1:250,000 GEOLOGICAL SERIES—EXPLANATORY NOTES

MARBLE BAR
WESTERN AUSTRALIA

SHEET SF50-8 INTERNATIONAL INDEX

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COMPILED BY A. H. HICKMAN AND S. L. LIPPLE

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Explanatory Notes on the Marble Bar Geological Sheet

Compiled by A. H. Hickman and S. L. Lipple

INTRODUCTION

Bounded by latitudes 21° and 22°S and longitudes 118°30′ and 120°E, the Marble Bar 1:250 000 sheet, SF/50-8 on the International Grid, lies within the western part of the Pilbara Goldfield. The only town is Marble Bar which is the administrative centre of the area and has most essential services. Daily air services operate between Port Hedland and Marble Bar, and there are frequent flights to Nullagine. Certain of the pastoral station homesteads have small airstrips suitable for light aircraft.

Marble Bar is connected to Port Hedland and Nullagine by the Great Northern Highway. Graded earth roads link Marble Bar with Wittenoom and Wittenoom with Port Hedland. Access to most of the sheet area is possible by poor quality pastoral and mining tracks.

The main industries are mining, pastoral activities and tourism. Some gold is extracted by the State Battery at Marble Bar. About one half of the State's total cassiterite production and some tantalite has come from the area. Other minerals previously mined include chrysotile, copper and beryl.

Previous investigations

In 1962 Noldart and Wyatt published geological maps of the Marble Bar and Nullagine sheet areas to accompany a bulletin on part of the Pilbara Goldfield. The bulletin contains an account of early exploration and mining development in the area.

PHYSIOGRAPHY

Most of the sheet area lies between 150 and 400 m above sea level and consists mainly of sand plains and extensive ranges of low razor-back hills. It forms part of Jutson's (1950) Pilbaraland, a dissected plateau of which remnants are still preserved. The rivers responsible for the extensive erosion of the old plateau, the Yule, Turner, Shaw and Coongan, now form a superimposed drainage system. The Yule, Shaw and Coongan Rivers rise near the southern limit of the sheet area and flow almost due north along courses which, in the cases of the Shaw and the Coongan, bear little relation to the geology of the ancient rocks they traverse. Examples of river capture are shown by the change in the course of the Shaw River from Miralga Creek to its present position, and the capture of part of the Yule River headwaters by Garden Creek.

Five physiographic units occur within the area (Fig. 1).

ARCHAEAN ROCKS

LAYERED SUCCESSION

The Archaean layered succession or "greenstone" sequence is preserved within several linear and arcuate belts between granitic batholiths. The extent of these greenstone belts and the quality of their exposure ranks the sheet as a key area in the understanding of Australian Archaean geology. Lithologically the succession is very diverse and contains most of the rock types present in other greenstone sequences of the world. Ultramafic, mafic and felsic volcanic and intrusive rocks form the lower part of the succession. Relatively thin chert units occur throughout and are frequently interposed between ultramafic-mafic and ultramafic-felsic cycles. The upper part of the entire sequence is predominantly a sedimentary

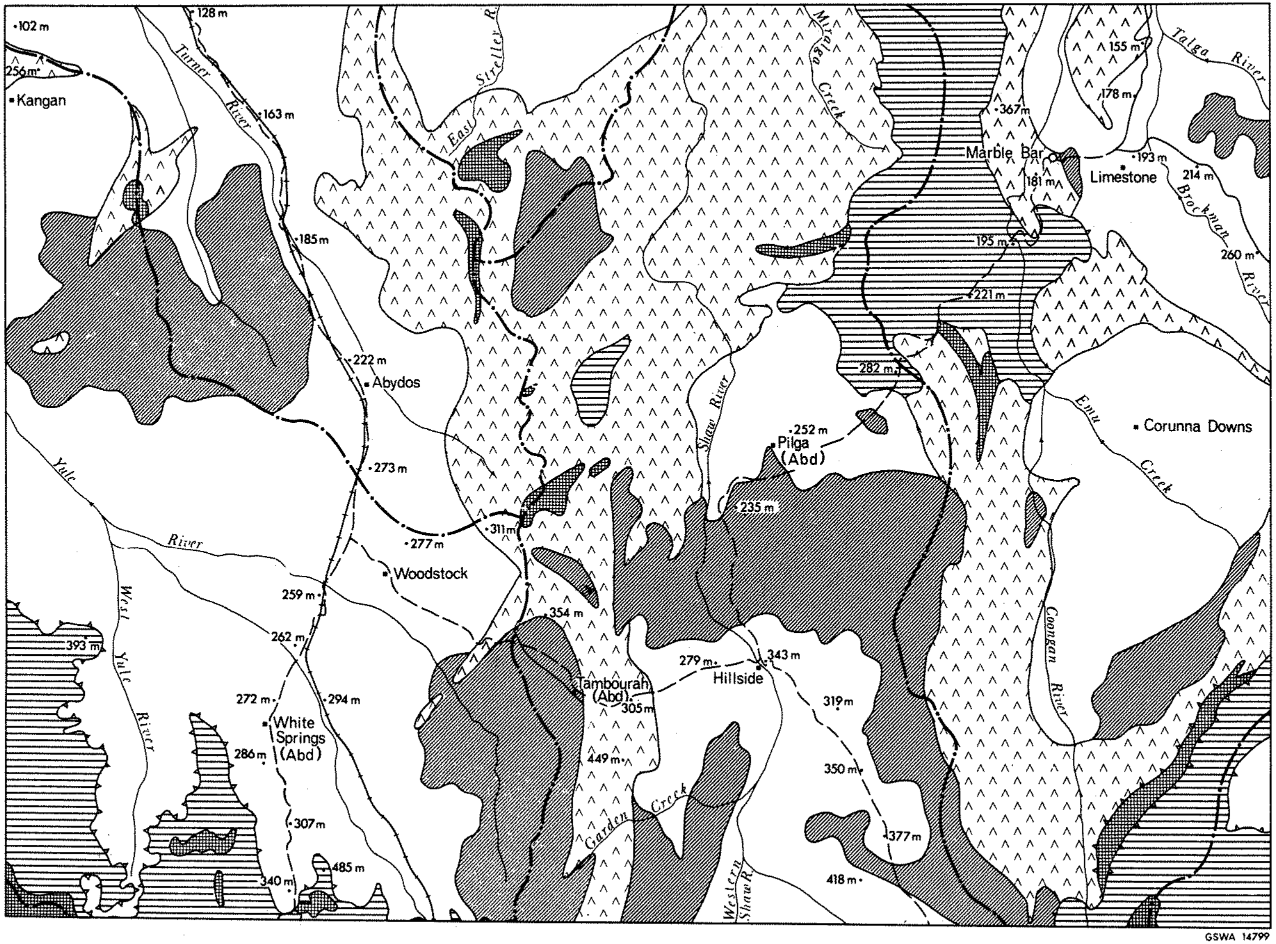


FIGURE 1

PHYSIOGRAPHIC DIAGRAM

MARBLE BAR SHEET SF 50-8

SCALE

10 0 10 20 30 40
KILOMETRES

REFERENCE

- Hamersley Surface Plateau, mostly over Archaean greenstones (assoc. Td, Tp units) (up to 520 m)
- Dissected Plateau generally corresponding to Proterozoic Fortescue Group units (180 m – 450 m)
- Range, rugged hills and ridges generally over Archaean greenstone units (150 m – 520 m)
- Low granite hills (200 m – 400 m)
- Plain over granitic rocks, with associated Quaternary units (100 m – 300 m)
- Scarp
- Watercourse
- Watershed
- Highway
- Road
- Abydos Homestead
- o Town
- ·252 m Spot height

assemblage of banded iron-formations, argillaceous rocks, and sandstone with subordinate pillow basalt. It is separated from the lower assemblage by local unconformities. Accordingly, on lithological and stratigraphic grounds, the layered succession is divided into two groups: the predominantly sedimentary Gorge Creek Group, and the predominantly volcanic Warrawoona Group.

TABLE 1. GENERALIZED STRATIGRAPHY OF THE ARCHAEAN LAYERED SUCCESSION

Group	*Subgroup*	*Formation*	*Maximum Thickness (km)*	*Lithology*
Gorge Creek Group		Budjan Creek Formation Lalla Rookh Sandstone	2-3	Sandstone and conglomerate
		Honeyeater Basalt	0.5	Pillow basalt
	Soanesville Subgroup	Paddy Market Formation	1	Banded iron-formation and ferruginous clastic sedimentary rocks
		Corboy Formation	1-2	Quartzite, sandstone and psammopelitic sedimentary rocks
Warrawoona Group		Wyman Formation	1	Porphyritic rhyolite
	Salgash Subgroup		2-3	Pillow basalt and chert
		Panorama Formation Kelly Formation	1	Dacitic lava, tuff and agglomerate with local sedimentary rocks
			3-5	Pillow basalt and chert
		Marble Bar Chert	0.1	Banded chert
		Duffer Formation	5-8	Dacitic agglomerate
	Talga Talga Subgroup		5-8	Pillow basalt with subordinate felsic, ultramafic and chert units

The type areas of the Warrawoona and Gorge Creek Groups are respectively the Warrawoona Syncline-Marble Bar Belt (Fig. 2) and the Lalla Rookh-Soanesville district. The constituent units are given in Table 1. A stratigraphic and structural interpretation is shown on Figure 3.

The thickness of the layered succession commonly exceeds 15 km. No single stratigraphic column can fully represent it, primarily because of lateral facies changes and local unconformities. Secondary modification of the sequence by isoclinal folding, tectonic sliding and disruptive igneous intrusion sometimes obscures the true order of deposition. Figure 4a, b illustrates some regional differences in the succession.

