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ADELAIDEAN AND EARLY CAMBRIAN STRATIGRAPHY OF THE SOUTHWESTERN GEORGINA BASIN: CORRELATION CHART AND EXPLANATORY NOTES

by

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ABSTRACT

A study has been made of the Adelaidean and Early Cambrian stratigraphy of the southwestern Georgina Basin, and the basic results are presented as lithologic and chronostratigraphic correlation charts and a palinspastic section. Within the Adelaide sequence four tectosomes are recognised; two of these are correlated with the two Adelaidean tillites of other Australian basins. Tectonic movements preceding the deposition of each tectosome have been recognised and named. The palinspastic section shows that Adelaidean deposition took place in fault-bounded troughs. An unconformity separating the Adelaidean and Early Cambrian sequences has been recognised.

The following stratigraphic units are defined or redefined: Black Stump Arkose, Donkey Creek beds, Elkera Formation, Elyuah Formation, Gnallan-a-gea Arkose, Grant Bluff Formation, Mount Baldwin Formation, Mount Cornish Formation, Oorabra Arkose, Wonnadinna Dolomite, Yackah beds, Yardida Tillite, Keepera Group and Mopunga Group. Trace fossils are reported from several Early Cambrian sandstones.

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Printed copies of the correlation chart (760 mm x 1020 mm) may be purchased from the Bureau of Mineral Resources, P.O. Box 378, Canberra City, ACT 2601.

INTRODUCTION

This project began as an attempt to correlate the Field River Beds (Smith, 1963) and the Mopunga Group (Smith, 1964) with the much better known Proterozoic sequence of the nearby Amadeus Basin. It was intended to try to use stromatolites to achieve the correlation - some work had already been done on the stromatolites of the Mopunga Group (Walter, 1972) - but it soon became clear that the stratigraphy of these rocks in the Georgina Basin was inadequately known, and the project expanded (under the auspices of the BMR's Georgina Basin Project) to include delineation of the Proterozoic stratigraphy of the south-western Georgina Basin. However, this proved infeasible without first mapping in detail the outcrop areas of the Field River Beds, which are very poorly exposed and structurally more complex than thought at first. As a result, large areas of the Mt Whelan, Hay River, and Tobermory 1:250 000 Sheet areas were mapped, mostly at 1:25 000 scale by a team comprising M.R. Walter, C.J. Simpson, P.J. Kennewell, R.G. Warren, J.H. Shergold, and others, using colour aerial photographs and detailed ground observations. Six stratigraphic holes were drilled, and new seismic information was obtained (Harrison & Schmidt, 1978; Harrison, 1979).

Data from stratigraphic drill hole, Geological Survey of Queensland Mt Whelan No. 1, drilled as part of the Georgina Basin Project, and gravity and magnetic models of the Georgina Basin (Tucker & others, 1979) were also used in the project, which for the sake of completeness and current international interest in the Proterozoic-Cambrian transition, was further expanded to include Early Cambrian rocks.

The results of the drilling are reported here and by Shergold & Walter (1979), and Walter & others (1979b). Stromatolite studies are reported by Walter & others (1979a). Adam Special and Toko 1:100 000 scale maps preliminary geological (parts of Hay River and Tobermory 1:250 000 Sheet areas) were released in 1979 and 1980, respectively. Further detailed mapping, particularly of the Jervois Range, is required in Huckitta 1:250 000 Sheet area. The interpretations presented here, where they are derived from the Jervois Range, are subject to some uncertainties.

The Georgina Basin as defined by Smith (1972) excluded rocks older than early Middle Cambrian in age. It has become apparent during the current work, and as a result of geophysical modelling (Tucker & others, 1979), that

the major sedimentary cycle which produced the rocks of the basin commenced in the Adelaidean. A period of crustal warping was followed by the formation of fault-bounded troughs and ridges. The troughs filled until, by the beginning of the time represented by the Mopunga Group, the area had a subdued relief. The topography was even more subdued and the sediments more widespread still by the Middle Cambrian. When the tectonic history of the region is viewed this way, it seems most reasonable to include the Adelaidean sediments in the basin. For that reason, the basin is here redefined to include the Adelaidean sensu stricto (based on correlation with the Adelaide Geosyncline sequence, not on a postulated older age limit for the Adelaidean; sediments of the South Nicholson Basin are not included in the Georgina Basin). Shergold & Druce (in press) have already used the term Georgina Basin in this extended sense.

