southeastern margins of the Wyloo Dome and to the Hardey Syncline (Fig. 1). The group reaches a maximum thickness of almost 4 km in the Hardey Syncline, but thins rapidly to zero towards the northwest, beneath the unconformity at the base of the Wyloo Group.

The sequence of sedimentary facies in the Turee Creek Group indicates that the infilling of the Hamersley Basin was associated with a gradual increase in terrigenous clastic input. The lowermost 2 850 m represents two major episodes of "deep-water" shelf sedimentation, separated by a period of tidal-shoreline deposition. The uppermost 1 000 m of strata was laid down during the progradation of a delta system.

A 260 m thick pebbly mudstone in the middle of the succession was interpreted by Trendall (1976) as a glacial deposit. Although no other glacial deposits are recognized in the group, it may be relevant that this pebbly mudstone was deposited after a period of considerable shallowing. It is possible that this shallowing may have been the result of penecontemporaneous glaciation.

The presence of BIF fragments in the fluvial conglomerates of the uppermost Turee Creek Group indicates that the Hamersley Group was at least partly uplifted and subaerially exposed at this time. This uplift probably marked the initial stage of pre-Wyloo Group deformation, which culminated in the folding, uplift, and erosion, of the Mount Bruce Supergroup on WYLOO.

DOLERITE DYKES AND SILLS IN THE MOUNT BRUCE SUPERGROUP

The Mount Bruce Supergroup is intruded by dolerite sills which are folded together with their host rocks. A thick northwest-trending dolerite dyke cutting the Metawandy Granite in the core of the Wyloo Dome may have been a feeder dyke to these sills because it differs in trend from the younger post-tectonic dyke swarms. It is not folded because it is perpendicular to the direction of tectonic shortening.

Multiple dolerite sills, some of them transgressive, intrude the Mount Jope Volcanics and the Jeerinah Formation of the Fortescue Group, the Weeli Wolli Formation of the Hamerlsey Group, and the low-middle Turee Creek Group.

POST-MOUNT BRUCE SUPERGROUP, PRE-WYLOO GROUP DEFORMATION

The Mount Bruce Supergroup is deformed in the western part of the Opthalmia Fold Belt (Gee, 1979), which extends across the southern part of the Hamersley Basin. Major folds are curved, and the trend varies from east to southeast. Dome and basin structures occur on MOUNT BRUCE. These were interpreted by de la Hunty (1965) and Halligan and Daniels (1964) as fold-interference patterns formed from two episodes of deformation: the Opthalmian deformation, which formed folds with east or southeast axial trends, and the Rocklea deformation with generally northeast-trending axes.

Trendall and Blockley (1970), Gee (1979), and Horwitz (1981) noted an en echelon style of folding, in which anticlinal axial traces pass along strike into synclinal axial traces. They also noted that the axial traces of some folds, such as the Jeerinah Anticline are sigmoidal. Gee (1979) interpreted these features as being due to regional variations in layer-parallel buckling, and rotational strain induced by basement segmentation. Macleod (1966) also suggested basement control, whereby structures such as the Rocklea, Milli Milli, and Sylvania Domes, may have resulted from the rise of basement blocks. Gee (1979) saw no evidence for the northeast-southwest "cross-folding" described by previous workers and considered that variations in axial trends resulted from deflections of folds around basement domes. This interpretation is favoured on WYLOO because minor structures with northeast trends are absent, whereas minor folds with east-trending axes are abundant.

On WYLOO, pre-Wyloo Group folds trend east-west and are interpreted as being the product of a single phase of north-south tectonic shortening. Folds at the margin of the Hamersley Basin are truncated by the Ashburton Trough (Gee, 1979). This is especially clear in the region of the Hardey Syncline (Fig. 1), where a gently westward-plunging syncline of Turee Creek Group rocks is truncated by the unconformity at the base of the Wyloo Group.

In places, the western part of the Hamersley Basin is affected by folds with northwest trends. An example is the large northwest-plunging, fault-modified, anticline-syncline pair at 22° 33′S, 116° 35′E. These folds also affect the Wyloo Group; and, therefore, post-date the main folds of the western Hamersley Basin.

The Wyloo Dome was affected both by pre- and post-Wyloo Group deformation. The northeastern flank and eastern closure show open-concentric to flattened-concentric folds with minor cleavage, which resemble structures in the western part of the Hamersley Basin. Furthermore, the eastern closure has an eastward-plunging hingeline. However, the southwestern flank and western half of the dome have a pronounced cleavage that strikes west-northwest; and, in the vicinity of 22° 35′S, 116° 06′E, this is parallel to a crenulation cleavage in the Ashburton Formation (Wyloo Group). This evidence suggests the Wyloo Dome is the result of several phases of deformation. Horwitz (1978, 1982) noted that its tectonic history was complex and that intermittent uplift took place during deposition of both the Mount Bruce Supergroup and the Wyloo Group.

WYLOO GROUP

The Wyloo Group (*W*) was informally established and subdivided by Macleod and others (1963) and subsequently revised by Trendall (1979) and Horwitz (1980). These works form the basis of the scheme used here (Table 1). The group has a maximum thickness of approximately 10–12 km, and outcrops in a broad southeast-trending tract, the Ashburton Basin, in the central part of WYLOO. It unconformably overlies the Mount Bruce Supergroup and is itself overlain unconformably by the Mount Minnie and Bangemall Groups and by Phanerozoic rocks.

The age of the Wyloo Group is poorly known. Clasts of Woongarra Volcanics (Hamersley Group) occur in conglomerates at the base of the Wyloo Group and provide an older age limit of 2 470 ± 30 Ma (U-Pb zircon, Compston and others, 1981). The Ashburton Formation, the uppermost stratigraphic unit of the Wyloo Group, is untruded by the Boolaloo Granodiorite, for which Leggo and others (1965) obtained a Rb/Sr mineral isochron of 1 680 Ma*. Data from the June Hill Volcanics give Rb/Sr whole-rock ages of 1 977 ± 165 Ma* (Compston and Arriens, 1968) and 1 811 Ma (Leggo and others, 1965). On this basis, Gee (1980) favoured an age of approximately 2 000 Ma for the Wyloo Group.

The Wyloo Group is subdivided (in ascending order) into: Beasley River Quartzite, Cheela Springs Basalt, Wooly Dolomite, Mount McGrath Formation, Duck Creek Dolomite, June Hill Volcanics, and Ashburton Formation.

BEASLEY RIVER QUARTZITE

The Beasley River Quartzite (*Wq*) is the lowermost formation in the Wyloo Group and rests with angular unconformity upon the Mount Bruce Supergroup. The Formation has a maximum thickness of 360 m, but thins to zero around the western margin of the Wyloo Dome. It consits of cream- or white-weathering, silicified quartz sandstone, local, BIF-derived conglomerate, mudstone, and carbonate. On WYLOO, four major facies are recognized: mid-alluvial fan, outer-alluvial fan, tidal shoreline, and offshore. These are well exposed at 22° 46′ 50″S, 116° 37′ 47″E.

In the vicinity of the Wyloo Dome, the lower part of the Beasley River Quartzite comprises mid- to outer-fan deposits (BIF-derived conglomerate and sandstone) overlain by tidal shoreline lithotypes (quartz sandstone). These are succeeded by offshore facies (mudstone), which are overlain by a second suite of fan and tidal shoreline deposits. Immediately west of the Hardey Syncline, fan deposits are thin and overlie shoreline sandstones. The succeeding offshore deposits are interbedded with further shoreline facies in the upper part of the succession. North of the Wyloo Dome, the formation consists of alternating outer-fan, shoreline, and offshore facies, although strike faulting makes it difficult to establish a reliable stratigraphy.

The distribution of facies points to the presence of an ancient fan-delta complex located to the north and southeast of the Wyloo Dome. Here palaeocurrent and provenance data indicate that the eastern Wyloo Dome and the adjacent Hamersley Basin were the principal sources of detritus (Thorne, 1986b, Thorne and Seymour, 1986). The stratigraphy of the formation records two periods of fan-delta growth, which resulted from tectonic uplift in the source area. The

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* Recalculated using ^{87}Rb decay constant 1.42 constant 1.42 x 10^{-11} a^{-1}

period of tectonic quiescence and subsidence which followed each phase of uplift was marked by coastal retreat and reworking of the fan deposits by tidally influenced coastal processes.

CHEELA SPRINGS BASALT

The Cheela Springs Basalt (*Wb*), previously regarded as a member of the Mount McGrath Formation (Macleod and others, 1963) was elevated to formation status by Horwitz (1980). Over much of WYLOO, it conformably overlies the Beasley River Quartzite. On the southern margin of the Wyloo Dome, however, the succession disconformably overlies the Mount Bruce Supergroup.

The formation has a maximum thickness of about 2 km and comprises basalt, subordinate fine- to coarse-grained tuff, immature sandstone, siltstone, and mudstone. Dolerite sills up to 50 m, thick are abundant.