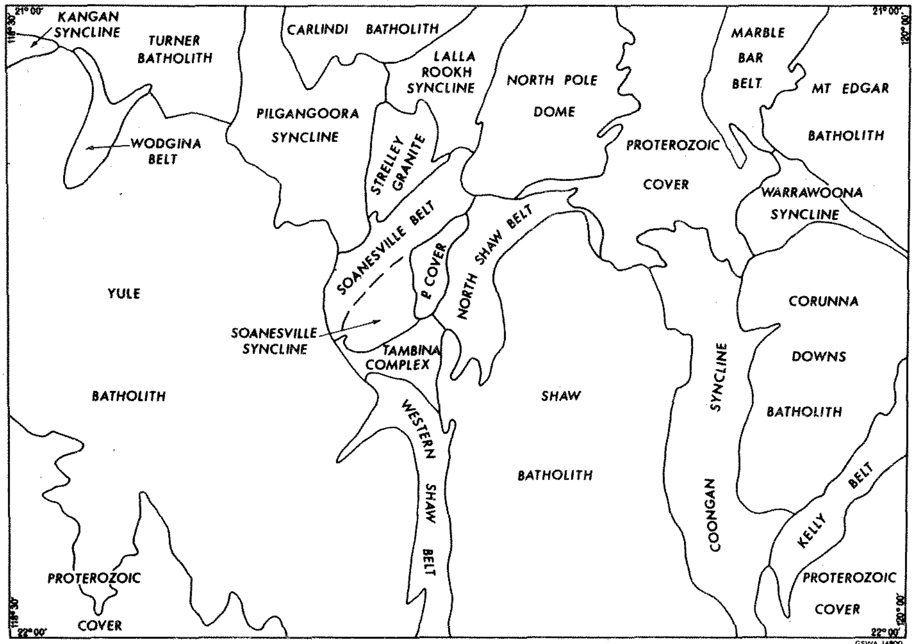


FIGURE 2
MAJOR STRUCTURAL UNITS

10 0 10 20km

Clastic sedimentary rocks

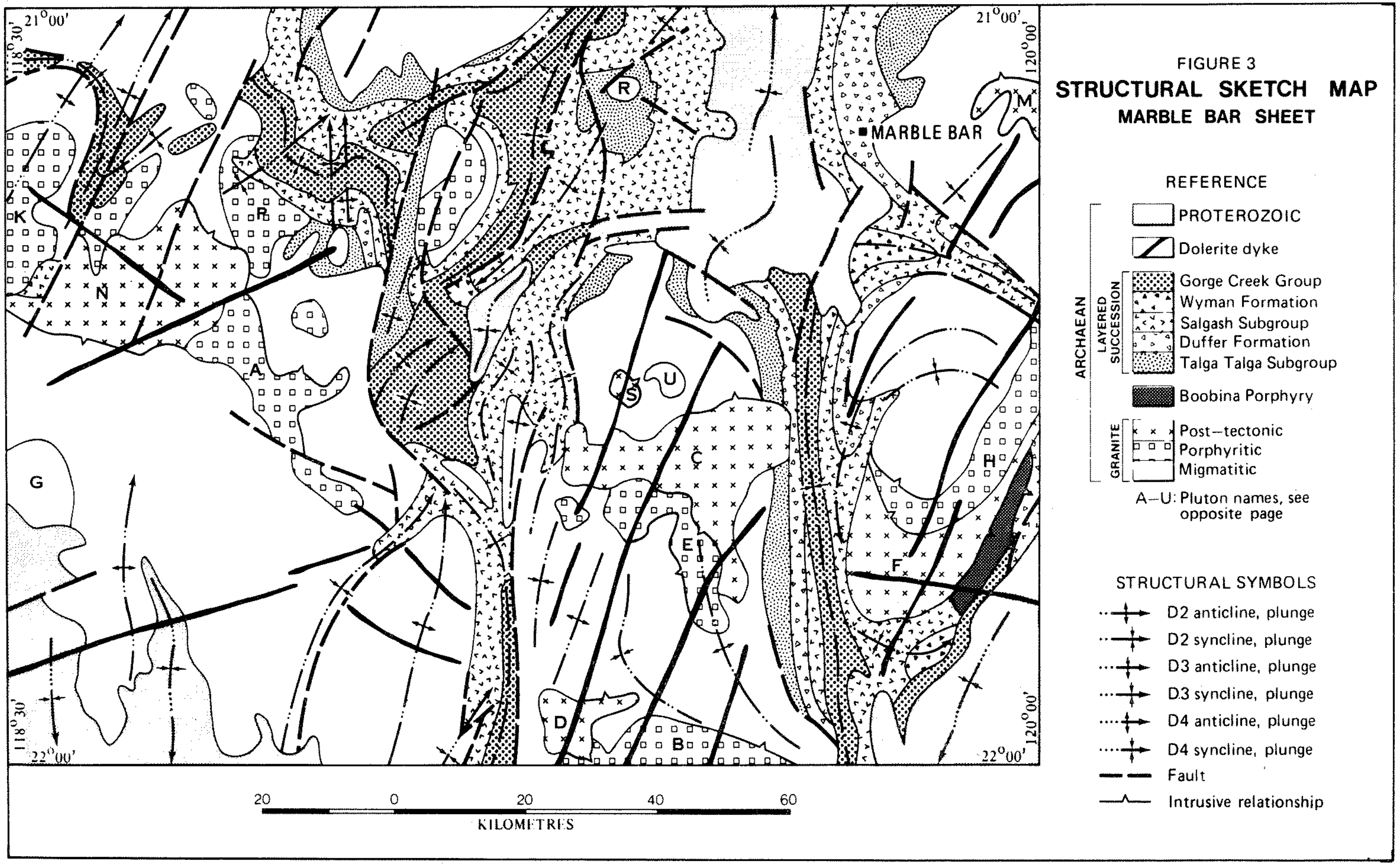
As: Archaean clastic sedimentary rocks are designated *As,* where unit composition is variable or imprecisely known. Further lithological information on better known units is given by using a third letter (e.g. *Asq*).

Most *As* units occur in the upper part of the Warrawoona Group and the lower part of the Gorge Creek Group and are composed of psammopelitic or pelitic sedimentary rocks. In the centre of the Coongan Syncline, *As* schist contains thin quartzite and chert units which provide useful stratigraphic marker horizons. A local change of sedimentary facies towards the south results in an increasing development of psammitic beds.

At Salgash, the unit comprises dark grey pelitic sedimentary rocks containing sandstone beds. Refolded megascopic isoclines within the latter may represent syn-depositional slump structures. In the North Pole area a narrow belt of interbedded sandstone, tuff, shale and chert crops out around the eastern flank of the North Pole Dome. Near the northern edge of the sheet area pale siliceous and dark grey psammopelitic schists, intercalated with chert, quartzite and mafic volcanics, are assigned to the unit. This unit also includes siliceous shaly sedimentary rocks, locally quite ferruginous, on the eastern side of the Western Shaw Belt, and similar rocks cropping out on the western side of the Strelley Granite. Other occurrences of the unit generally comprise rocks of the types mentioned above.

Asq: Quartzite units representing metamorphosed quartz sands occur in many areas. The type varies from white to grey but at some localities (e.g. Miralga Creek) is greenish owing to the presence of chlorite. The quartzite is usually bedded at intervals of 0.1 m to 1.0 m and sometimes exhibits cross-stratification and ripple marks.

Asc: Conglomerate units are most common in the upper part of the layered succession. In certain localities they clearly overlie unconformities and thus mark important stratigraphic breaks. Examples are seen where the Shaw River passes



Pluton names: A, Abydos Adamellite; B, Bamboo Springs Adamellite; C, Cooglegong Adamellite; D, Coondina Granite; E. Eley Adamellite; F. Mondana Adamellite; G, Mount Gratwick Granodiorite; H Carbana Pool Adamellite; K, Kangan Granite; M, Moolyella Adamellite; N, Numbana Granite; P, Pincunah Adamellite; R, North Pole Adamellite; S, Spear Hill Adamellite; U, Mulgandinnah Granite.