METHODS

The correlations are based not only on the sections depicted on the chart, but also on a large number of observations in intervening areas. That is particularly so in the area mapped in detail on the Tobermory, Hay River and Mt Whelan 1:250 000 Sheet areas. Observations near Mt Barrington and Mt Winnecke on the Hay River Sheet area, and Limestone Creek on the Tobermory Sheet area were particularly important in tracing the Wonnadinna Dolomite and Gnallan-a-gea Arkose from their type areas.

Short sections were measured with a Jacob's staff with an attached clinometer. Long sections were measured from 1:25 000 or 1:80 000 scale aerial photographs, or from 1:100 000 scale maps, with appropriate corrections for topography. Hill relief was measured from aerial photographs by C.J. Simpson using a parallax bar. Sections measured by K.G. Smith and his colleagues were taped; where these data were used, the original field note books and aerial photographs were checked wherever possible. All sections were traversed on foot and all cores were logged personally. The following notes indicate the methods used for each section (the numbers refer to the sections on the lithologic correlation chart).

1 - Tape. Measured by A.J. Stewart and L.A. Offe. 2 - Photograph.
3 - Staff for upper 60 m, photograph for lower part. 4 - Photograph.
5 - Staff. 6 - Core. 7-9 - Photograph. 10 - Lower part after Section 63 of Smith (1964) and upper part after Section 64 of Smith, Vine &

Woolley (1960). Photograph for the remainder. 11 - Composite section. Upper parts taped, after section 200 (Smith, 1964) and Sections 59 and 60 (Smith, Vine, & Woolley, 1960). Photograph for the remainder. 12 - Photograph. 13 - After taped sections 3, 4 and 4a of Smith (1964). 14 - Staff. 15 - Taped section 10 of Smith (1964) supplemented by observations on a NW-SE section through Valley Bore. 16 - Staff for GE0712 and GE0713. Taped sections 15 and 15a from Smith (1964). 17 - Lower part from Smith (1964). Upper part from photographs. The precise location of Smith's section was determined from notebooks and original aerial photographs. 18 - Photograph. 19 - Staff. 20 - GE0705 - staff; GE0706 - photograph, and staff for the uppermost 60 m. Core where indicated. Photographs and Adam Special 1:100 000 map for the remainder. 21 - Tape for Section 3 from K.G. Smith's 1959 Hay River notebook. Core where indicated. Seismic data for approximately the lower 800 m. Remainder from photographs. The placing of BMR Hay River No. 5 and particularly of the seismic data on the section is imprecise because extremely poor outcrop makes it difficult to determine relative stratigraphic positions. 22 - Staff for two short segments up scarps. Remainder from photograph and Adam Special 1:100 000 map. 23 - Staff for GE0708, core where indicated. Remainder from photographs and Adam Special 1:100 000 map. 24 - Photograph. 25 - Core. Measured by P.M. Green and P.E. Balfe.

PALAEONTOLOGY

Trace fossils are very abundant, diverse, and frequently well preserved in the Donkey Creek beds, and in the Mt Baldwin Formation of the northeast Jervois Range. It is necessary to comment briefly on their identification and interpretation. Trace fossil nomenclature is in a rather confused state; as far as possible, I have followed the second edition of Part W of the Treatise of Invertebrate Paleontology, with little recourse to the original literature, other than that which deals with Australian Proterozoic and Cambrian fossils. As a consequence, and also because of poor preservation of some examples, many identifications are tentative. However, to draw attention to the diversity of forms present, I have considered it useful to identify the trace fossils as far as possible in the time available.

Daily's (1972, 1976) important work in attempting to use trace fossils for biostratigraphy in the Proterozoic-Cambrian transitional interval has been followed in making correlations between the Donkey Creek beds, Mt Baldwin Formation and Arumbera Sandstone.