Basalt flows are commonly vesicular and range from 0.5 m to 35 m thick. Thicker beds are medium grained in the middle and may be mistaken for dolerite sills. Flow tops are irregular and are locally draped with clastic detritus. Most basalts have undergone prehnite-pumpellyite to lower greenschist metamorphism and now consist of andesine and clinopyroxene (partly or completely replaced by actinolite and chlorite) in a groundmass of andesine, actinolite, chlorite, sphene, epidote, pumpellyite, and iron oxide.

The relationship between the basalt flows and interbedded sediment and the position of the Cheela Springs Basalt in the Wyloo Group stratigraphy suggests the formation was laid down in a coastal to shallow-marine environment.

No feeder pipes or volcanic centres are recognized within the formation; however, a possible feeder conduit, now separated from the main outcrop, occurs at 22° 23′ 40″S, 116° 30′E. Here, coarse basaltic agglomerate, basalt, and a gabbro dyke, occur as a small fault-bounded outlier in the Hamersley Basin. Because the adjacent Brockman Iron Formation dips steeply into the complex, it is unlikely to be a faulted inlier of Fortescue Group. Similarly, it is difficult to envisage it as a 3 km high ridge of Fortescue Group which acted as a topographic high throughout much of Hamersley Group deposition (cf. Daniels, 1970). Apart from the Cheela Springs Basalt, the only other mafic volcanic unit present in this area is the June Hill Volvanics (upper Wyloo Group), whose eruptive centre occurs 30 km to the west. On this basis, it is proposed that the inlier is a feeder conduit for the Cheela Springs Basalt.

WOOLY DOLOMITE

The Wooly Dolomite (*Ww*) is confined to the southern margin of the Wyloo Dome, where it outcrops over a strike length of 30 km. This unit (325 m, maximum thickness) was mapped, though not named, as part of the Turee Creek Formation by Daniels (1970). It is assigned a formation status on the basis that it forms a distinct lithological unit conformably overlying the Cheela Springs Basalt and unconformably overlain by the Mount McGrath Formation.

The type area for the Wooly Dolomite occurs between 22° 47′ 00″S, 116° 25′ 00″E and 22° 47′ 50″S, 116° 28′ 21″E. Here the lowermost 75 m of the formation, comprises small- to medium-scale, trough cross-stratified dolomites and stromatolitic dolomites, and is interpreted as a moderate- to high-energy, shallow-marine sequence. These beds are overlain by 50 m of quiet-water shelf carbonates, which are in turn succeeded by 200 m of moderate- to high-energy shallow-marine carbonates. The top of the Wooly Dolomite is well exposed at 22° 48′ 48″S, 116° 28′ 21″E. At this locality, a patchy ferruginous horizon caps the irregular upper surface of the dolomite.

MOUNT McGRATH FORMATION

The Mount McGrath Formation (*Wm*) was subdivided by de la Hunty (1965) and later redefined by Horwitz (1980) as "the essentially clastic rocks that overlie disconformably the Cheela Springs Basalt and overlap unconformably onto older formations. It is overlain conformably by the Duck Creek Dolomite, which itself overlaps onto older units". This definition is followed here with the qualification that along the southeastern margin of the Wyloo Dome, the Mount McGrath Formation unconformably overlies the Wooly Dolomite. The formation has a maximum thickness of 900 m on WYLOO but thins to zero around the western margin of the Wyloo Dome. It comprises ferruginous conglomerate and sandstone, quartz sandstone, siltstone, mudstone, and carbonate.

The major lithofacies are interpreted as distributary channel, distributary-mouth bar, shoreface and beach, and offshore deposits of an extensive delta system. They are well exposed on the southern flank of the Wyloo Dome at 22° 48′ 09″S, 116° 28′ 21″E. Here the succession comprises an upward-coarsening deltaic unit overlain by shoreline and offshore deposits. North of the Wyloo Dome, the formation contains several thick carbonate units separated by off-shore and siliciclastic shoreline deposits. Sparse palaeocurrent and provenance data from the distributary channel facies indicate that southern margin of the Hamersley Basin was the principal source of detritus.

DUCK CREEK DOLOMITE

The 1 km thick Duck Creek Dolomite (*Wd*) rests conformably upon the Mount McGrath Formation except around the western part of the Wyloo Dome, where it unconformably overlies the Fortescue and Hamersley Groups. The Duck Creek Dolomite is conformably overlain by the Ashburton Formation except in the area north of the Wyloo Dome, where there is a gradational contact with the locally developed June Hill Volcanics.

The Duck Creek Dolomite consists of thin- to thick-bedded, buff- or mauve-weathering dolomite. It is commonly stromatolitic. Five major sedimentary facies are recognized: slope, barrier-bar, lagoon, intertidal, and supratidal. These are exposed in the vicinity of Duck Creek Gorge (22° 28′ 39″S, 116° 19′ 25″E). The lowermost beds outcrop on the eastern slopes overlooking Duck Creek, and the middle levels are well exposed in the gorge. The upper beds outcrop in a series of patchy exposures northwest of the gorge.

Throughout WYLOO, the lower and upper levels of the Duck Creek Dolomite are thick accumulations of slope carbonate. The middle 50-300 m consists of barrier-bar, lagoon, intertidal, and supratidal facies, that occur in repeated upward-shallowing sequences, 0.5-4.0 m thick. These sequences are thought to be the result of transgressive and regressive sedimentation on a barred carbonate shoreline (Thorne, 1985; Grey and Thorne, 1985).

JUNE HILL VOLCANICS

The June Hill Volcanics (*Wj*) (Williams, 1968) are mafic lavas (some pillowed), tuffs, and agglomerates, interbedded with felsic volcanics and sedimentary rocks. The formation conformably overlies the Duck Creek Dolomite in the area north of the Wyloo Dome. It is disconformably overlain by the Ashburton Formation, a relationship recognized by Daniels (1970), who nevertheless included the volcanic rocks within the Ashburton Formation. The June Hill Volcanics are up to 120 m thick in the vicinity of June Hill (22° 29′ 28″S, 116° 16′ 00″E); but northwards, they thin and wedge out over a distance of 45 km.

North of June Hill, the contact between the volcanics and the Duck Creek Dolomite is transitional; thin beds of tuff (containing relic shards) and basalt are interbedded with the uppermost dolomites. These beds are succeeded by up to 75 m of crystal/lithic tuff, or coarse pillow breccia and basalt. The uppermost volcanics are interbedded with dolomite and volcanoclastic rocks. To the north of the June Hill area, this assemblage makes up most of the June Hill Volcanics.

ASHBURTON FORMATION

The Ashburton Formation (*Wa*) conformably overlies the Duck Creek Dolomite over most of WYLOO. Exceptions to this occur on the western closure of the Wyloo Dome, where it directly overlies the Fortescue Group, and north of the Wyloo Dome, where it disconformably overlies the June Hill Volcanics. The formation is unconformably overlain by the Mount Minnie and Bangemall groups and by Phanerozoic rocks. It consists of mudstone and immature sandstone interbedded with small amounts of conglomerate, BIF, and felsic to mafic volcanics. The succession is estimated to be 5–10 km thick, but structural complexity and lack of marker horizons make it impossible to provide an exact measurement.

Many workers consider the Ashburton Formation to have been deposited in a deep-water basin, variously referred to as the Ashburton Geosyncline (Daniels, 1975b) Ashburton Trough (Doust, 1975; Gee, 1975; Horwitz, 1986) or Ashburton Basin (Doust, 1985). Horwitz (1978, 1980, 1981) and Horwitz and Smith (1978) describe olistostromes and large exotic blocks thought to have been transported into the Ashburton Trough by gravity-induced slumping, sliding, and related processes. One of these blocks, a 5 km long quartz-feldspar porphyry, outcrops 7 km east of Mount Amy (22° 15′S, 115° 53′E). This body lacks chilled margins and a contact metamorphic aureole, and occurs at approximately the same stratigraphic level as other large exotic fragments (quartz sandstone and dolomite) 3 km to the northeast. It is tentatively interpreted as an alochthonous slab of Woongara Volcanics (Horwitz, 1981).

Three major sedimentary facies occur within the Ashburton Formation: basin-plain/interchannel (mudstones and thin sandstones), distributary-channel and lobe (thin- to thick-bedded sandstone and pebbly sandstone) and major-channel (thick-bedded conglomerate and massive sandstone) (Table 2). South of the Wyloo Dome, the lowermost 0.2–0.5 km of the formation is a basin-plain facies, transitional with the Duck Creek Dolomite. This is overlain by 2–4 km of distributary-channel and lobe deposits, which are succeeded by an estimated 6 km of interchannel facies and subordinate distributary-channel/lobe and major-channel lithotypes. North of the Wyloo Dome, the lowermost basin-plain/interchannel unit contains chert, ferruginous mudstone, and BIF. In addition, major-channel facies occur in the upper part of this unit at 22° 22′S, 116° 07′ 20″E. The succeeding distibutory-channel and lobe assemblage is 1–2 km thick and is overlain by an unknown thickness of interchannel/basin-plain facies with sparse major-channel deposits.