FIGURE 4a ARCHAEAN STRATIGRAPHIC COLUMNS

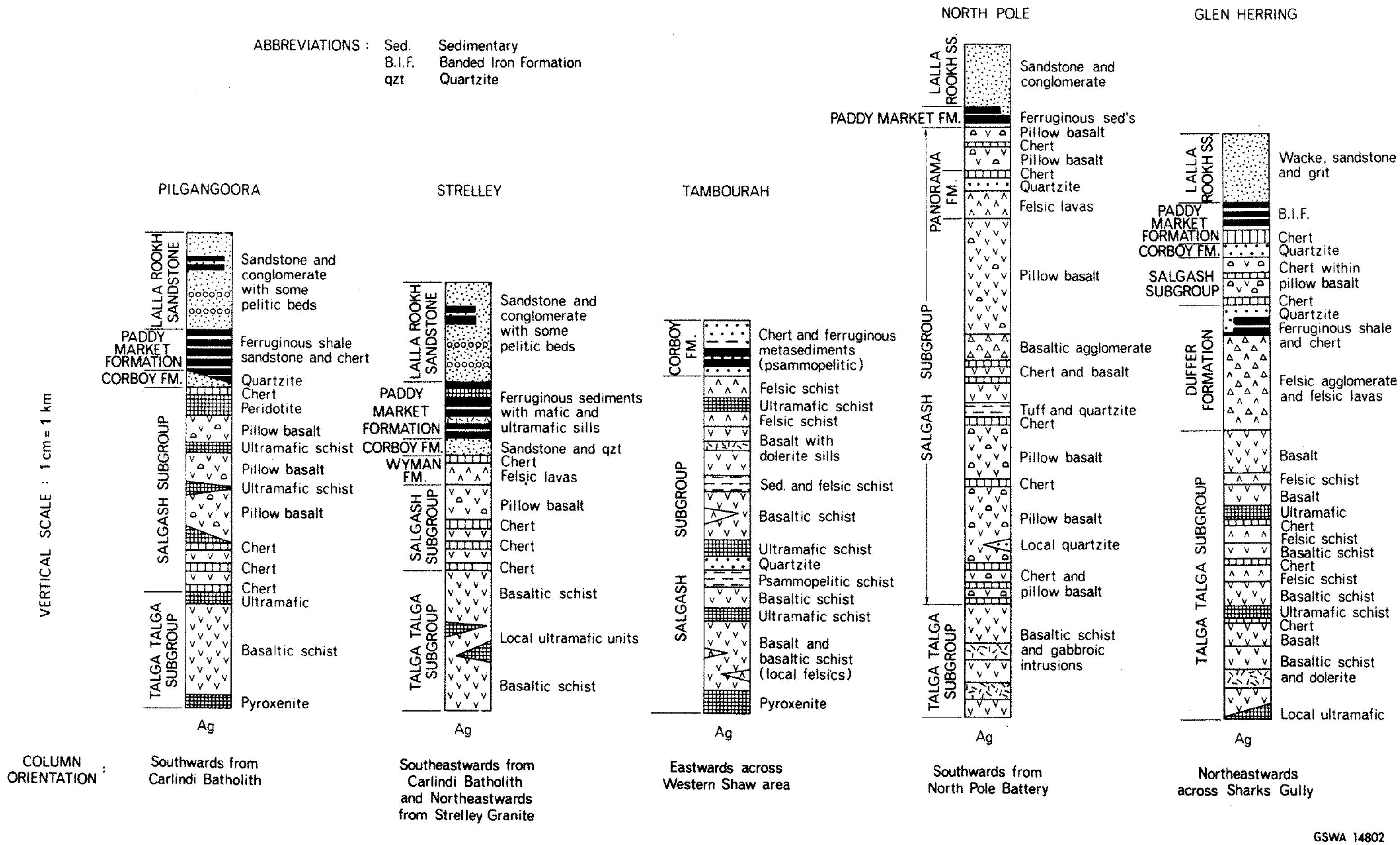
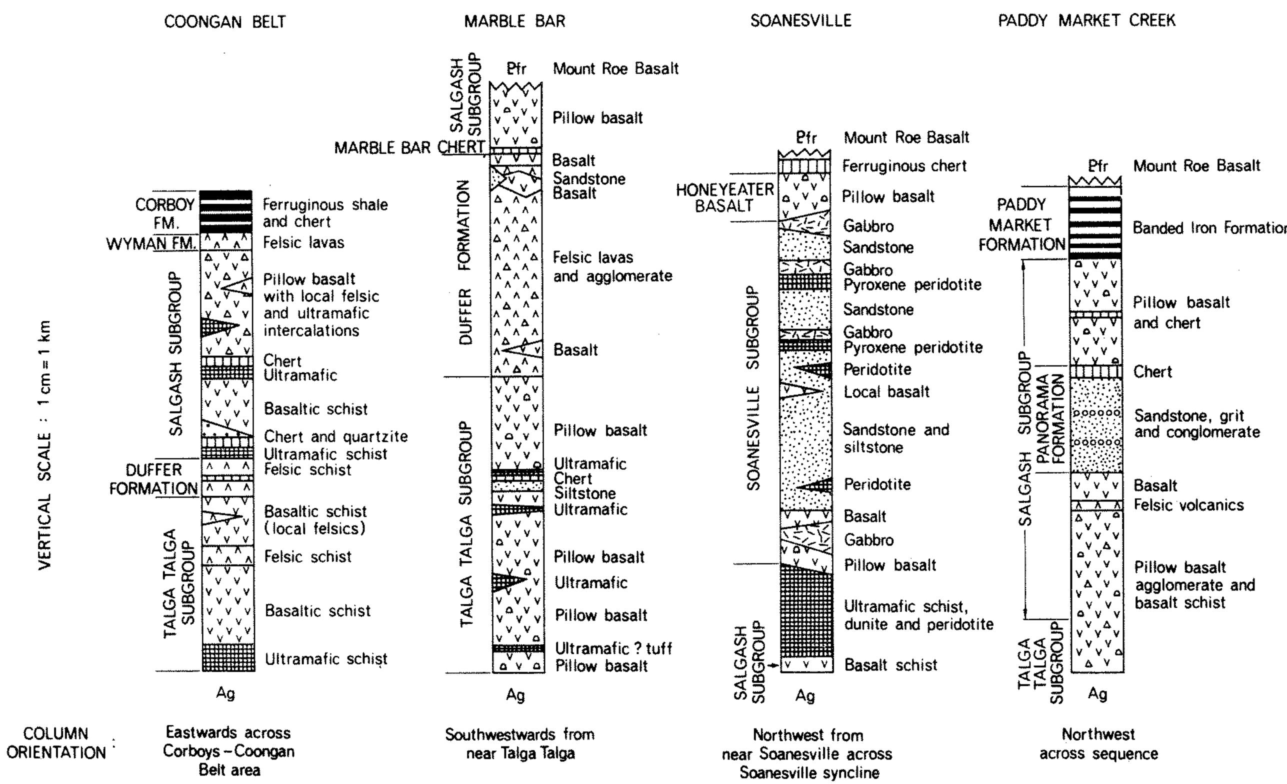


FIGURE 4b ARCHAEAN STRATIGRAPHIC COLUMNS



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through the Shaw Gorge, and at the base of the Budjan Creek Formation in the Kelly Belt. Both examples are basal conglomerates of local importance but it should be noted that most conglomerates are merely intercalations within sandstone units. All the conglomerates are lenticular and change thickness laterally.

Though vein quartz, quartzite and chert are by far the most common clast components, other lithologies such as basalt, dacite, and serpentinite are represented at some localities. The apparent absence of any granitic pebbles or boulders in all the rocks examined is notable and suggests appreciable weathering and corrosion prior to the deposition of the conglomerate.

Ast: Grit and sandstone with subordinate beds of conglomerate make up much of the Gorge Creek Group. The rock is generally well bedded at intervals of 10 to 30 cm and commonly contains cross-bedding. Ripple marks are less common.

Asl: Siltstone units sufficiently thick to be distinguished on the map occur in the Kelly Belt, near Calvert's White Quartz Hill (North Shaw Belt), in the Soanesville Syncline, near Marble Bar and at Talga Talga. They are found in both the Warrawoona Group and Gorge Creek Group. The rock is typically well laminated, sometimes tuffaceous and is often associated with thin chert, mudstone and shale units. Cross-bedding, graded bedding, ripple marks, scour marks and slump folds are locally displayed. Near Soanesville, dark-coloured siltstone with a high lithic content exhibits graded bedding, slumps and scours indicating that some beds were deposited as turbidites.

Asf: Ferruginous clastic sedimentary rocks associated with ferruginous chert and banded iron-formations crop out across large tracts of country in the Pilgangoora Syncline and the Soanesville and Kelly Belts. Ferruginous shale, chert, siltstone and sandstone form a lithogenetic association which seems to be confined to the lower part of the Gorge Creek Group. The rock types alternate rapidly and cyclic sedimentation is present in certain areas.

Chemical sedimentary rocks

Ac: Chert occurs at all but the highest levels of the layered succession. The general symbol *Ac* is used on the map where chert units have not been examined in the field or where a particular chert cannot be assigned to one of the subdivisions described below.

Acq: Sheared quartz-flags of uncertain origin in the Wodgina Belt and on the flanks of the Kangan Cyncline, are tentatively designated as a variety of chert. The rock resembles sheared quartzite at some localities but elsewhere is represented by chert. It is possible that both rock types are present, or, as Blockley (1970) concluded, that the "quartzite" is recrystallized chert. Microscopic examination has not resolved the problem.

Acw and Acj: Some of the most attractive rocks are the banded cherts. Black and white (*Acw*) and red and white (*Acj*) chert units, occurring generally at the top of mafic-felsic volcanic cycles, are common in the Warrawoona Group. Colour banding at intervals of 1 mm to 10 mm is displayed by both types and probably reflects regular periodic depositional changes. As the chert is cryptocrystalline, grain-size grading is not discernible, but colour grading in the rocks may prove to be a source of facing information. The Marble Bar Chert, from which the town of Marble Bar derives its name, is a strikingly beautiful red and white chert cropping out in the Coongan River at Marble Bar Pool, 3 km west of the town. Brecciation of the banded chert at this and other localities may have resulted from slumping. Angular blocks of banded chert are set in an amorphous dark grey chert matrix, presumably introduced by hydroplastic injection.

Acf and Aci: Ferruginous chert (*Acf*) is widespread throughout the area. Iron contents average 10 to 20 per cent, the iron occurring as oxides, generally in discrete bands about 10 mm thick. Where iron oxides compose over 50 per cent of the rock the chert is described as banded iron-formation (BIF) and the symbol *Aci* used. BIF is mostly dark grey or black, but some units are of the attractive red and black banded variety known as jaspilite. Jaspilite consists of red jasper and iron oxides in alternate bands 5 to 10 mm thick. Many of the BIF occurrences may be silicified cappings above shale.

Felsic volcanic rocks

Aa: Felsic volcanic rocks crop out in all greenstone areas except the Wodgina Belt and the Kangan Syncline. They are concentrated around volcanic centres in the Marble Bar, Kelly and Soanesville Belts.

Felsic schist is shown on the map by the symbol *Aa* and the schistosity pattern. Where *Aa* is not accompanied by this pattern the rocks are rhyolite or dacite. It should be noted that intensely deformed felsic rocks, now quartz-sericite schists, are difficult to identify further, either in hand specimen or under the microscope. It is thus probable that some units shown as felsic schists are sheared siliceous sediments.

Rhyolite and dacite lava flows locally constitute a major part of the volcanic pile forming the Warrawoona Group. In less deformed areas the lavas are massive, often porphyritic and locally vesicular, columnar jointed or pillowform.

Aat: Felsic tuff units large enough to be depicted on the map occur at Copper Hills, Kelly, Marble Bar and Soanesville. The Copper Hills occurrence was termed the Copper Hills Porphyry by Noldart and Wyatt (1962) and regarded as an intrusive rock. The unit is considerably weathered in outcrop but bedding can be observed in certain areas and agglomerate is locally present. Microscopic examination of the rock has revealed the presence of shards. Rock from Copper Hills was dated at 2 880 ± 66 m.y. by de Laeter and Trendall (1970).

Aav: Thick felsic agglomerate occurs at Marble Bar, Shark Gully, Kelly, Copper Hills (north) and Soanesville. The rock generally consists of angular to subrounded fragments, up to 10 cm in diameter, of felsic lava and locally basalt and chert. The groundmass is usually a rhyolitic or dacitic tuff but may vary to a more basaltic composition.

Mafic volcanic rocks

Ab: Mafic volcanic rocks crop out over about half the total area occupied by the layered succession. Basalt and andesite, in most areas massive, but commonly variolitic, pillowform and vesicular, form thick and regionally extensive units at many levels of the Warrawoona Group. In some localities the mafic lavas are strongly deformed into schistose mafic rocks (note schistosity pattern on the map) and in places all primary structures such as pillows have been considerably attenuated or destroyed. Increasing schistosity is generally accompanied by an increase in metamorphic grade. Most mafic xenoliths occurring with granitic batholiths have undergone amphibolite facies metamorphism and are largely composed of amphibole-plagioclase rocks. Carbonatization is a common feature of the mafic volcanic rocks and locally has been so intensive as to "bleach" the lavas giving them a felsic appearance. The problem of carbonatization is discussed by Hallberg (1974).

Abt: Basaltic tuff forms mappable units west of Marble Bar and near Shady Camp well and elsewhere forms parts of units shown as *Ab*. Plagioclase-amphibole schist (*Ab*) may include metamorphosed basaltic tuff but this is usually impossible to determine in the field.

Abv: Basaltic agglomerate is associated with basaltic tuff at Marble Bar and Shady Camp well. Near the Coongan River (Ref. 255356) the rock consists of large fragments of vesicular basalt set in a groundmass of similar composition.