The Grant Bluff Formation and, locally, the Elkera Formation contain abundant vertical tubular structures, many of which have funnel-shaped upper ends. Many of these could be identified as Laevicyclus Quenstedt, but they are here considered to be abiogenic fluid escape structures. In the Grant Bluff Formation they form part of a characteristic facies of thin-bedded well-sorted fine to medium-grained sandstone with abundant ripple marks and sinuous desiccation cracks, as well as the fluid escape tubes and funnels.

PALINSPASTIC SECTIONS

In the drawing of palinspastic sections the data were projected onto a straight line through the localities of stratigraphic sections 1 and 21. The datum chosen was the top of the Mopunga Group. As this was irregularly eroded before the Cambrian transgression, some irregularities were inevitably introduced into the section. Because of this, the apparent troughs and ridges in the Mt Skinner and Central Mount Stuart areas have not been named - they may be artifacts of the drawing method.

Several troughs appear to be asymmetrical, with only the northeastern margin clearly being fault bounded. In the Toko Trough this interpretation follows from the gravity and magnetic modelling (Tucker & others, 1979), and must be considered tentative. In the Adam Trough it results from the fact that section 20 is considered to be much thinner than section 21; it should be noted, however, that only the lower units are preserved in section 21, and that extensive faulting is known in the area of section 20 (Adam Special 1:100 000 Geological Sheet). In the Keepera Trough, it may result from the obliquity of the section line.

The best evidence for the shape of the troughs comes from the Mopunga Trough, where several sections of the margins appear to be preserved. Even there the structure is complex and the exposure far from perfect. So, while the presence of the named troughs and ridges is firmly established, details of their shapes as depicted on the palinspastic sections should not be accepted uncritically.

CHRONOSTRATIGRAPHIC CHART

The chronostratigraphic chart illustrates the five tectosomes recognised and the hiatuses separating them. The hiatuses and tectosomes have been numbered for convenience. There is little evidence at this stage for

hiatus 5, but it has been numbered to draw attention to its possible presence. Each hiatus and following tectosome have been ascribed to a tectonic event, which has been named, according to previous practice for central Australian basins. The name Areyonga Movement has been extended from the Amadeus Basin (Wells & others, 1970); the Rinkabeera Movement was recognised in the Ngalia Basin (Wells & Moss, in prep.) and this name is preferred to South Range Movement (Amadeus Basin) because of uncertainties about the correlation of the rock units associated with the South Range Movement. A thick wedge of arkose, the Gnallan-a-gea Arkose, and a local angular unconformity are products of the Toomba Movement. Hiatus 4 marks a period of local uplift and erosion followed by an extensive marine transgression. The angular unconformity between the Gnallan-a-gea Arkose and the Marqua Beds in the Toko 1:100 000 Sheet area may be related to the same event, the Huckitta Movement.

Tectosome 1

The correlatio of the Yackah beds with the Bitter Springs Formation and Heavitree Quartzite is based on superposition, lithological similarity, and the common occurrence of the stromatolite Acaciella australica Walter (Walter & others, 1979 a).

Tectosome 2

The assumption is made that, at least on the scale which applies here, the two late Proterozoic glaciations were each synchronous throughout the region. The correlation of the Yardida Tillite and the Mt Cornish Formation with the Areyonga Formation (lower tillite) of the Amadeus Basin was established by Preiss & others (1978), as part of the study reported here. The correlation of the tillite at the base of the Central Mount Stuart Formation is uncertain; Preiss & others (1978) noted its similarity to the older of the two Sturtian tillites of the Adelaide Geosyncline. From the preliminary palaeomagnetic data, it is indistinguishable from the Mt Cornish Formation (M. Idnurm, BMR pers. comm. 1979).

Tectosome 3

The correlation of the Keepera Group with the Olympic Formation (upper tillite) of the Amadeus Basin follows from the work reported here and from the magnetostratigraphic study reported by Burek & others (1979) - also an aspect of this program. The magnetostratigraphic results contradicted my earlier (unpublished) correlation of the Gnallan-a-gea Arkose with Arumbera Sandstone I, and the Wonnadinna Dolomite with the Julie Formation.