Palaeocurrent and provenance data, and facies distributions, define three source areas for the Ashburton Formation. The Sylvania Dome and northeast Gascoyne region supplied granite-greenstone sediment to the area south of the Wyloo

TABLE 2. PRINCIPAL SEDIMENTARY FACIES OF THE ASHBURTON FORMATION

Facies	Description	Interpretation	Typical locality
Basin-plain/ Interchannel	Tens to thousands of metres of parallel-laminated mudstone; local BIF and chert; interbedded minor siltstone and sandstone; BIF and chert are parallel laminated and the thickest units show small slump folds and boundinage structures. Siltstones and sandstones form laterally extensive beds up to 20 cm (Usually less than 10 cm) thick. They are ripple cross-laminated or parallel laminated, often with some modification by soft sediment deformation. Flute or tool marks are present on the bases of some beds.	Mudstones were probably deposited from low-density turbidity currents. Siltstones and sandstones are interpreted as turbidites, deposited from unconfined high-density flows. BIF and chert were laid down as chemical sediments during breaks in terrigenous supply.	22° 11′ 30″S, 116° 00′ 30″E (mudstone & thin sandstone) 22° 24′ 00″S, 116° 03′ 00″E (BIF and chert)
Submarine distributary channel/lobe	Five to hundreds of metres of thin- to very thick-bedded sandstones and pebbley sandstones with minor siltstone, mudstone, and conglomerate. Thin-bedded sandstones show incomplete Bouma sequence. Thick-bedded sandstones are coarse grained, massive, and occur in tabular or broadly lenticular units. Pebbley sandstones and conglomerates are commonly parallel-stratified.	Thick-bedded sandstones, pebbly sandstones and conglomerates, were probably deposited from high-density turbidity flows in braided submarine channels and on their associated depositional lobes. Thin-bedded turbidites and mudstones were probably confined to the margins of active lobes and to abandoned channel/lobe systems.	22° 13′ 30″S, 116° 01′ 25″E
Major submarine channel	Tens to hundreds of metres of pebble to cobble conglomerate, pebbley sandstone and massive sandstone. Units are of limited lateral extent and individual beds are commonly lenticular. Cobble conglomerates are massive with both clast and sandy matrix support. Pebble conglomerates and pebbly sandstones are often parallel stratified. At 22° 22′S 116° 07′ 20″E, clasts are rounded fragments of quartz sandstone, felsic igneous rock, chert and vein quartz with angular clasts of dolomite.	Bar and terrace deposits of a major submarine channel complex.	22° 22′S, 116° 07′ 20″E

Dome. The western Hamersley Basin and northeastern Ashburton Basin provided detritus from the Mount Bruce Supergroup and Wyloo Group to the area north of the Wyloo Dome.

SUMMARY OF WYLOO GROUP SEDIMENTATION

For the purpose of this discussion, the Wyloo Group is informally divided into the lower Wyloo Group which comprises, the Beasley River Quartzite, Cheela Springs Basalt, Wooly Dolomite, Mount McGrath Formation, Duck Creek Dolomite, and June Hill Volcanics; and upper Wyloo Group, which consists of the Ashburton Formation.

The deposits of the lower Wyloo Group reflect an upland area of moderate relief, which occupied the area of the present-day Hamersley Range, and an open-marine shelf to the south and west of this landmass. Sedimentation was predominantly shallow-marine to fluvial. Detritus was supplied to the shelf via braided-delta and fan-delta systems, and subsequently reworked by marine processes. Throughout the WYLOO area, temporary breaks in the supply of detritus, possibly caused by delta lobe switching, are marked by local dolomite units. The input of terrigenous detritus to the entire region started to decline by the time the uppermost Mount McGrath Formation was deposited. In addition, there was a gradual deepening of the shelf waters such that quiet, below-wave-base sedimentation prevailed over much of southern and western WYLOO. These conditions culminated in the deposition of the Duck Creek Dolomite, which, apart from an interval of shallow-subtidal to supratidal deposition in the middle of the unit, largely records shelf-edge sedimentation.

The influence of tectonism on lower Wyloo Group sedimentation is most evident in the vicinity of the Wyloo Dome, where the Wyloo Group sequence below the Duck Creek Dolomite thins westward as a result of erosion or non-deposition. This suggests that the dome was then an area of intermittent positive relief. The mafic volcanic units in the lower Wyloo Group (Cheela Springs Basalt, and June Hill Volcanics) probably reflect extensional tectonism which, in the case of the June Hill Volcanics, was confined to the area immediately north of the Wyloo Dome.

Downfaulting and subsidence during the latter part of lower Wyloo Group sedimentation led to the formation of a deep craton-margin basin—the Ashburton Trough. Deposition of the upper Wyloo Group reflects major terrigenous input into this basin. These sediments were deposited in submarine-channel and lobe complexes now preserved in the Ashburton Formation. The initial sediments were derived from the Sylvania Dome, 300 km to the east. Subsequent uplift in the northern Gascoyne and the southwestern Hamersley Basin resulted in detritus being shed from these areas during the latter stages of Wyloo Group deposition. (Thorne, 1986a).

DEFORMATION OF THE WYLOO GROUP

The Wyloo Group was deformed by two major episodes of deformation D_1 and D_2. D_1 minor structures occur in certain areas, whereas D_2 minor structures are widespread. Consequently, overprinting relationships can not be seen in many parts of the region; and a morphological classification of minor structures is used on the map, rather than one based upon structural generation.

D_1 deformation occurred during the peak of regional metamorphism; and, over much of the region, produced steeply dipping bedding and a strong foliation (S_1). In the northwestern part of WYLOO, S_1 foliation is mainly restricted to the areas northwest of a line joining Red Hill (22° 06′S, 116° 02′E) with the Boolaloo Granodiorite, where it is a well-developed penetrative cleavage which dips in the same sense as, but more steeply than, bedding. Intersections of bedding and S_1 are horizontal to gently plunging lineations. In the southeastern part of WYLOO, S_1 foliation is restricted to the area west of a line joining Hardey Junction (22° 44′S, 116° 07′E) with the 116° longitude on the southern boundary of the map area. With the increase in metamorphic grade westward from this line, it grades into a metamorphic schistosity sub-parallel with bedding. Only a few F_1 fold closures were recognized. In the northwest, F_1 minor folds occur near 22° 10′S, 115° 47′E, and in the southwest, at 22° 46′S, 115° 50′E and 22° 49′ 30″S, 115° 49′E. Some reversals of younging direction which cannot be explained by effects of D_2(e.g. at 22° 05′ 30″S, 115° 50′E) are also attributed to the presence of F_1 folds.

Bedding and S_1 cleavage or schistosity are folded by open to tight F_2 folds with sub-vertical axial surfaces and moderate to steeply plunging hingelines which trend between east and east-southeast. Where an S_1 metamorphic foliation occurs, most minor F_2 folds are straight limbed and have narrow, angular closures, merging into chevron folds; an axial-planar crenulation cleavage (S_2) is generally present. Because of the general lack of small- to medium-scale F_1 folds, most of the obvious folding in the Ashburton Formation is the result of the second regional deformation (D_2). Furthermore, because of spatial restriction of the S_1 foliation, there are large areas in which the only metamorphic foliation seen is S_2. In the area between Red Hill, Mount Amy (22° 15′S, 115° 53′E), and June Hill, steep northwesterly plunging, upright D_2 folds with southeast-trending axial-planar cleavage developed on bedding that had previously been rotated into steeply dipping attitudes during D_1. The effects of D_2 on the mount Bruce Supergroup in the western and southwestern parts of the Wyloo Dome have already been noted.

Steeply plunging, tight, upright folds, with easterly trending axial surfaces and axial planar cleavage, which are to be seen in the area between Glen Florrie (22° 56′S, 115° 58′ 50″E) and Kooline (22° 54′ 30″S, 116°17′E) homesteads, are interpreted as D_2 structures. The trends of associated minor structures show a gradual swing towards the west-northwest when traced to the west and northwest; and, near 22° 52′S, 116°E, where S_1 foliation occurs, the D_2 deformation formed a crenulation cleavage.

East of the Ashburton River, in the southernmost part of WYLOO, the structure is dominated by D_2 upright folds with steeply south-southwest dipping axial surfaces and penetrative axial-planar cleavage striking east-southeast. These folds also occur in the Duck Creek Dolomite just to the north.

In the Morrissey Metamorphic Suite to the west of the Parry Range, traces of primary metamorphic foliation outline a complex pattern. This foliation is correlated with S_1 schistosity and cleavage in the Ashburton Formation. In the vicinity of 22°59′S, 115°32′30″E, the S_1 foliation outlines a dome, whose core is an early-stage gneissic granitoid. Further north at 22°46′30″S, 115°33″E, a small elongate dome defined by S_1 occurs around a core of Kilba granite. At 22°55′S, 115°36′E, minor folds with west-northwest trending hingelines and axial-planar crenulation cleavage are probably of the same generation as regional D_2 structures east of the Parry Range.

REGIONAL METAMORPHISM OF THE WYLOO GROUP

Southwestern WYLOO is part of the northwest marginal zone of the Gascoyne Province, a region of granitoid intrusion, multiple deformation, and high-grade regional metamorphism (Williams, 1986). West of the Parry Range, mudstones and sandstones of the Ashburton Formation are affected by this regional metamorphism, whose grade progressively increases in the west and southwest.