Abm: Tremolite-chlorite rock probably representing high-magnesia basalt, occurs in the Warrawoona and Soanesville Synclines. The rock is medium-grey and contains crudely radial tremolite laths up to 1 cm long within a finely crystalline groundmass. Microscopic examination reveals tremolite pseudomorphs after pyroxene. Chlorite occurs in the interstitial areas, and as pseudomorphs after rare euhedral crystals which were possibly olivine; it also occurs in some pyroxene pseudomorphs where it is intervleaved with tremolite. In the Soanesville area, the rock is coarsely dendritic, and vesicular at the upper margins of flows.

Mafic sills

Ao: Gabbro sills intrude the layered succession south of Strelley Pool, and in the Soanesville Syncline gabbro occurs both as discrete sills and in composite intrusions also containing peridotite and pyroxenite.

Dolerite-gabbro sills 50 to 200 m thick occur in the layered succession surrounding the Strelley Granite, and as at Soanesville there is an association with ultramafic sills, peridotite and lherzolite being prominent.

Adi: Diorite sills intrude the layered succession 15 km northeast of Woodstock and the same distance east-northeast of Abydos. The sills occur as massive, well jointed lensoid bodies and may be genetically related to the gabbroic rocks of the Soanesville Syncline.

Ultramafic rocks

Au: Ultramafic rocks occur chiefly as concordant or sub-concordant bodies within the layered succession and also as dykes within the granitic batholiths. In many places extensive alteration or metamorphism of the ultramafic rocks makes determination of their primary composition and form difficult or even impossible. Units shown on the map as *Au* are composed of ultramafic rock not further categorized and include intrusive rock, lava, tuff and probably even sediment at a few localities.

Aua: Dark green amphibole and chlorite schist occurs as discrete stratigraphic units within basaltic sequences in the Coongan Syncline and the Western Shaw Belt. Unlike amphibolite representing metabasalt, plagioclase is inconspicuous in this rock. Its primary mineralogy is uncertain but it may have been rich in pyroxene.

Auc: Serpentinite bodies, identified in several areas, represent altered ultramafic intrusions. Serpentinization is widespread in ultramafic rocks but generally is not sufficiently intensive to obscure original composition.

Aup: Pale green, granular peridotite and dunite commonly occupy zones of major crustal fracturing. Chrysotile veining is fairly common, especially in the vicinity of later intrusions. The peridotite and dunite invariably crop out in valley floors and are usually much weathered. The primary minerals were olivine with lesser amounts of pyroxene.

Some peridotite and dunite units form parts of layered sills, and grade upwards into gabbroic types and even (as at Soanesville No. 2 Asbestos Mine) local anorthosite.

Aul: Pyroxene peridotite occurs as thick sills intruded into sedimentary rocks in the Soanesville Syncline and in the Strelley area. At Pilgangoora it is found in a mafic volcanic sequence. The rock is black and more resistant to weathering than the olivine-rich variety of peridotite. Phlogopite lherzolite with cumulate textures is included in the unit.

Aut: Talc schist generally occurs as thin but laterally persistent units adjacent to chert, and represents sheared ultramafic rock. Black talc-carbonate rocks south of Soanesville and 6 and 12 km west-southwest of Shaw Gorge, exhibit banding ,and problematical pillow structures.

Aux: Pyroxenite forms sills within the layered succession in several districts. Thin sections reveal extensive alteration.

GRANITIC ROCKS

Granitic rocks form batholiths containing several discrete intrusions ranging in composition from alkali-feldspar granite to diorite. The batholiths, particularly the Shaw and Yule Batholiths, are structural domes. Their tectonic history covers a prolonged period of plutonism commencing with the early formation of a migmatite suite and the subsequent emplacement of syntectonic plutons. This period culminated in the intrusion of post-tectonic masses, including "tin-bearing" adamellites.

Pre-and syntectonic granitic rocks

Agm and Agmx: Fine to coarse, equigranular biotite adamellite, biotite granodiorite and less commonly biotite tonalite form a migmatite complex. Representatives of several intrusive episodes distinguished by well foliated, nebulitic, stromatic, veined, banded or gneissic textures are present. Migmatite foliation is characterized by the orientation of feldspar, micas, hornblende and quartz. Banding is exhibited by wisps, schlieren and mafic and ultramafic paleosomes. Leucosomes of thin aplite and pegmatite intruded parallel to the foliation locally give the rock a pronounced striped appearance.

In root zones and along margins of greenstone belts, mixtures of country rock (generally, ultramafic and basaltic rock) and granitic rocks form a type of migmatite (*Agmx*) similar to that described by Mehnert (1968) as agmatite.

Agt: Fine to medium, even-grained leucogranodiorite intrudes greenstones northeast of Marble Bar. It has no associated pegmatites, is strongly foliated parallel to the foliation in the adjacent greenstone, and locally forms a quartz muscovite schist.

Also included in the unit is dark, fine- to medium-grained, well foliated biotite hornblende granodiorite occurring 28 km northeast of Marble Bar as large xenoliths within migmatite. Another occurrence comprises three small plutons of grey, fine-grained, well foliated biotite granodiorite intruded into greenstones about 5 to 12 km northeast of Abydos.

Agi: Medium-grained, cream-coloured, poorly foliated granodiorite cropping out over an area of about 110 km^2, northwest of Mount Gratwick, is termed the Mount Gratwick Granodiorite (Fig. 3). In outcrop the rock resembles anorthosite and contains coarse pegmatite veins. Although poorly foliated, the rock has some mafic schlieren and xenoliths. It consists mainly of calcic oligoclase (An_{25}) and minor quartz.

Agd: Equigranular, poorly foliated granitic rock forms intrusive bodies within areas of greenstones at North Shaw and northwest of Spear Hill. These have variable composition resulting from assimilation of greenstone material, and are notable for the preservation of their igneous textures. In the North Shaw area, the rock (designated the North Shaw Tonalite), includes fine-grained biotite tonalite. This is well exposed near the North Shaw well. Other varieties in the pluton are medium- to coarse-grained biotite granodiorite, and medium-grained hornblende biotite granodiorite with hornblende phenocrysts.

Northwest of Spear Hill xenoliths within the rock preserve a relict stratigraphy of the surrounding layered succession.

Agl: The Mulgandinnah Adamellite (Fig. 3), a fine-grained to medium-grained, well foliated biotite adamellite, is a typical example of remobilized migmatitic granitic rocks. The remobilized material occurs as small stocks having diffuse contacts with the enclosing migmatite. Some apophyses extend into the country rock along the foliation direction and generally the regional foliation persists within the stock as alignment of feldspar and micas.

Southeast of Hillside, medium-grained to coarse-grained poorly to well foliated biotite adamellite contains abundant schlieren and xenoliths of the older migmatite complex, and xenoliths of porphyritic biotite adamellite possibly derived from the Bamboo Springs Adamellite. The boundaries between the adamellite and the migmatite complex are transitional and the adamellite probably represents remobilization of the migmatite.

Agp: Porphyritic, medium- to coarse-grained, biotite adamellite and granodiorite are an important component of the granitic rocks. The rocks are generally well foliated although some portions are massive. Plutons of adamellite and granodiorite were probably successively emplaced between 3 100 and 2 700 m.y.

Aga: Medium-grained to coarse-grained alkali-feldspar granite forms a prominent belt of low hills east of Marble Bar. The granite has no clear foliation but contains some greenstone xenoliths; it is generally leucocratic and contains perthite, minor magnetite and biotite. The granite may represent the relict source of the Duffer Formation.

Agb: A massive to poorly foliated biotite adamellite located northwest of Abydos is the only representative of this unit. It is fine to medium-grained in the northern portion becoming medium-grained towards the south. The mass is strongly jointed and is particularly well exposed as low rocky ridges and large rounded tors. The pluton cuts the strong foliation of banded migmatite in the north and is intruded in the south by Numbana Granite which contains abundant xenoliths of the adamellite.

Ags: The outer zone of the granite south of Strelley Pool consists of grey, medium to coarse, even-grained massive to poorly foliated granophyre in the eastern portion, grading northwards into a medium-grained to coarse-grained, locally sheared, alkali-feldspar granite, and grading westwards into medium even-grained massive granite spotted with biotite and containing minor feldspar phenocrysts. The unit is cut by fine to medium equigranular granitic dykes with a lower biotite content than the host.

A distinctive white columnar-jointed. amygdaloidal rhyolite, rimming the eastern margin of the granophyre, may be genetically related to it.

Post-tectonic granitic rocks

Agc: Medium-grained to coarse-grained, poorly foliated biotite adamellite or biotite granite is represented by the Cooglegong, Spear Hill, Coondina, Mondana and Numbana plutons (Fig. 3). Cassiterite deposits have been found associated with all these intrusions except the Mondana Adamellite.

Although normally even-grained, the unit may be locally porphyritic. Typically the rock consists of quartz, perthitic microcline, oligoclase (or sodic andesine), and biotite, with variable amounts of muscovite. Fluorite is a common accessory, and in parts of the Cooglegong Adamellite, makes up 1 or 2 per cent of the rock.

Agy: Medium, equigranular, poorly foliated albite adamellite is restricted to the Moolyella Adamellite (Fig. 3), where it is associated with the largest tin field in the Pilbara Block. It forms a stock of irregular shape in which the grainsize increases from southwest to northeast. The distribution of pegmatitie and greisen associated with the stock, together with this grain-size variation suggests that the intrusion plunges southwesterly.

PROTEROZOIC LITHOLOGY

Lower Proterozoic rocks of the Fortescue Group crop out over approximately 15 per cent of the sheet area. The succession consists of flood basalts and andesites with thick intercalations of tuff, shale, sandstone, grit and conglomerate. In all areas it rests with strong angular unconformity on the Archaean rocks. Its maximum total thickness is 2 500 m, but the complete succession is not found in any single area.

Noldart and Wyatt (1962), referred to this sequence collectively as the "Nullagine Succession" but did not provide details of its stratigraphy.

SOUTHEAST AND SOUTHWEST AREAS

Mount Roe Basalt (Ꝑfr)

The Mount Roe Basalt (Kriewaldt, 1964) of the Roebourne and Pyramid sheets is also present in the southeastern part of the Marble Bar sheet area where it is the lowermost formation of the Fortescue Group. The unit is 50 m thick and consists of basaltic and andesitic amygdaloidal, vesicular and columnar lavas, beds of agglomerate and impersistent thin basal shales.