Tectosome 4

Shaw's & others' (1979) recognition of the Grant Bluff Formation at depth below the Central Mount Stuart Formation at Mt Skinner has now been confirmed. The upper Central Mount Stuart Formation is confidently correlated with Arumbera Sandstone I not only on lithological grounds, but also because of the common presence of the Mt Skinner fauna of medusoids and coelenterates. Confirmation of this correlation focused attention on the close similarity between the Mt Skinner sequence and the Adelaide sequence of the NE Amadeus Basin, and particularly on the clear correlation of the Grant Bluff Formation (sensu stricto) with the Cyclops Member of the Pertatataka Formation, and the calcareous part of the Elkera Formation with the Julie Formation.

These correlations and lithologic similarities indicate that the Mopunga Group is most reasonably correlated with the upper glacial sequence, the Olympic Formation and Pioneer Sandstone of the Amadeus Basin. This indicates that upper glacial diamictites are areally very restricted in central Australia, and the glaciation is represented mainly by arkose and sandstone units, which almost everywhere are dolomitic at the top.

The unconformable relationship of the Mopunga Group with the Keepera Group was not recognised in the field, and, consequently, has not been checked in the field. It was recognised first by photointerpretation of the contact between the Elyuah Formation and the Oorabra Arkose in the eastern Mopunga Range, where a clear, though slight, angular discordance was detected. The abrupt coarsening of siliciclastic facies at this level throughout the region studied, and the fact that the Mopunga Group is much more extensive and uniform than the underlying Keepera Group, lead to the interpretation that the unconformity is of regional extent. A similar facies change occurs at the same level in the Amadeus Basin, but no unconformity has yet been recognised there.

The stromatolites of the Elkera Formation are unique and thus do not contribute to the correlation with the Julie Formation; the correlation is based on superposition and lithology.

Tectosome 5

For our purposes here, the base of the Cambrian is taken as the base of the Tommotian Stage of the Siberian Platform, and the correlation by Daily (1972, 1976) of Arumbera Sandstone II with the early Tommotian rocks is accepted. The correlation of the upper Mount Baldwin Formation with Arumbera Sandstone III seems well established on the basis of superposition, lithology and trace fossil assemblage, but the recognition of a correlative of Arumbera Sandstone II in the basal Mt Baldwin Formation is, at this stage, speculative. It is based largely on the green and grey colour of the basal Mt Baldwin Formation, colours which are typical of the Adam Shale and parts of Arumbera Sandstone II.

The correlation of the Donkey Creek beds with Arumbera Sandstone III is based largely on the work of Daily (1974), although new data are presented here. Daily referred to the Donkey Creek beds as the Grant Bluff Formation near Mt Octy and on the Barrow Creek Sheet area.

The Adam Shale is correlated with Arumbera Sandstone II (and the Uratanna Formation of the Adelaide Geosyncline) on the basis of superposition and lithological similarity, supported by the occurrence of bioturbation (which is not reported from Precambrian sediments in Australia); see Walter & others (1979 b). An assemblage of acritarchs has been recovered from the upper Adam Shale; this assemblage is regarded as earliest Cambrian in age (Muir, in Walter & others, (1979 b).

The archaeocyathan dolomites (including the Red Heart Dolomite) all have a distinctive fauna in common with the Todd River Dolomite of the Amadeus Basin, with which they are correlated (Kruse & West, in press; Walter & others (1979 b).

STRATIGRAPHIC NOMENCLATURE

All bore cores referred to here are stored in the BMR Core & Cuttings Laboratory, Canberra.

BLACK STUMP ARKOSE (new name)

Proposer: M.R. Walter

Derivation of name: Black Stump Dam, Hay River 1:250 000 Geological Series Sheet.

Distribution: The formation is exposed on the Tobermory, Hay River and Mt Whelan 1:250 000 Sheet areas.

Type section: A composite section compiled from the observation of outcrops north of Hay River No. 7 (Adam Special 1:100 000 Geological Sheet).