Despite the metamorphism, bedding and stratigraphy can still be recognized in the Ashburton Formation east of the Parry Range; and, in this region, the extent of moderate to high-grade metamorphism is shown on the map by an overprint on the *Wa* colour and by the symbol *1m*. The boundary between *1m* and the Ashburton Formation represents the first appearance of quartz-mica schist as opposed to the strongly cleaved mudstones and sandstones of the Ashburton Formation. Despite the fact that this boundary is sub-parallel to the margin of the Boolaloo and Mount Danvers Granodiorites, it is believed that the peak of regional metamorphism was synchronous with D_1 in the Ashburton Formation, while the intrusion of the granodiorites was probably late-tectonic or post-tectonic to D_1. This conclusion is supported by field observations around the intrusive margins, where generally narrow contact-metamorphic aureoles are superimposed upon the effects of regional metamorphism.

Immediately east of the Parry Range, the regional metamorphics are characterized by pronounced metamorphic schistosity (S_1), typically deformed by D_2 folds and crenulation cleavage. The cordierite and andalusite schists to the north and southeast of the Old Meilga Homestead (22° 44'S, 115° 47'E) and almandine-andalusite-biotite-quartz-muscovite assemblages near 22° 39′ 30″S, 115° 55′ 30″E indicate medium-grade metamorphic conditions. The assemblages there show partial retrogression with sericitization of andalusite, and growth of chlorite and porphyroblastic plates of muscovite.

West of the Parry Range, higher metamorphic grades together with the development of pronounced metamorphic foliation have generally obscured bedding and stratigraphy, and the rocks are part of the Morrissey Metamorphic Suite of the Gascoyne Province (Williams, 1986). In this area, S. J. Williams (pers. comm, 1980) noted rocks ranging in metamorphic grade from quartz-muscovite schist through biotite-muscovite-quartz-feldspar gneiss (interpreted as a meta-arkose) to an assemblage of quartz-muscovite-biotite schist interfoliated with bands of tourmaline granitoid and pegmatoid, (interpreted as partially melted meta-arkose).

A distinct assemblage of quartzite, schist, amphibolite, and marble, near Mount Alexander (22° 39'S, 115° 32'E) and north of Mount Murray (22° 29′ 30″S, 115° 32′ 30″E), was named the Mudong Member by Daniels (1970), who believed its stratigraphic position to be in the upper part of the Ashburton Formation. The primary way-up evidence is generally obscured because the rocks are strongly deformed and are (locally) migmatites; and, as a result, the stratigraphic position of the sequence is uncertain. The sequence is here renamed the Mudong Metamorphics (*X*) in order to avoid a stratigraphic connotation.

GRANITOID INTRUSIONS IN THE WYLOO GROUP

There are five major plutons of Proterozic granitoid on WYLOO, four of which were described and named by Daniels (1965). In the core of a dome in the southwest corner of WYLOO is a fifth, a body of gneissic granodiorite (*Pgs*). It is considered to belong to the early-stage group of Williams (1986); plutons of that group were emplaced during D_1 deformation and regional metamorphism of the Wyloo Group.

A large granitoid body at Mount Alexander (22° 39′S, 115° 32′ E), which intrudes the Morrissey Metamorphic Suite (Williams, 1986), was named the Kilba Granite by Daniels (1965). It is of a medium-grained, muscovite-biotite granitoid (*Pgmb*) with a marginal porphyritic facies (*Pgm1*). The latter contains large euhedral microcline crystals, generally showing preferred long-axis orientation. Thin veins of the granitoid intrude adjacent country rock along schistosity planes. The granitoid itself is not foliated and contains xenoliths of mica schist country rocks (Daniels, 1965). The granitoid is associated with bodies of migmatite (*mb*) in the adjacent country rocks. These observations suggest the Kilba Granite was derived by anatexis from the Morrissey Metamorphic Suite.

The three other granitoid bodies named by Daniels (1965) are: Wongida Creek Granodiorite (22° 57′S, 115° 45′E); Mount Danvers Granodiorite (22° 47′ 30″S, 115° 51′E); and Boolaloo Granodiorite, a large body outcropping extensively between 22° 45′S, 115° 52′E and 22° 22′S, 115° 54′E. All are mainly medium- to coarse-grained biotite granodiorite (Pgbr). Daniels (1965) recognized a muscovite-rich tourmaline granite facies near the western margin of the Wongida Creek granodiorite. This pluton is also unusual in containing large xenoliths of tourmalinized schist as well as mafic xenoliths. The Mount Danvers granodiorite appears to be a sheet-like body, whose margins are parallel to the schistosity in the country rocks. It was probably emplaced by progressively wedging aside the pre-existing foliation of the host rocks.

Rounded mafic xenoliths, up to 0.3 m diameter, are abundant in the Boolaloo granodiorite. They are fine to medium grained, and some are rich in hornblende and calcic plagioclase. Williams (1986) considers that they are a restite phase; this implies derivation of this granitoid from igneous source rocks; and a high initial strontium ratio of 0.722 (Leggo and others, 1965) suggests a crustal origin. The Boolaloo Granodiorite has given a whole-rock Rb-Sr isochron of 1 684 Ma (Leggo and others, 1965; adjusted to a ^{87}Rb constant of 1.42×10^{-11} a^{-1}).

Contact Metamorphism

The Kilba Granite and Boolaloo granodiorite show contact metamorphic aureoles. The aureole (CM) around the Boolaloo Granodiorite is very narrow, except along its eastern margin between Middle Bore (22° 32′S, 115° 57′E) and Mount Elizabeth (22° 41′S, 115° 56′E), where it is up to several kilometres wide. Within a few metres of the contact at 22° 25′S, 115° 46E, the regional metamorphic chlorite-muscovite-quartz schists are spotted because of the growth of chloritoid porphyroblasts which are syn- to late-tectonic relative to the S_1 foliation. The schists also show a crenulation cleavage which post-dates the contact metamorphism and which is correlated with the regional D_2 deformation in the Ashburton Formation. It is, therefore, concluded that the Boolaloo Granodiorite was intruded before the D_2 deformation.

More extensive contact metamorphism occurs in a 20 km-long belt around the eastern margin of the Boolaloo Granodiorite. The southern part of this zone appears to be sandwiched between the main granodiorite body and an offshoot, and may possibly be a roof pendant. In this area, the hornfelses are characterized by granoblastic interlobate texture which overprints the pronounced regional foliation. Just north of Mount Elizabeth the hornfelses contain the mineral assemblages: andalusite + biotite + muscovite + quartz (+ tourmaline); and garnet + sillimanite (incipient) + andalusite + biotite + muscovite + quartz.

The incipient appearance of sillimanite indicates metamorphic temperatures of 600-650°C. Pressure was low to intermediate, perhaps 200-400 MPa. These conditions indicate the higher temperature portion of medium-grade metamorphism. Partial retrogression to chlorite-white mica assemblages is widespread.

In the northern part of the contact aureole, near Middle Bore, assemblages include: andalusite + cordierite + K -feldspar + biotite + quartz (+ oligoclase) (+sillimanite) (+garnet (almandine)).

Muscovite was not seen in many of these rocks, except where retrograde alteration produced aggregates of fine white mica. In some samples, sillimanite occurs as well-formed, bladed crystals; this suggests that it was stable at the peak of metamorphism. This, coupled with the general lack of muscovite, constrains the P-T field to about 650-680° at or less than 300 MPa. This is consistent with high-grade contact metamorphic conditions.

MOUNT MINNIE GROUP

The Mount Minnie Group (*I*) unconformably overlies the Ashburton Formation in northwestern WYLOO. It is unconformably overlain by both the Bangemall Group and Phanerozoic rocks. The group is approximately 1 600 m thick and comprises silicified conglomerate, sandstone, and mudstone.

The age of the Mount Minnie Group is poorly known. The lowest beds, at 22° 03′S, 116° 01′ 30″E, contain clasts of Ashburton Formation with S_1 cleavage. At this locality the Mount Minnie Group shows a weak, spaced cleavage, sub-parallel to the S_2 crenulation cleavage in the adjacent Ashburton Formation. It is concluded, therefore, that the Mount Minnie Group was deposited during the interval between the D_1 and D_2 episodes of post-Wyloo Group deformation. The Boolaloo Granodiorite was intruded into the Wyloo Group during this interval, however the timing of this event relative to deposition of the Mount Minnie Group is not known. On such evidence, this unit has an older age limit of 2 000 Ma, the likely age of the Wyloo Group. The younger age limit, though probably close to 1 680 Ma, could be either side of this date.

Daniels (1970) subdivided the Mount Minnie Group into three formations: Brodagee Sandstone, Wabco Shale, and Warramboo Sandstone.

BRODAGEE SANDSTONE

The 750 m thick Brodagee Sandstone (*Ib*) consists of thick-bedded, cross-stratified sandstone, and conglomerate. The latter may constitute most of the formation's thickness and contains rounded clasts of quartz-sandstone, chert, vein-quartz, and jaspilite, together with cleaved fragments derived from the Ashburton Formation.