Hardey Sandstone (Ꝑfh)

In the southeastern part of the sheet area a thick sequence of sandstone, grit and conglomerate overlies the Mount Roe Basalt and laps over onto the Archaean basement. Subordinate to the coarse clastic sediments are beds of shale, mudstone and ooidal deposits. Towards the top of the succession, tuffaceous beds become increasingly prominent and a shaly tuff unit (*Ꝑfht*) occurs. Beds of conglomerate are locally developed at the top of the formation but these are of variable thickness and thin out along strike. An intercalation of massive columnar-jointed basalt, up to 30 m thick is present in the upper part of the sequence at Jim Well (Ref. 272263).

The total thickness of the formation varies up to 1 000 m, the unit tapering southwestwards due to an overlap in that direction. Between 10 and 15 km northeast from Jim Well a grey shale unit is developed at or near the base of the formation. This shale has been previously correlated with the Glen Herring Shale (Noldart and Wyatt, 1962) of the Glen Herring-Salgash-Warralong Creek area.

Kylena Basalt (Ꝑfk)

The Kylena Basalt consists of dark grey to grey-green, massive, amygdaloidal and vesicular basalt and andesite. Pillow structures are sometimes developed and many of the flows are columnar jointed. In the southeastern area the formation includes agglomerate (e.g. near Coolbanacoula Pool, Ref. 263255) and tuffs, and in its lower beds, lavas contain rare rhyolite fragments. Thin grit lenses are sometimes present near the base of the unit. Beds of shaly pisolitic tuff occur within the Kylena Basalt in the southwestern part of the sheet area. Here, the formation's thickness varies up to 300 m due to the uneveness of the unconformity (prevailing slight northerly dip) with the underlying Archaean granite. Its absence in the southwest, east of Beabea Creek and in the headwaters of the west Yule River reveals that the Kylena Basalt sequence of flows failed to completely engulf the granitic land surface in these areas. Elsewhere it seems certain that the formation originally covered most of the sheet area.

Tumbiana Formation (Ꝑftt, Ꝑftc)

The Tumbiana Formation is a distinctive unit recognized throughout the east Pilbara. As such it is considered to have status not as a member (MacLeod and de la Hunty, 1966) but as a formation, as originally defined (Noldart and Wyatt, 1962, p.66-67, 80; de la Hunty, 1964, 1965).

About 40 to 60 m thick, the formation contains two distinctive parts, a lower pisolitic tuff member (*Ɛftt*) and an upper carbonate member (*Ɛftc*). Names proposed for these new stratigraphic divisions are respectively, the Mingah Tuff Member and the Meentheena Carbonate Member (Lipple, 1975).

Nymerina Basalt (Pfn)

The Nymerina Basalt (MacLeod and de la Hunty, 1966) occurs only in the southwest. It consists of intercalations of dark grey-green vesicular and amygdaloidal lava within a thick succession of massive mottled basaltic flows. The mottled appearance of the rocks is produced by directionless interlocking feldspar laths within a finer basaltic groundmass. Amygdales and vugs of agate, chalcedony and quartz are common in the central and upper parts of the formation. Thin beds of tuff are developed in the lower part. The total thickness of the formation is about 50 m.

Kuruna Siltstone (Ɛfs)

Overlying the Nymerina Basalt is a 20 m thick succession of well bedded siltstone, pisolitic tuff and thin intercalations of banded carbonate. Outcrops of the formation are restricted to the southwest where they often form cappings on the surface of the dissected plateau.

Maddina Basalt (Ɛfm)

The Maddina Basalt (MacLeod and de la Hunty, 1966) overlies the Kuruna Siltstone in the extreme southwest and can be traced directly from the adjoining sheets of Pyramid and Roy Hill. Only the lower part of the unit is exposed in the sheet area. It is composed of monotonous dark grey-green vesicular and amygdaloidal basalt. Large vugs of well formed quartz crystals are common.

GLEN HERRING—SALGASH—WARRALONG CREEK AREA

To the west of Marble Bar, Proterozoic rocks are preserved within a broadly north-trending syncline. The succession rests with sharp angular unconformity on intenseley folded greenstones. Archaean rocks, in places, protrude as inliers through the Proterozoic cover.

NORTH SHAW—SOANESVILLE AREA

Several outliers of Proterozoic basalt and sedimentary rocks occur in the North Shaw-Soanesville area. These are correlated with the main sequences occurring in the southwest and southeast.

UNASSIGNED UNITS

Ɛb: Basalt is fine-grained, generally massive and vesicular but also pillowform.

Pbv: Basaltic agglomerate contains angular basalt fragments in a basaltic tuff groundmass.

Ɛt: This unit, consisting of tuff, tuffaceous shale, mudstone and siltstone, is lithologically similar to the tuff of the Hardey Sandstone.

Ɛg: Sandstone and grit deposits exhibit structures such as scours and cross bedding.

Ɛc: Conglomerate units are usually polymictic containing clasts of vein quartz, chert, Archaean and Proterozoic basalt (the former are more massive and metamorphosed, the latter are extremely vesicular and fresh), granite, quartzite, and rare ultramafic fragments. Well exposed examples are those forming a valley-fill structure next to the Comet mine and the conglomerates at the Just-in-Time mine. Both contain gold in the groundmass.

TABLE 2. FORTESCUE GROUP: CORRELATIONS WITH OTHER SHEET AREAS

Marble Bar sheet area			† *Roy Hill sheet area*	† *Pyramid sheet area*	† *Mount Bruce sheet area*
Southwest and Southeast areas	*Glen Herring-Salgash-Warralong Creek Area*	* *Nullagine succession (Noldart and Wyatt, 1962)*			
MADDINA BASALT	Present erosion surface	LITTLE DE GREY LAVA	Maddina Basalt Member	MADDINA BASALT	Bunjinah Pillow Lava Member
KURUNA SILTSTONE			Kuruna Siltstone Member	PILLINGINI TUFF / Basalt	Pyradie Pyroclastic Member
NYMERINA BASALT			Nymerina Basalt Member		
TUMBIANA FORMATION: Meentheena Carbonate Member		CARAWINE DOLOMITE (IN PART) AND TUMBIANA PISOLITE	Tumbiana Pisolite Member		
TUMBIANA FORMATION: Mingah Tuff Member					
KYLENA BASALT	Basaltic lava intercalated with sandstone, etc	LITTLE DE GREY LAVA (Early) / COONGAN VOLCANICS (Late)	Kylena Basalt Member	KYLENA BASALT	Boongal Pillow Lava Member
			Unconformity		
HARDEY SANDSTONE (some volcanic units) / Archaean rocks in Southwest	Conglomerate, sand-stone, tuff and shale	GREEN HOLE CONGLOMERATE GLEN HERRING SHALE	Archaean rocks	Lyre Creek Agglomerate Member CLIFF SPRINGS FORMATION	HARDEY SANDSTONE Medium-grained ophitic basalt
MOUNT ROE BASALT (Some grit lenses) / Archaean rocks in Southwest	Basaltic lava with minor sedimentary rocks	COONGAN VOLCANICS		MOUNT ROE BASALT	Unconformity
		BEATONS CREEK CONGLOMERATE		BASAL SANDSTONE	ARCHAEAN ROCKS
Unconformity	Unconformity	Unconformity		Unconformity	
ARCHAEAN ROCKS	ARCHAEAN ROCKS	ARCHAEAN ROCKS		ARCHAEAN ROCKS	

* Succession drawn up from statements made in text of Bull. 115, p.78-94.

† Correlations between Roy Hill, Pyramid and Mt. Bruce are as given by Kriewaldt and Ryan, 1967, Table 5.

CORRELATIONS AND STRATIGRAPHIC NOMENCLATURE

The stratigraphic nomenclature used by Noldart and Wyatt (1962) has been abandoned. Correlations with units of adjacent sheet areas are shown in Table 2, part of which follows Table 5 of Kriewaldt and Ryan (1967). Except for the simple division of the Tumbiana Formation into two members and the definition of the Spinaway Porphyry, no other stratigraphic names have been introduced. Members recognized by MacLeod and de la Hunty (1966) have been upgraded to formations on the grounds that each is a discrete mappable unit of predominantly one lithology.

MINOR INTRUSIVE ROCKS

Apf: A distinctive dacite porphyry with phenocrysts of plagioclase, quartz, biotite and locally hornblende, set in a dark grey-green, purple or black aphanitic groundmass occurs as two masses extending north and southwest of Copper Hills. It is referred to by Noldart and Wyatt (1962) as a "coarse-grained, feldspar porphyry . . . to fine-grained, black feldspar porphyry", and formally named the Boobina Porphyry by Lipple (1975). The porphyry intrudes felsic tuff of the Duffer Formation and is intruded by the Mondana Adamellite.

Apa: Numerous light coloured feldspar-quartz porphyries form shallow-level intrusions in the greenstone sequence, particularly in the Tambourah area. The rock is typically a fine-grained, foliated to schistose, porphyritic rhyodacite. Numerous fine-grained, white quartz-feldspar porphyries trending north-northwest, intrude the porphyry near Kelly.

p: Blockley (1970) distinguished three types of cassiterite-bearing pegmatites in the sheet area. Zoned, quartz-cored, albite pegmatites with minor microcline contain cassiterite, beryl, lepidolite, zinnwaldite, spodumene, tantalite and certain radioactive minerals. They often form large intrusions in the greenstone sequence. Swarms of pegmatites associated with the post-tectonic granitic bodies cut the banding of the migmatites and gneissic granitic rocks. In these, cassiterite, tantalite, monazite and gadolinite are present. Aplitic veins also cut the younger granitic rocks. Several generations of quartz-microcline pegmatites without accessory minerals of economic value intrude most of the older granitic rocks.

Af: Lenticular sills of cream to white felsite intruding greenstones have been described by Blockley (1971a, p.39) from Stannum and Wodgina.

c: The nature and origin of T-chert (tectonically-controlled chert) is discussed by Hickman (1973). This type of chert is prominent in the North Pole area, forming massive, discordant veins, probably derived by solution of sedimentary chert in areas of maximum strain and migration to regions of lower pressure.

q: Quartz veins are numerous, cutting both Archaean granite rocks and the greenstone sequence. The veins may be either massive or sheared, and locally form prominent ridges.

Ultramafic dykes (Aul, Aux, Ɇux)

Aul: A peridotite dyke, of similar composition to the ultramafic sills of the layered succession, crops out near Shilliman well on the Carlindi Batholith. It is a medium-grained, altered peridotite and is intruded by dolerite.

Aux: Pyroxenite dykes occur in the North Pole area, where they intrude both the North Pole Adamellite and the greenstone sequence.

Ɇux: An east-west trending pyroxenite dyke cuts dolerite dykes of the Black Range suite about 18 km southeast of Hillside.