WABCO SHALE

The Wabco Shale (*Iw*) is an association of mudstone and thin quartz sandstones which conformably overlie the Brodagee Sandstone. It is 500 m thick in the Mount Minnie area, but absent in the Parry Range.

WARRAMBOO SANDSTONE

The Warramboo Sandstone (*Ia*) conformably overlies the Wabco Shale except in the Parry Range, where it rests disconformably on the Brodagee Sandstone. The formation comprises approximately 400 m of thin- to medium-bedded, fine- to coarse-grained sandstone and minor amounts of mudstone. The sandstone is frequently cross-stratified and may display current ripples and small slump structures.

The Mount Minnie Group is interpreted as an association of fan-delta deposits laid down in a single basin or in separate, unconnected sub-basins (Daniels, 1970).

BANGEMALL GROUP

The Bangemall Group (*M*) was established by Halligan and Daniels (1964) and further subdivided by Daniels (1966, 1969, 1970, 1975), Brakel and Muhling (1976), Chuck (1984), and Muhling and Brakel (1985). It outcrops as an elongate arcuate belt in the west and southwest of WYLOO. Felsic rocks which occur within the succession on EDMUND and MOUNT EGERTON have been dated at approximately 1 100 Ma using Rb-Sr methods (Gee, 1980).

The stratigraphic scheme used here is that of Daniels (1970, 1975), who subdivided the group in the western Bangemall Basin into eight formations. Of these only the lower two units—the Irregully Formation and Kiangi Creek Formation—are present on WYLOO. They have a combined thickness of approximately 3 km.

IRREGULLY FORMATION

The Irregully Formation is approximately 2 800 m thick. Daniels (1970) subdivided it into: Yilgatherra Member, Wongida Dolomite Member, Gooragoora Sandstone Member, Wannery Member, Chubilyer Member, Weewoddie Dolomite Member, Yeelingee Member, Warrada Dolomite Member, and Revels Corner Sandstone Member.

Yilgatherra Member

The Yilgatherra Member (*Mis*) comprises silicified sandstone and iron oxide cemented, quartz-pebble conglomerate. It is 300 m thick on the western side of the Parry Range, but thins abruptly towards the east. Near Warrada Creek Well (22° 31′S, 115° 41′E), it occurs as a quartz-pebble conglomerate, only 0.3 m thick.

Wongida Dolomite Member

The Wongida Dolomite Member (*Mi*) (650 m) conformably overlies the Yilgatherra Member. The basal unit is a 150 m-thick, massive, white-weathering dolomite. It is overlain by well-bedded, white, cream, mauve, and grey dolomite, and some edgewise conglomerate, sandy dolomite, dolomitic sandstone, and chert. The upper part contains abundant, patchily silicified stromatolites, concentrated in well-defined horizons. Interbedded horizons of sedimentary breccia (*Mib*), which consist of fragments of silicified stromatolitic dolomite and cross-stratified sandstone occur in the vicinity of Mount Price (22° 37′S, 115° 42′E). Eight kilometres north of Mount Price, the breccias are draped over an older, rounded topography on the dolomite. This erosion surface contains a few small pot-holes, partly filled by rounded BIF pebbles. Daniels (1965) attributes the breccias to sedimentation affected by penecontemporaneous tectonism. Many other brecciated horizons recognized by Daniels (1965), such as those occurring to the west of the Henry River, are here interpreted as Tertiary silcrete and calcrete cappings on Bangemall Group dolomites.

Gooragoora Sandstone Member

In the Mount Florry region (22° 57′S, 115° 55′E), the Gooragoora Sandstone Member (*Mid*), which overlies the Wondiga Dolomite Member, is a 300 m thick, thin-bedded sandstone. It is commonly cross-stratified and contains iron-oxide pseudomorphs after pyrite. Further north, in the southern part of the Parry Range, it consists of mudstone with thin sandstone units and a few thin beds of dolomite. In the Scarborough Bore region (22° 19′S, 115° 41′ 30″E) the member consists of sandstone and interbedded mudstone.

Wannery, Chubilyer, Weewoddie Dolomite, and Yeelingee Members

Immediately north of Gooragoora Pool (22° 53′ 20″S, 115° 50′ 30″E), the Gooragoora Sandstone Member is conformably overlain by the mudstone of the Wannery Member (*Min*). To the southeast, near Mount Florry, the Wannery member thickens and can be subdivided into three equivalent units, in upward sequence Chubilyer (*Mih*), Weewoddie Dolomite (*Mio*), and Yeelingee Members (*Mie*).

The Chubilyer Member is 180 m of mudstone intercalated with thin sandstone bands. The Weewoddie Dolomite Member (150 m thick) is a lenticular body of black-weathering, dark blue-grey dolomite that contains a few thin sandstone bands. The Yeelingee Member (120 m) consists of finely laminated mudstone, sandstone, and thin dolomite beds. It overlies the Weewoddie Dolomite Member near Mount Florry, but rests on the Chubilyer Member a little to the northwest.

The Wannery Member and its lateral equivalents are absent in the southeastern Parry Range.

Warrada Dolomite Member

The Warrada Dolomite Member (*Mil*) (640 m) conformably overlies the Gooragoora Sandstone Member in the southeastern Parry Range. The lower half is massive cream-weathering dolomite, and the upper half is well-bedded dolomite containing beds of edgewise conglomerate and thin silicified horizons. The member is not present south of the Ashburton River.

Revels Corner Sandstone Member

The Revels Corner Sandstone Member (*Ma*) is 300 m thick and conformably overlies the Warrada Dolomite Member in the southern Parry Range, but was not recognized south of the Ashburton River. It consists of brown-weathering, thin-bedded sandstone, some of which contains mudstone clasts.

KIANGI CREEK FORMATION

South of the Ashburton River, the Wannery Member and its lateral equivalents are conformably overlain by the Kiangi Creek Formation (*Mk*) (240 m). It consists of grey, highly silicified, quartz sandstone, and forms the prominent capping to Mount Florry.

DOLERITE DYKES IN THE BANGEMALL GROUP

Dolerite dykes (*d*) cut the Bangemall Group and older rocks. They post-date the major episodes of folding, and can be subdivided on the basis of their orientation: the larger group trends northeast and the smaller group trends north. These dykes are generally less than 10 m thick, but some are over 100 m thick and can be traced for tens of kilometres.

DEFORMATION OF THE BANGEMALL GROUP

The Bangemall Group is folded into large-scale, open to tight, upright folds, with horizontal to gently plunging, curvilinear hingelines whose trends vary from southeast to south. Daniels (1970) noted only minor development of axial-plane cleavage. The episode of folding was called the Edmundian by Halligan and Daniels (1964) and post-dates the regional D_2 event in the Wyloo Group. Its effect on the pre-Bangemall Group basement is unknown, but it may be responsible for some of the variations in trend of D_2 minor structures in the Ashburton Formation.

PHANEROZOIC

MESOZOIC

A few small mesas and buttes of Cretaceous rock occur in northwest WYLOO. They are ferruginous sandstone and conglomerate, and represent parts of both the Nanutarra Formation and the Yarraloola Conglomerate (McWhae and others, 1958; Williams, 1968).

CAINOZOIC

The Cainozoic on WYLOO is subdivided into: Robe Pisolite (*Tp*), partly consolidated colluvium (*Tc*), silcrete/calcrete cappings to the Precambrian dolomite (*Ts*) and valley-fill calcrete (*To*). They are considered to be Tertiary; however, their ages are poorly known and some may be Quaternary.

The Robe Pisolite, 15-45 m, is a pisolitic limonite and forms elevated terraces and mesas above valley fill. It contains limonite and hematite pisoliths, generally small amounts of terrigenous detritus, and scattered fragments of fossil wood. It is largely confined to the northeast of WYLOO, where it clearly outlines ancestral drainage patterns. Indirect evidence from MOUNT BRUCE suggests a Late Eocene age for the deposit (Hocking and others, 1987).

Quaternary deposits on WYLOO include: unconsolidated colluvium (*Qc*), wind-blown sand (*Qs*), and fluvial sand and gravel (*Qa*).

Cainozoic deposits are good aquifers and contain most of the unconfined groundwater of the region.

ECONOMIC GEOLOGY

There are many mineral occurrences and a number of small deposits and associated mines on WYLOO; but no important orebody has been found. The Fortescue Group has the potential to host gold and massive sulphide mineralization; the Hamersley Group has the potential for high-grade iron-ore deposits; and the Wyloo Group (in particular the Ashburton Formation) has the potential to host gold, base-metal, and uranium mineralization.

Production figures for various mines on WYLOO are listed in Table 3.