Felsic dykes (Am, Ar, Ᵽp)

Am: Microgranite dykes cut by the Black Range dolerite occur 10 km south-southwest of Coondina where two dykes 10 to 15 m wide strike in a northerly direction. The dykes are pink, massive, granophyric, medium-grained leucocratic and porphyritic with rare phenocrysts of microcline. A similar dyke occurs north of Corunna Downs homestead.

Ar: Rhyolite dykes, cream or pale pink, consist of phenocrysts of quartz, microcline, plagioclase and biotite set in a groundmass of similar minerals.

Ᵽp: Dark feldspar porphyry dykes of dacitic composition intrude the Archaean volcanic and granitic rocks near Marble Bar township (Maintland, 1908, p.7, 19 and 205; Noldart and Wyatt, 1962, p.88-89).

Dolerite dykes (Ad, Ᵽd, d)

Ad: Within the greenstones, mafic sills and dykes, which are often schistose and metamorphosed, are probably genetically associated with the enclosing Archaean volcanic rocks.

Ᵽd: In the Yule Batholith, contaminated xenolithic dykes with an east-northeast trend (Mundine Well suite) are associated with a suite of west-northwest trending dolerite dykes (Round Hummock suite). East-trending dolerite dykes about 10 m wide crop out *en echelon* along a major fault zone in the Mondana area.

d: Extensive, thick, medium- to coarse-grained dolerite dykes trending in a north-northeast direction and forming prominent dark ridges, particularly on the Shaw and Corunna Downs Batholiths, are termed the Black Range Suite. The Black Range dolerite itself has a total length of over 100 km and is up to 150 m wide. The dolerite remelted the granitic country rock within 3 m of the contact and has a metamorphic aureole extending for about 70 m from the contact. Some west-northwest trending dykes are also of uncertain age.

Plagioclase quartz porphyry (Ᵽp)

A sill of coarse-grained dacite porphyry referred to as the Spinaway Porphyry (Lipple, 1975) intrudes the Hardey Sandstone in the southeast of the sheet area. Euhedral calcic oligoclase phenocrysts up to 10 x 20 mm in size make up about 30 per cent of the rock, and phenocrysts of quartz and pyroxene pseudomorphed by chlorite comprise a further 20 per cent. These are set in a dark blue-black siliceous groundmass. Light-coloured felsic porphyry and lava northeast of Marble Bar township are correlated with this porphyry.

CAINOZOIC ROCKS

The Cainozoic deposits of the Pilbara region are described by MacLeod (1966) and Kriewaldt and Ryan (1967).

TERTIARY

Td: Laterite is best developed over chert and BIF. The unit includes some consolidated breccia.

Tp: Pisolitic limonite and goethite is between 10 and 30 m thick; fossil wood is locally abundant. It is correlated with the Poondano Formation and the Robe Pisolite (de la Hunty, 1961, 1965; and MacLeod, 1966).

To: A small mesa at Cunmagunna Hill consists of 10 m of vuggy, white opaline silica with rude horizontal banding, overlying 25 to 30 m of gravel, ferruginous grit and clayey sandstone. The opaline silica has small angular relics of carbonate embayed by silica. A hill 5 km south of Pinga consists of 25 m of similar opaline silica. These rocks are correlated with the Oakover Formation (see Noldart and Wyatt, 1962, p.70; and MacLeod, 1966, p.61-62).

QUATERNARY

Qk: Small thin deposits of massive to cavernous white kankar (impure earthy limestone and magnesite) have formed by weathering of Archaean greenstones, particularly ultramafic and basaltic rocks. Kankar also overlies colluvium and gravel, and may cement and partially replace these deposits by deposition of lime and magnesia from ground and surface waters.

Qg: Flats of poorly consolidated gravel and boulder deposits up to 30 m thick, are commonly associated with the Yule Surface (Kriewaldt and Ryan, 1967). Some deposits such as those occurring south of Shaw Gorge are extensively carbonate-cemented. They are dissected by the present drainage system.

Qc: Colluvium of lithic sand, gravel and boulders forming outwash fans and scree is common in the rugged areas of Archaean greenstones (particularly along the margins of chert ridges) and Proterozoic basalt. In many places, colluvium merges downslope with the gravel deposits described above.

Qb: Heave soil or gilgai is well developed by weathering over basalt, especially the Maddina and Kylena Basalts. Heave soil is also developed over the poorly consolidated gravel and boulder deposits.

Qs: Transported quartz sand occurs in the western third of the sheet area, mainly, but not necessarily over granitic rocks. Some west-northwest-trending seif dunes have formed.

Qeg: Widespread but thin deposits of quartz, feldspar, and lithic sand overlying granitic rocks are present throughout the sheet area. The deposits are mostly eluvial in origin but some may have been transported.

Qa: Alluvial silt, sand, gravel and boulder deposits occupy modern drainage channels. These unconsolidated deposits are up to 20 m thick and some, principally those occurring in the Yule, Turner, Shaw and Coongan Rivers, are over 75 km long.

STRUCTURE

The sheet area embraces a large part of the Archaean structural unit termed the Pilbara Block (Ryan, 1964, p.76, Daniels and Horwitz, 1969). It is composed of granitic domes separated by broadly synclinal greenstone belts. Resting unconformably on the deeply eroded surface of this unit is a partial cover of gently folded Lower Proterozoic rocks.

The structural geology of the granite and greenstone areas is extremely complicated, both types of rock exhibiting evidence of several episodes of deformation. The Proterozoic rocks have undergone one period of deformation.

EARLY DEFORMATION D_1

All structures formed before the main episode of deformation are referred to as D_1 structures. They include early isoclinal folds of greenstones forming detached structures within the granites, gneissic banding, deformed pegmatite veins and, on a regional scale, all granitic plutons across which S_2 is superimposed.

Isolated megascopic masses of greenstone material are quite common in the area's granitic batholiths. Some probably represent detached isoclinal fold cores whereas others are stoped blocks or remnant roof pendants. Certain of these greenstone strips are visibly deformed by D_2 folds and crossed by S_2 (e.g. in the Garden Creek area). Their contained schistosity is likewise deformed and may be regarded as S_1.

That most D_1 structures are preserved within the area's gneissic granitic rocks could imply that these rocks are older than the main body of the layered succession and represent part of an early sialic basement. Alternatively, it could be argued that D_1 either produced no recognizable structures in the layered succession or formed structures that have since been obscured or destroyed by D_2.

MAIN DEFORMATION D_2

The dominant structural elements of the area, the granitic domes and greenstone synclinoria, were formed during the main episode of deformation. The domes are broad, steep-sided structures, generally round to ovoid (elongate north-south) in plan and measuring 30 to 100 km in diameter. Their margins usually contain strongly foliated, and in places schistose, granitic gneiss and migmatite attenuated and sheared during diapiric uplift. The central parts of the domes normally exhibit only a weak biotite foliation representing S_2, and a well preserved primary flow foliation is quite common. The structure of the domes at depth is uncertain but surface geology suggests that they probably merge to form a predominantly granitic basement (at least partly intrusive) generally underlying the greenstones.

Most of the greenstone belts are composed of upright tight to isoclinal non-cylindrical similar folds. Individual limbs of these folds are sometimes extremely attenuated and slides (sheared-out limbs) are common. The D_2 movements responsible for these structures have locally vertically stretched and flattened pillows, conglomerate pebbles and agglomerate clasts and have established well developed mineral lineations in some rocks.

Vertical shear, often parallel or sub-parallel to bedding, has produced a widespread steeply inclined schistosity (S_2) in the greenstones and marginal granitic rocks. This schistosity rims the domes and consequently has no preferred orientation on a regional scale.

LATE DEFORMATION D_3

In many areas D_2 structures are visibly deformed by folds, faults and cleavage belonging to a later episode of deformation. Structures of this type not deforming Proterozoic rocks are classed as D_3 structures and regarded as late Archaean in age.

D_3 folds are steeply plunging angular flexures, in places showing opposite senses of rotation and forming conjugate pairs. Their axial surfaces are sub-vertical, striking northeast and, less commonly northwest (conjugate folds) and their plunge is usually northerly (local variations result from interference with D_2 structures). Good examples of D_3 folding occur in the Pilgangoora Syncline where major D_2 fold axes are defelected several times over a distance of 30 km.

Northeast-striking crenulation cleavage (S_3) is widespread in schist and phyllite of the greenstone belts. It bears a broadly axial relationship to the northeast-trending D_3 folds, is steeply inclined, and often produces a steeply plunging microscopic crenulation of S_2.

Faults, commonly veined by quartz, are an extremely common D_3 structure, and fall into two sets, one striking northeast, the other northwest. Most of the faults are wrenches, movement generally implying a sub-horizontal north-south maximum compressive stress during fracturing; though the geometry of conjugate folding in the Pilgangoora Syncline suggests at least one period of east-west compression.

PROTEROZOIC DEFORMATION D_4

Open folding about north to northeast-trending axes deforms the Proterozoic rocks. As noted elsewhere in the Pilbara (Kriewaldt, 1964; Ryan, 1966) there is a marked tendency for Proterozoic synclines to be positioned over Archaean synclines. It appears that Archaean synclines were slightly tightened during D_4 with the result that the overlying Proterozoic rocks were harmonically folded on broadly Archaean trends. Gravitational down-warping in Lower Proterozoic rocks may have played a minor role in deformation.

A conjugate system of wrench faults is developed in the Proterozoic cover. East-northeasterly striking dextral wrenches and west-northwest sinistral wrenches testify to an east-west maximum compressive stress. Such a stress field is in accord with that indicated by the regional D_4 fold trend. Vertical Proterozoic movement is present along several major faults. Examples are the north-striking normal fault crossing the North Pole area, the easterly graben south of Panorama Ridge (North Shaw) and the set of northerly faults between Miralga Creek (North Pole) and Wyman Well.

METAMORPHISM

Metamorphism of the Archaean rocks was principally regional in character and associated chiefly with the main Archaean phase of deformation, D_2. Proterozoic rocks generally appear remarkably fresh in hand specimen and are virtually unaffected by metamorphism though non-metamorphic minor carbonatization is seen in thin sections of siltstone and volcanic rocks. Contact metamorphism is only locally important, for example the peripheral zones of the North Pole and Cooglegong Adamellites and next to large dolerite dykes and the Spinaway Porphyry.

The Archaean layered succession and granitic rocks were affected by pervasive greenschist facies metamorphism (as defined by Turner, 1968). At lower structural levels metamorphic grade within the layered succession has attained amphibolite facies (Turner, 1968). These higher grade rocks are exposed in the Western Shaw and North Shaw Belts and in the Warrawoona and Coongan Synclines. Some prehnite-pumpellyite-metagreywacke (Turner, 1968) facies metamorphism occurred on the southwestern flank of the North Pole Dome, in the Soanesville Syncline and locally in the Marble Bar Belt.