TABLE 3. RECORDED PRODUCTION FROM MINES ON WYLOO TO 1980

Mine	Ore treated	Amount produced
Gold:		
Belvedere	1 585 t	13 864.1 g
Paulsen (Melrose)	2 955 t	28 549.6 g
Total	**4 540 t**	**42 413.7 g**
Silver:		
Belvedere		3 568.5 g
Paulsen		271.5 g
Silent Sisters		13 778.6 g
Aerial		27 152.9 g
Thowagee		5 878.4 g
North Kooline		5 131.9 g
Total		**55 781.8 g**
Copper:		
Cane Hill	267.00 t	76.68 t
Range Well	15.67 t	3.68 t
Belvedere	1.32 t	0.19 t
Paulsen	8.45 t	1.40 t
Total	**292.44 t**	**81.95 t**
Lead:		
Silent Sisters		115.80 t
Aerial		100.17 t
Belvedere		1.77 t
Thowagee		15.20 t
North Kooline		22.30 t
Near Mount De Courcy		2.00 t
Total		**257.24 t**

IRON

Both hematite and limonite ores occur in the Hamersley Group. The hematite ores are associated with the Brockman and Marra Mamba Iron Formations on the northern and eastern flanks of the Wyloo Dome. Individual bodies are small, generally between 100 and 200 Mt of high-phosphorous ore grading between 55 and 65% Fe. The limonite deposits occur in many river valleys, especially Boolgeeda Creek. They are of lower grade than the hematite ores, but contain less phosphorous.

An unusual low-tonnage hematite deposit known as the Barett-Lennard ore body occurs 17.5 km north of Mount De Courcy within the Mount McGrath Formation. Hematite has replaced the conglomerate horizon but preserved the original texture (MacLeod, 1966).

ASBESTOS

Crocidolite occurs in the upper part of the Marra Mamba Iron Formation in Kungarra Gorge (22° 48′S, 116° 57′ 20″E). Trendall and Blockley (1970) consider this to be the best fibre prospect in the western Hamersley Range. Several seams of fibrous crocidolite occur in a 10 m-thick section, where the greatest cumulative length of fibre is 32 cm. The thickest single seam measured 11.5 cm over a strike length of 1.4 m.

Two other fibre localities occur in the Marra Mamba Iron Formation, 16 km north, and 13 km northeast of Duck Creek homestead (22° 31′S, 116° 34′ 40″E), but they are thin.

In the 1930s, chrysotile was mined 8 km southeast of the now abandoned Meilga Station (22° 43′ 30″S, 115° 47′E) (Forman, 1938), where a dolerite dyke cuts dolomite of the Bangemall Group, and the asbestos occurs in seams within a zone of contact metamorphism. The fibre is of high quality; fibre lengths range from 10 to 100 mm; total reserves are small.

COPPER

Some production has been recorded from copper mines around Red Hill (22° 06′S, 116° 02′E) (Marston, 1979). In the Cane Hill and Whynot mines, copper mineralization occurs in limonitic quartz veins within clastic sedimentary rocks of the Ashburton Formation. Production was also recorded from the Range Well area (22° 22′ 10″S, 115° 32′ 30″E) in quartz-muscovite-chlorite schists of the Morrissey Metamorphics (Marston, 1979). Several small shows within the Wyloo Dome produced small amounts of ore at the Belfrey/Blacks prospect (22° 37′S, 116° 18′ 30″E), Paulsen (22° 34′ 30″S, 116° 14′ 20″E) and Belvedere (22° 36′ 50″S, 116° 17′ 20″E) mines. Mineralization at the Paulsen and Belvedere mines is in quartz veins cutting rocks of the Fortescue Group, whereas at the Belfrey Prospect it is associated with an acid volcanic horizon within the Mount Roe Basalt.

Daniels and Halligan (1969) recorded a copper-gold mine 13 km east of the abandoned Meilga Homestead.

Extensive prospecting for copper mineralization within shales in the Jeerinah Formation has been undertaken in the past with only limited success (Marston, 1979).

LEAD

Two small, abandoned lead mines, Silent Sisters (22° 52′ 40″S, 116° 27′ 30″E) and Aerial (22° 53′S, 116° 37′E) occur within cross-cutting fractures in the Duck Creek Dolomite (Blockley, 1971).

Minor shows of lead mineralization, chiefly galena, occur in veins within the Ashburton Formation. These occur at North Kooline (22° 59′S, 116° 21′ 40″E), Mount Stuart (22° 26′S, 116° 02′E), Cane Hill (22° 09′ 30″S, 116° 02′ 50″E), Glen Florrie (22° 57′ 10″S, 115° 59′E), Mount Elizabeth (22° 46′S, 115° 54′ 20″), and Thowagee (22° 56′S, 115° 32′E) (Blockley, 1971).

The Nanutarra Mine (22° 41'S, 115° 33'E) contains lead and copper mineralization in quartz veins which cut the contact of granitoid and schists of the Morrissey Metamorphic Suite (Blockley, 1971).

Minor production of lead was recorded from the Belvedere Mine, together with copper and gold (Blockley, 1971; Marston, 1979).

Blockley (1971) also mentions slight lead production from the Wyloo Dome north-northeast of Mount de Courcy (22° 43'S, 116° 18' 30"E). The exact location of this small mine is not known, but it was presumably within the Fortescue Group.

GOLD

The Belvedere and nearby Paulsen mines are reported to have produced 14.1 kg of gold (Forman, 1938; Finucane, 1939).

A promising gold and silver prospect occurs southeast of Mount Clement at 22° 50'S, 116° 07' 30"E. This mineralization may be of stratiform exhalative type, and contrasts with the dominantly vein-related or alluvial deposits found elsewhere in the Ashburton Formation.

Small gold nuggets are rumoured to have been found southeast of the Paulsen Mine in the Metawandy Creek area (Daniels, 1970). A small show, known as the Monster Lode, occurs near the unconformity between the Hamersley and Wyloo groups (22° 42'S, 116° 14' 40"E) and is reported to contain 5 g/t ore (Talbot, 1926; Finucane, 1939).

SILVER

On WYLOO, silver production has totalled almost 55.8 kg. Most has come from the Silent Sisters, Aerial, Thowagee, and North Kooline lead mines. Silver is also associated with gold at the Mount Clement prospect.

TUNGSTEN

Southwest of Kilba Well (22° 46' 38"S, 115° 32' 54"E), scheelite occurs near the contact between a prophyritic granitoid and a regionally metamorphosed dolomite of the Morrissey Metamorphic Suite. The mineralization is concentrated in the limbs of isoclinal folds, on the flanks of a dome centred on the granitoid (Baxter, 1978).

MARBLE

A small amount of marble was produced for a short time from two mines at 22° 48'S, 116° 21' 30"E and 22° 54' 30"S, 116° 46'E but both are now closed. An attractive brecciated carbonate from within the Duck Creek Dolomite was worked at both quarries. It is believed that both operations closed because fractures limited the size of block that could be cut.

AMETHYST

A small deposit of amethyst occurs within the Duck Creek Dolomite at 22° 47' 30"S, 116° 21' 40"E. The deposit has been intermittently worked to produce poor-quality material for jewellery and a small amount of gem-quality amethyst.

WATER

Permanent pools exist on some of the larger rivers and creeks on WYLOO and are used for stock watering. However, most of the water for domestic and stock purposes is obtained from shallow bores and wells, generally in alluvium, colluvium, or calcrete. The majority of these bores are located in low-lying country in the western part of the area.

Deep sources of water may exist in several of the synclines in the Hamersley Range.

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WYLOO

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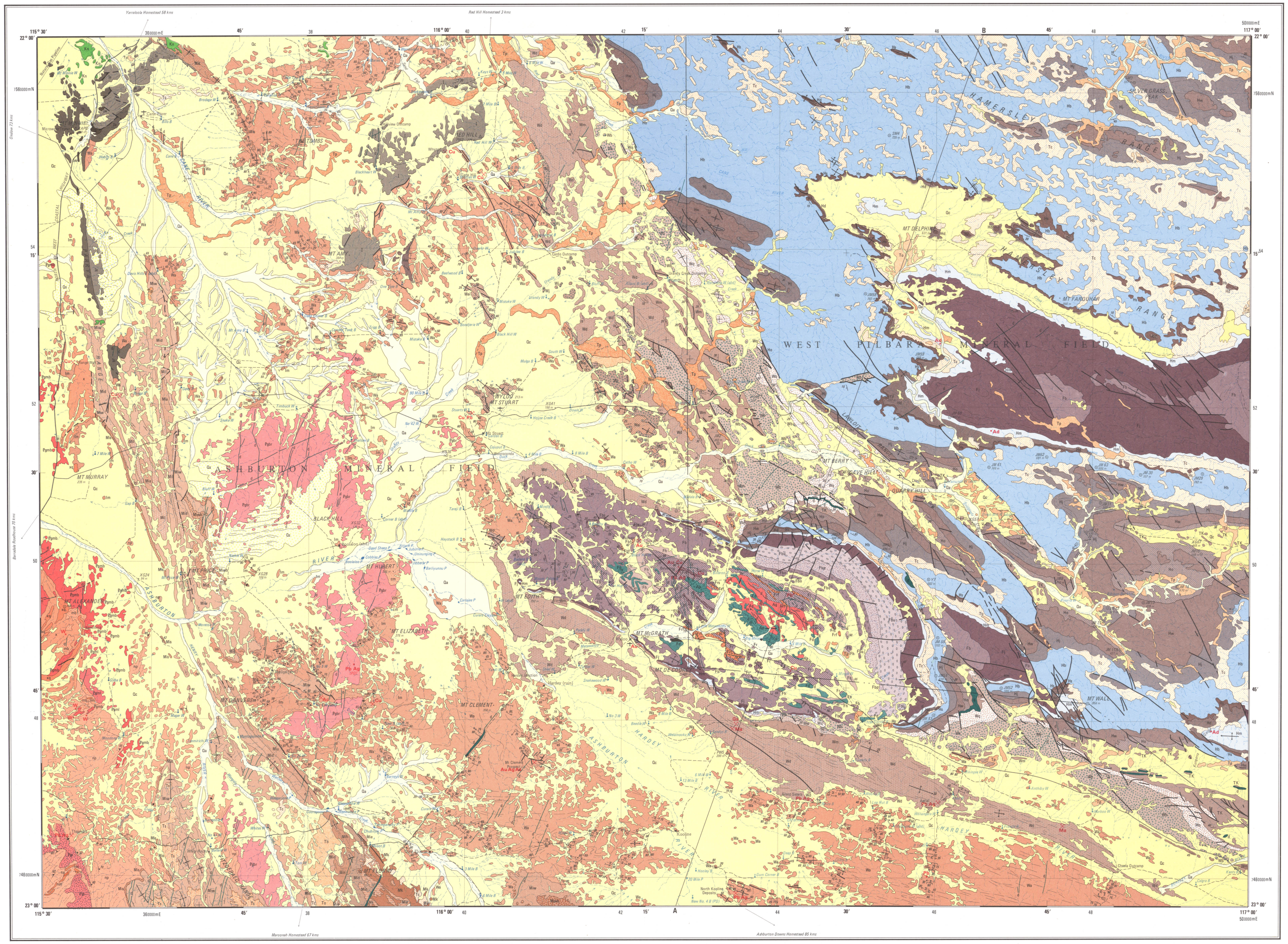
GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SHEET SF 50-10