GEOLOGICAL HISTORY

The Archaean layered succession began to be deposited some time prior to 3 100 m.y. Within the gneissic granitic rocks, D_1 structures indicate that the main period of regional volcanism responsible for the greenstones was preceded by an early stage of granitic intrusion, mafic volcanism and crustal reworking. The crust was probably thinner and less rigid at this time than during the accumulation of the layered succession and consequently more susceptible to deformation from changes in heat flow and stress.

That, as yet, no stratigraphic unconformity has been recognized at the base of the layered succession is partly explained by extensive shearing at many granite-greenstone contacts. In certain areas marginal granitic rocks are clearly intrusive into the layered succession. However, granitic rocks earlier than D_2 do not all belong to a single episode of intrusion, and the intrusive bodies seen may belong to a relatively late, although still D_1, episode.

The present wide distribution of the layered succession and its fairly constant regional thickness (generally 5 to 15 km) indicate that prior to D_2 it covered most of the area, and was not confined to linear belts.

Felsic pyroclastic units are most thickly developed in three principal areas, reflecting a tendency towards localized accumulation around explosive centres. Widespread pillow lava and chert indicate that a large part of the Warrawoona Group was laid down subaqueously.

Following earth movements and local erosion of the layered succession grit was locally deposited disconformably or with shallow unconformity on the volcanics. Above these lowest beds ferruginous sediments forming much of the lower part of the Gorge Creek Group probably accumulated in a low-energy depositional environment. The upper clastic sequence of feldspathic grit, sandstone and conglomerate indicates active erosion of nearby granitic terrain and deposition from fast flowing currents.

The main episode of deformation, D_2, commenced during the later stages of deposition of the layered succession. Open folding, perhaps partly initiated by gravitational down-warping beneath the thickening supracrustal deposits, must have led to the exposure of granitic rocks. The precise age of D_2 has not yet been established. Clearly it preceded 2 600 m.y. (*Agy* and *Agc* are not deformed by D_2) and it post-dated 2 900 m.y. (Duffer Formation at Copper Hills).

A period of extensive erosion preceded the deposition of the volcanic and sedimentary rocks of the Fortescue Group. The present relief of the Archaean/Proterozoic unconformity of the base of the Proterozoic succession reveals that during this period of 200 to 300 m.y. at least 20 km of rock were eroded from certain areas. Late Archaean deformation, D_3, took place during this interval.

Following deformation of the Proterozoic rocks, erosion produced, by Tertiary times, a mature peneplain which gently slopes towards the present coast. The surface has been partially preserved by an armour of laterite developed during the Tertiary. Active rejuvenation with several periods of pediplanation and vigorous entrenchment by drainage has dissected and largely removed the peneplain. The present drainage system is actively eroding the landscape.

ECONOMIC GEOLOGY

The sheet area occupies parts of the Marbel Bar and Nullagine Districts of the Pilbara Goldfield. Early in the twentieth century the town of Marble Bar was a thriving gold mining community and mining centres were widespread across the area. Production has since greatly declined and almost all the mines are now abandoned. Of other economic minerals, only cassiterite is currently worked on a large scale. About half of Western Australia's past tin production has come from centres in the sheet area.

Gold

Gold production for the Marble Bar District to 31 December 1972, totalled 11 146 407.61 g from 357 394.53 t of ore, of which 625 560.02 g was alluvial and dollied.

Primary gold mineralization of economic importance is confined to the Warrawoona Group. Auriferous quartz veins occur in sheared mafic, ultramafic and sedimentary rocks, often adjacent to chert units. The primary gold deposits are thought to have originated from the greenstones during hydrothermal action and metasomatic replacement associated with regional deformation and intrusion of granitic magma at depth.

Erosion of the Archaean primary deposits during Proterozoic times has locally resulted in the formation of "deep leads" in Proterozoic conglomerate beds (e.g. at the Just-in-Time mine). Quaternary alluvial and eluvial deposits also contain gold in the vicinity of mineralized rock.

Silver

The Marble Bar District silver production to 31 December 1972 totalled 1 041 216.16 g, as a by-product of lead and gold mining.

Copper and cupreous ores

To 31 December 1972 copper production for the Pilbara Goldfield was 145.58 t of metal from 607.93 t of ore, and cupreous ore production had reached 17 285.02 t. Most of this production came from the Copper Hills mine. No production was recorded in 1972.

The sheet's larger copper deposits occur in felsic rocks of the Archean layered succession. At Copper Hills and Kelly, copper mineralization is present in west-northwest striking sub-vertical shears and faults through felsic tuff and agglomerate. These fractures, often veined by quartz, cut sharply across the strike of the volcanic rocks and extend into late Archaean granite (*Agc*) in the northwest. The age of the deposits is either late Archaean or Proterozoic.

Copper-zinc deposits in Archaean felsic volcanics (e.g. Big Stubby) are strata-bound, following chert units in many places. The Big Stubby prospect is described by Reynolds and others (1975) as containing minor copper.

Cassiterite

Production of cassiterite concentrate from the Marble Bar Mining District to the end of 1972 amounted to 14 950.66 t, of which all but about 300 t came from centres within the sheet area. Tin mining is currently in progress at Moolyella and Coondina, and tailings are being treated at Cooglegong.

The more important cassiterite deposits are related to the "younger granites" (Blockley, 1970). The only important production of primary tin ore came from the Wodgina centre where albite pegmatites and associated tourmaline lodes were mined in the early part of the century to produce about 380 t of concentrate.

Secondary concentrations of cassiterite are found in alluvium and eluvium close to the outcrops of cassiterite-bearing pegmatites. The most extensive production has come from deposits of buried alluvium (deep leads) mined at Moolyella, Cooglegong and Eley.

Older, possibly Tertiary, cassiterite deposits are mined from a dissected lime and clay-cemented gravel at Coondina. Similar deposits contain cassiterite near Cooglegong.

Tanto-columbite

To 31 December 1972 tanto-columbite production for the Marble Bar District exceeded 506.58 t of concentrate plus 1 669.44 Ta_2O_5 units from more than 393.20 t of lowgrade ore. Lode production from the Tantalite lode at Wodgina has amounted to 112.03 t. In recent years tanto-columbite has been obtained from alluvial tin workings at Moolyella, Cooglegong and Coondina.

Beryl

Production of beryl for the Marble Bar District to 31 December 1972 was 2 502.92 t of ore yielding 28 599.84 BeO units. The beryl has been mainly derived from shallow cuts in pegmatite bodies.

Gadolinite

In 1928, 1.02 t of gadolinite was mined approximately 6 km east of the Cooglegong tin workings, and the mineral has been reported from Wodgina (Simpson, 1928, p.225) and Pinga (Simpson, 1951, p.293).

Asbestos (Chrysotile)

Production of chrysotile for the Marble Bar sheet to 31 December 1972 was 283.25 t.

Chrysotile occurs in seams and fractures in altered ultramafic rocks and is especially associated with periodotite intruded by later dykes or sills.

Lead

A total of 2.03 t of lead ore (galena) was mined from North Pole and Woodstock. A promising volcanogenic prospect at "Big Stubby", 5 km south of Marble Bar contains about 5 per cent lead (Reynolds and others, 1975).

Tungsten

In 1952, 0.62 t of concentrated tungsten ore yielding 413.6 kg of WO_3, were mined 5 km southeast of Split Rock homestead, where wolfram occurs in jointed, coarse-grained granite, 9 m east of a prominent north-striking quartz vein.

Barite

Large barite deposits occur at several localities in the North Pole area (Hickman, 1973) and in 1970, 528 t were mined at a locality 3 km south of Miralga Crossing. Barite occurs as an abundant gangue to copper-zinc-lead sulphides at Big Stubby, near Marble Bar (Lipple, 1976).

Iron

Though no production of iron ore has been recorded, large deposits of low to medium grade are widespread. These comprise Archaean BIF (*Aci*), laterite over BIF (*Td*) and pisolitic limonite deposits (*Tp*). Assay results of four pisolite deposits sampled by de la Hunty (1961) ranged from 53.3 per cent to 57.0 per cent.

Road-building materials

Numerous small quarries and pits have been developed along the main roads and along the Mount Newman Railway. Principal road surfacing materials utilized have been eluvium and colluvium, and granitic rock has been quarried for rail ballast.

Water

Rivers and creeks flow intermittently during the wet season but for the remainder of the year are dry and contain only isolated pools and rock holes separated by long stretches of sand and shingle.

About 300 wells and bores have been sunk, partly to satisfy stock requirements but also to provide water for mining and domestic purposes.

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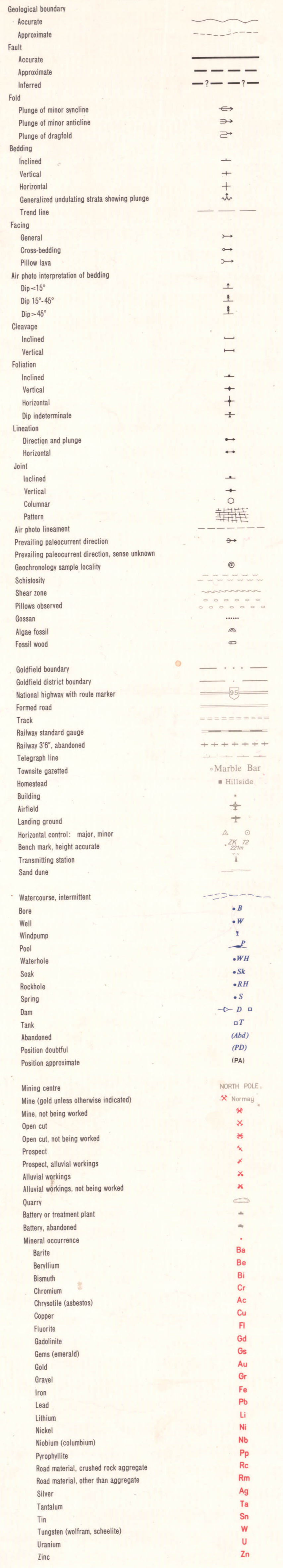
AUSTRALIA 1 : 250 000 GEOLOGICAL SERIES