Geology by D.F. Blight 1980, D.B. Seymour 1980/81, and A.M. Thorne 1980

SYMBOLS

- Geological boundary
- Fault
  - accurate
  - approximate
- Shear zone
- Folds, plunge indicated
  - anticline
  - syncline
  - overturned syncline
  - with axial plane crenulation cleavage
    - anticline
    - syncline
- Minor folds, plunge indicated
  - upright
  - inclined
  - reclined
  - showing dip of axial plane
  - showing vergence
    - S vergence
    - Z vergence
    - M vergence
- Minor folds associated with crenulation cleavage development plunge indicated
  - upright, vergence not shown
  - showing vergence
    - S vergence
    - Z vergence
    - M vergence
- Bedding
  - inclined
  - vertical
  - horizontal
  - overturned
  - top of bed
  - trend line
- Flow banding
- Cleavage
  - penetrative (slaty)
    - inclined
    - vertical
    - strike coincident with bedding
  - crenulation
    - inclined
    - vertical
- Metamorphic foliation (other than cleavage)
  - inclined
  - vertical
  - trend line
- Lineations
  - bedding-cleavage intersection
  - crenulation
- Later structures
  - minor fold, plunge indicated
  - crenulation cleavage inclined
  - crenulation lineation

- Mineral field boundary
- Highway with national route marker
- Formed road
- Track
- Homestead — Wyloo
- Building
- Locality — Hardey Junction
- Landing ground
- Horizontal control; major, minor
- Vertical control, height accurate — XG36 142 m
- Sand dune

- Watercourse intermittent
- Pool — P
- Bore — B
- Well — W
- Windpump
- Abandoned — (abd)
- Position doubtful — (PD)

- Mine with recorded production — Belvedere
- Mineral occurrence
  - Arsenic — As
  - Chrysotile — Ac
  - Copper — Cu
  - Crocidolite — Ad
  - Gem stones — Gs
  - Gold — Au
  - Iron — Fe
  - Lead — Pb
  - Marble — Ma
  - Silver — Ag
  - Tungsten — W

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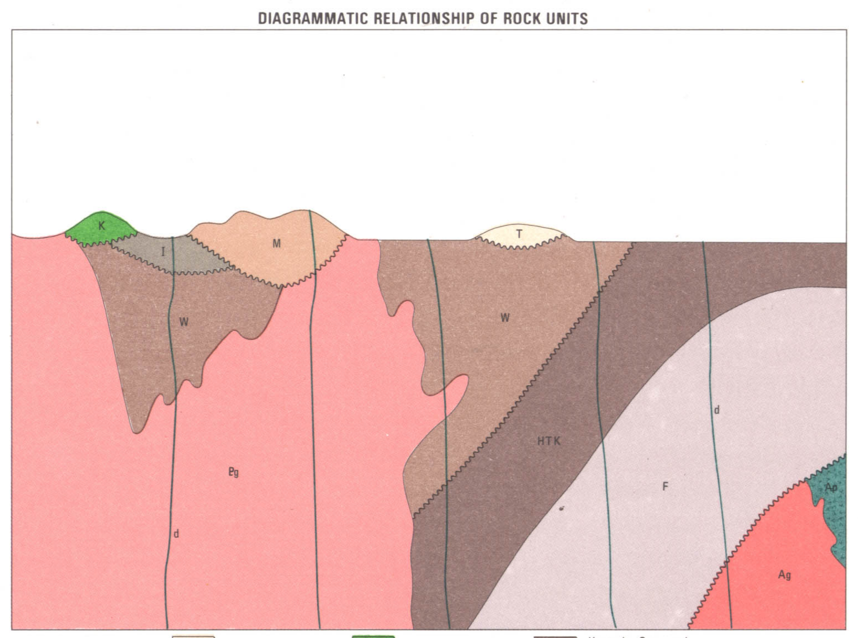
The lines indicate magnetic declination, 1980 + means declination is east and correction must be added to compass bearing to give true bearing − means declination is west and correction must be subtracted from compass bearing to give true bearing

Annual change is − 2′ westerly

DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



T Tertiary — K Cretaceous — HTK Hamersley Group and Turee Creek Group

P.E. PLAYFORD
DIRECTOR, GEOLOGICAL SURVEY
OF WESTERN AUSTRALIA

SCALE 1 : 250 000

5000 Metres 0 5 10 15 20 25 30 Kilometres

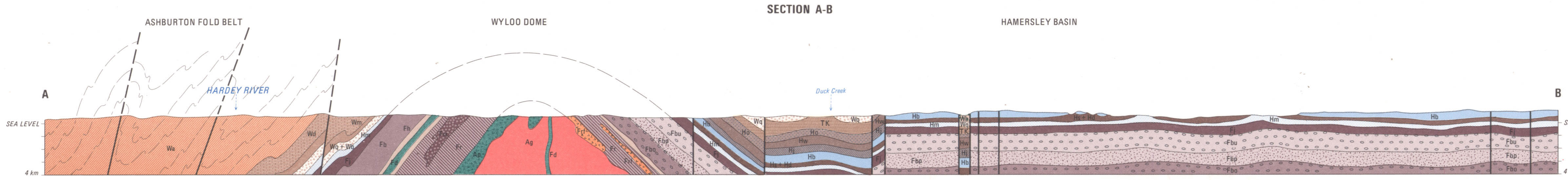
TRANSVERSE MERCATOR PROJECTION

ZONE 50 AUSTRALIAN MAP GRID

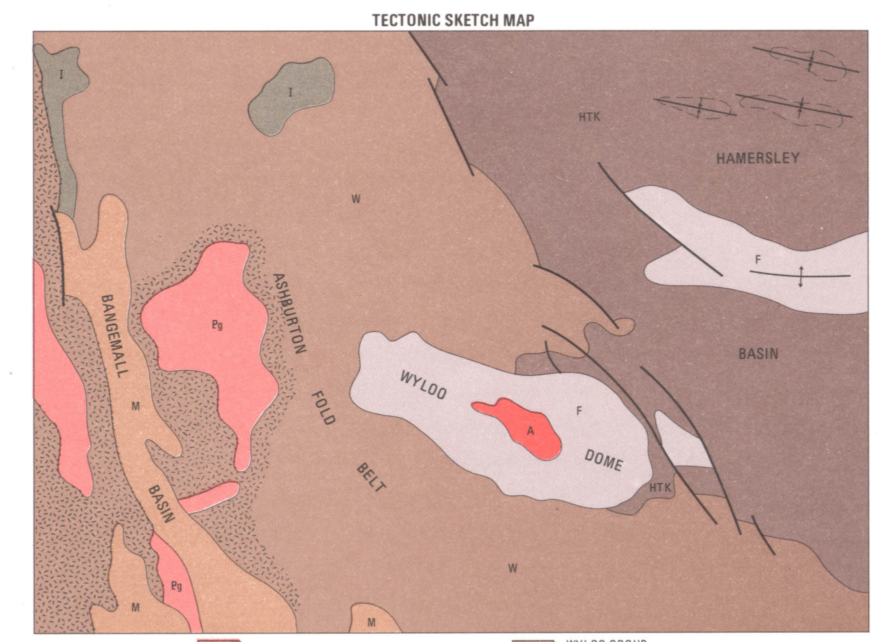
DIAGRAMMATIC SECTION

NATURAL SCALE

SECTION A-B



TECTONIC SKETCH MAP



Pg 'Younger granitoids'