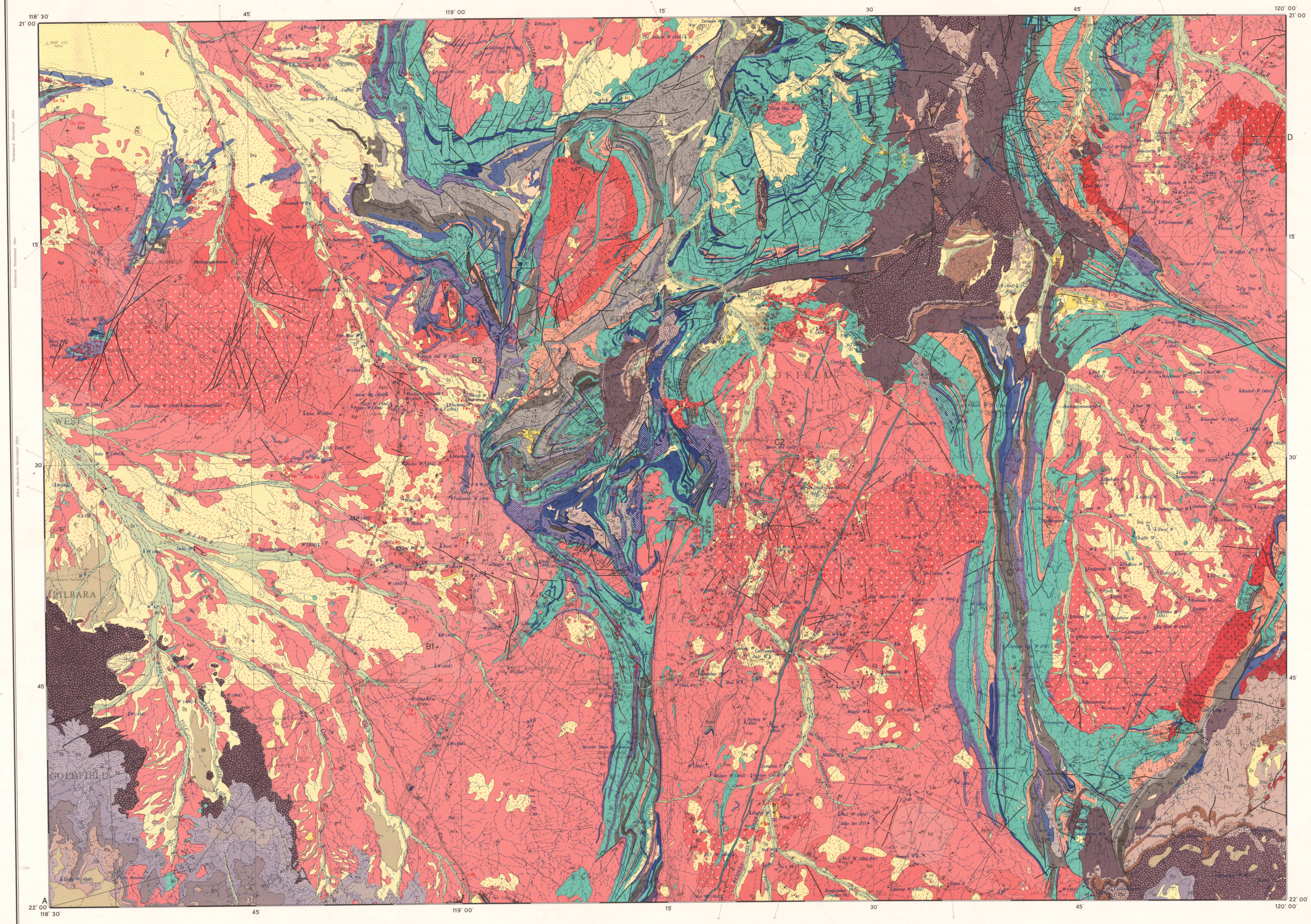
MARBLE BAR

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SHEET SF 50 - 8

SYMBOLS





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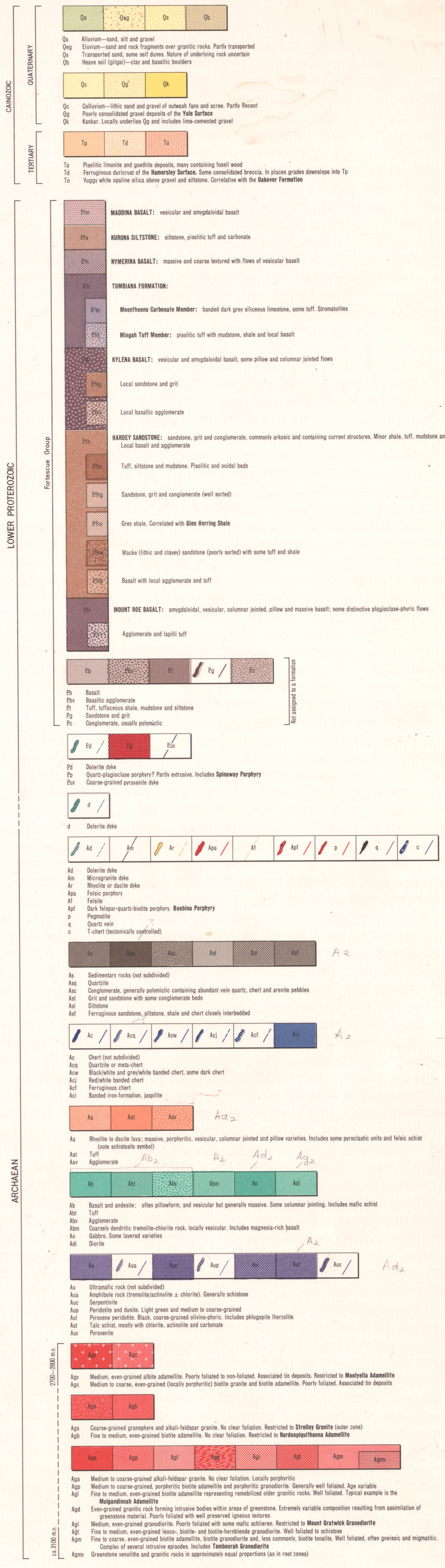
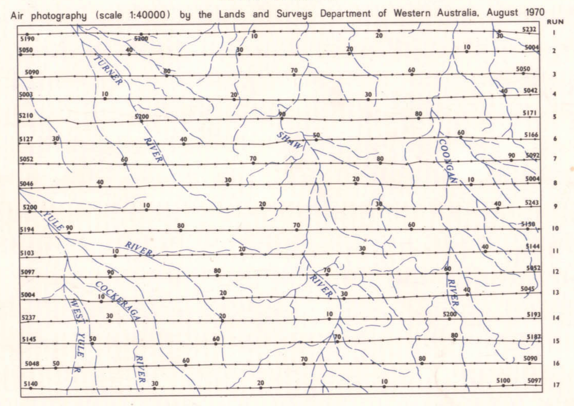


FLIGHT DIAGRAM

Air photography (scale 1:40000) by the Lands and Surveys Department of Western Australia, August 1970



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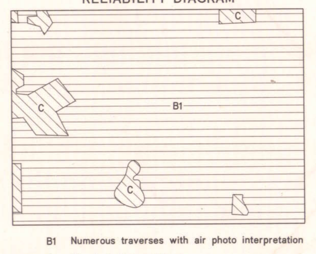
RELIABILITY DIAGRAM



B1 Numerous traverses with air photo interpretation

C Air photo interpretation

HON. A. MENSAROS, M.L.A.
MINISTER FOR MINES
J. H. LORD, DIRECTOR, GEOLOGICAL SURVEY

SCALE 1 : 250 000

5 0 5 10 15 20 25 30 Kilometres

TRANSVERSE MERCATOR PROJECTION
ZONE 2 AUSTRALIA SERIES

INDEX TO ADJOINING SHEETS

ROEBOURNE SF 50 - 3	PORT HEDLAND SF 50 - 4	YARRIE SF 51 - 1
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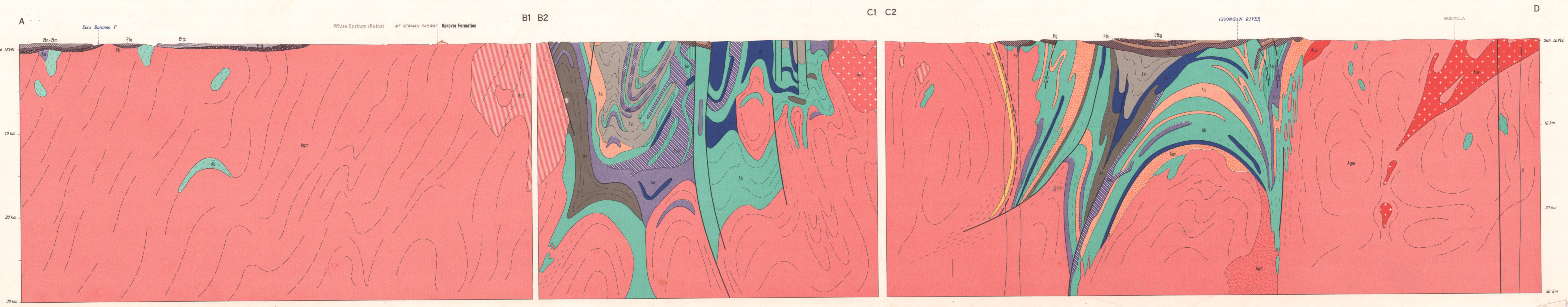
Geology by A. H. Hickman and S. L. Lipple, 1972

DECLINATION DIAGRAM

DIAGRAMMATIC SECTIONS

NATURAL SCALE

SECTION A-C1 · B1 B2 · C1 C2 · SECTION C2-D



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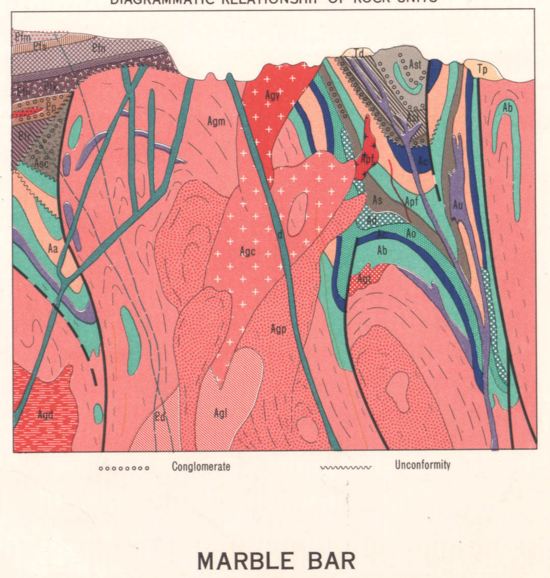

Conglomerate

Unconformity

MARBLE BAR

SHEET SF 50 - 8

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