A Crystalline basement

W WYLOO GROUP low greenschist facies; higher metamorphic grades (Morrissey Metamorphic Suite)

REFERENCE

CAINOZOIC

QUATERNARY

- Qa — Alluvium
- Qc — Colluvium – superficial, unconsolidated sand and gravel
- Qs — Wind-blown sand

TERTIARY

- Tc — Colluvium – partly consolidated valley-fill deposits
- To — Calcrete – limestone and calcareous gravels with opaline silica
- Tp — **ROBE PISOLITE :** pisolitic limonite deposits with fossil wood fragments. Occurs along old river channels. Contains iron ore.
- Ts — Silcrete/calcrete capping developed on dolomite of BANGEMALL GROUP

MESOZOIC

CRETACEOUS

- Kn — Conglomerate, arenite and siltstone with some fissile mudstone. Includes NANUTARRA FORMATION and YARRALOOLA CONGLOMERATE

PRECAMBRIAN

- q — Quartz veins
- d — Dolerite, intrudes rocks of all ages up to and including BANGEMALL GROUP

Bangemall Group (M) — c. 1100 Ma

- Mk — **KIANGI CREEK FORMATION :** arenite (some silicified)
- **IRREGULLY FORMATION :**
  - Mia — **Revels Corner Sandstone Member :** thin-bedded arenite (some silicified)
  - Mil — **Warrada Dolomite Member :** dolomite; lower part massive with some sandy dolomite and calcarenite; upper part well-bedded with thin silicified bands
  - Mie — **Yeelingee Member :** mudstone and shale with some arenite and thin dolomite
  - Mio — **Weewoddie Dolomite Member :** grey-blue, fine-grained dolomite and shale. Contains manganese nodules
  - Mih — **Chubilyer Member :** mudstone and shale with thin arenite and rare dolomite
  - Miu — **Wannery Member :** mudstone and shale. Probable lateral equivalent of Yeelingee, Weewoddie and Chubilyer Members
  - Mid — **Gooragoora Sandstone Member :** thin-bedded, cross-laminated brown arenite (some silicified). Locally pyritic
  - Miw — **Wongida Dolomite Member :** well-bedded, white, cream, mauve and grey dolomite. Some sandy dolomite, dolomitic sandstone and chert. Contains abundant stromatolites
  - Miwb — Locally developed sedimentary breccia within Miw : includes fragments of silicified dolomite and cross-stratified sandstone
  - Mis — **Yilgatherra Member :** arenite (some silicified) and quartz-pebble conglomerate. Frequently cemented by iron oxides

Mount Minnie Group (I)

- I — **MOUNT MINNIE GROUP :** undifferentiated; arenite (some silicified), shale and rare jaspilite
- Ia — **WARRAMBOO SANDSTONE :** thin-bedded arenite (some silicified) with some shale
- Iw — **WABCO SHALE :** brown shale with interbedded arenite
- Ib — **BRODAGEE SANDSTONE :** arenite (some silicified), and conglomerate. Poorly bedded, some cross-lamination

c. 1700 Ma

- Pgbr — Biotite granodiorite, mainly coarse-grained. Contains mafic xenoliths (1684 Ma, Rb–Sr)
- Pgmb — Muscovite-biotite (-tourmaline) adamellite and granite; most phases are homogeneous, but some are inhomogeneous. Contains xenoliths of schist
- Pgml — Porphyritic, muscovite-biotite granite
- Pgs — Early stage granitoid : gneissic, biotite (-hornblende) granodiorite

Morrissey Metamorphic Suite

- x — **MUDONG METAMORPHICS :** undifferentiated; schist, amphibolite, marble, skarn, quartzite and metapelites
- xq — Quartzite unit within MUDONG METAMORPHICS
- Probable metamorphosed Ashburton Formation:
  - np — Medium-grade microgneiss and schist. Probable higher grade equivalent of lm
  - nm — Marble
  - na — Amphibolite
  - mb — Paragneiss migmatite
- Metamorphosed Ashburton Formation:
  - lm — Low to medium-grade schist, fine to coarse-grained
  - cm — Contact metamorphic gneiss and schist, developed in proximity to eastern margin of Boolaloo Granodiorite

Wyloo Group (W) — c. 2000 Ma

- Wa — **ASHBURTON FORMATION :** wacke, mudstone, ferruginous mudstone, arenite and lithic conglomerate
- Wai — Ferruginous mudstone and banded iron-formation (in some places basal to Wa)
- Wj — **JUNE HILL VOLCANICS :** predominantly intermediate and mafic lava, pillow breccia, fine to coarse pyroclastics and minor dolomite, sandstone and mudstone
- Wd — **DUCK CREEK DOLOMITE :** thin to thick-bedded locally stromatolitic dolomite with minor chert and mudstone
- Wm — **MOUNT McGRATH FORMATION :** mudstone, arenite (some silicified), lithic conglomerate, dolomite and dolomitic mudstone
- Ww — **WOOLY DOLOMITE :** thin to thick-bedded locally stromatolitic dolomite, mudstone and minor chert. Minor conglomerate and pebbly arenite at base
- Wb — **CHEELA SPRINGS BASALT :** vesicular and amygdaloidal basalt with minor tuff, tuffaceous mudstone and chert
- Wq — **BEASLEY RIVER QUARTZITE :** conglomerate, fine to coarse arenite (some silicified), mudstone and dolomite; locally includes basal **Three Corner Conglomerate Member :** clast and matrix supported lithic conglomerate with minor arenite and mudstone

Turee Creek Group

- TK — Lithic arenite and sublitharenite (some silicified), wacke, mudstone, pebble-cobble mudstone, carbonate and minor basalt. Intruded by dolerite sills

Hamersley Group (H) — c. 2500 Ma

- Ho — **BOOLGEEDA IRON FORMATION :** fine-grained, finely laminated, dark grey-brown to black, flaggy iron-formation. Minor chert
- Hw — **WOONGARRA VOLCANICS :** rhyolitic and dacitic volcanics, commonly porphyritic, some tuff. Some phases are intrusive (2470 ± 30 Ma, U – Pb; 2370 Ma, Rb–Sr)
- Hj — **WEELI WOLLI FORMATION :** banded iron-formation and some shale. Intruded by dolerite sills
- Hb — **BROCKMAN IRON FORMATION :** banded iron-formation, chert and shale. Contains hematite (2490 ± 20 Ma, U – Pb)
- Hs — **MOUNT McCRAE SHALE :** shale, siltstone, dolomitic mudstone with banded iron-formation and chert; and **MOUNT SYLVIA FORMATION :** three thin banded iron-formation units and dolomitic mudstone
- Hd — **WITTENOOM DOLOMITE :** grey, thin-bedded dolomite with some shale, chert and iron-formation
- Hm — **MARRA MAMBA IRON FORMATION :** chert and banded iron-formation with some shale. Contains crocidolite and hematite

Mount Bruce Supergroup — Fortescue Group (F) — c. 2700 Ma

- Fd — Concordant dolerite sills folded with FORTESCUE GROUP, and feeder dyke in basement
- Fj — **JEERINAH FORMATION :** mudstone, shale, chert, banded iron-formation and basalt. Intruded by abundant dolerite sills
- Fb — **MOUNT JOPE VOLCANICS :** undifferentiated; mainly pillow basalt with some pyroclastics. Commonly schistose in the south-western half of the WYLOO DOME
  - Fbf — Felsic volcanics : lapilli tuff and quartz-feldspar porphyry
  - Medium to coarse-grained arenite
  - Fbu — **Bunjinah Pillow Lava Member :** basalt with some well developed pillows
  - Fbp — **Pyradie Pyroclastic Member :** agglomerate and tuff. Intruded by abundant dolerite sills
  - Fbo — **Boongal Pillow Lava Member :** basalt with some pillow lava development
- Fh — **HARDEY SANDSTONE :** feldspathic arenite, lithic arenite and quartz arenite with minor mudstone and wacke (2707 ± 151 Ma, Rb – Sr)
- Fr — **MOUNT ROE BASALT :** vesicular basalt and basaltic agglomerate. Commonly schistose in the south-western half of the WYLOO DOME
  - Frf — Felsic volcanics: layered ashfall tuff, dacitic accretionary lapilli tuff and quartz-feldspar porphyry
  - Cobble mudstone and conglomerate (containing granite clasts), arenite and mudstone

?PILBARA CRATON

- Ag — **METAWANDY GRANITE :** sericitized adamellite, cataclastically deformed in part, with locally abundant mafic xenoliths
- Ap — Pilbara Supergroup: Mafic volcanics, intruded by dolerite

Cartography by the Mapping Branch, Department of Mines, W.A.
Topographic information supplied by the Department of Land Administration, W.A.
Published by and available from the Geological Survey Division of the Department of Mines, 66 Adelaide Terrace, Perth, W.A.
Printed by the Department of Services, State Printing Division, Perth, W.A.

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MINISTER FOR MINERALS AND ENERGY
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