Lithology: Medium red-brown to dark purple-brown micaceous, fine to very coarse-grained arkose, pebbly arkose, sandstone and laminated micaceous siltstone and shale.

Thickness: An estimated minimum of 700 m in the type area, and a minimum of 500 m on the southern limb of the Desert Syncline. Thicknesses are calculated from aerial photographs; in addition, use was made in calculating the thickness of the type section of a measured section in K.G. Smith's 1959 Hay River notebook. Thicknesses are unknown elsewhere.

Relationships and boundary criteria: The unit disconformably overlies the Yardida Tillite. On the southern limb of the Desert Syncline and at Boat Hill (Tobermory 1:250 000 Sheet area) it rests on the dolomitic shale at the top of the tillite. Elsewhere (e.g. Hay River No. 7 drill-hole) the dolomitic shale has been eroded off and the arkose overlies diamictite. The upper boundary is placed at the base of the first prominent dolomite bed of the Wonnadinna Dolomite 4.7 km NNE of Gnallan-a-gea Bore (Hay River 1:250 000 Geological Sheet; Adam

Special 1:100 000 Geological Sheet). The upper boundary is considered to be gradational as red-brown arkose and dolomitic arkose are components of the Wonnadinna Dolomite.

Age: Adelaidean. Stratigraphic position and regional correlations strongly suggest equivalence to the upper of the two major late Proterozoic tillites.

Synonomy: Part of the Field River Beds of Smith (1963) here superseded.

DONKEY CREEK BEDS* (new name)

Proposer: M.R. Walter.

Derivation of name: Donkey Creek, Barrow Creek 1:250 000 Sheet area.

Distribution: Barrow Creek and Alcoota 1:250 000 Sheet areas.

Type section: 25 km SE of Neutral Junction Homestead (Barrow Creek 1:250 000 Sheet area); section 3 on the accompanying chart.

Lithology: Brown and green-grey arkose, sandstone and siltstone with abundant trace fossils.

Thickness: In the type section only the upper 60 m has been measured accurately. The total thickness is estimated to be 180 m. Near Mt Octy 46 m of sequence is assigned to the Donkey Creek beds.

Relationships and boundary criteria: The upper boundary is unknown. In the type section the unit abuts sheared quartzite; the nature of this contact is unknown. Near Mt Octy the unit lies with structural conformity on the Central Mount Stuart Formation. Regional correlations indicate that this is a paraconformity.

* The term BEDS is used here informally and, in accordance with the International Stratigraphic Guide (Hedberg, 1976), should, in normal use, be spelt with a lower case 'b'.

Age: Following Daily (1972) the fossil assemblage is taken to indicate an Early Cambrian (Tommotian) age.

Synonomy: The Grant Bluff Formation and part of the Central Mount Stuart Beds of the Barrow Creek 1:250 000 Geological Series Sheet and of many subsequent authors.

ELKERA FORMATION (new name)

Proposer: M.R. Walter

Derivation of name: Elkera No. 1 Bore, Huckitta 1:250 000 Sheet area.

Distribution: Huckitta, Alcoota and possibly Mt Peake 1:250 000 Sheet areas.

Type section: Southwestern Jervois Range, the interval from 66 m - 284 m in section 15 of the accompanying chart. Thicknesses are derived from section 10 of Smith (1964), but the section through Valley Bore is regarded as the type (Huckitta 1:250 000 Sheet area).

Lithology: Interbedded siltstone, dolomite, sandstone and shale. The siltstone where fresh is green-grey, red-brown, and a very distinctive blue-grey to blue-green colour. The lower dolomites are medium to dark brown, yellow or grey, and frequently contain poorly preserved columnar branching stromatolites. The upper dolomite is yellow-brown to pink, laminated and oolitic, and contains the columnar stromatolite Georginia howchini Walter. The sandstone is light grey to red brown and locally is identical to that in the underlying Grant Bluff Formation. The section identified as Elkera Formation in drill hole DDC 1 near Mt Skinner contains anhydrite, dolomite nodules after anhydrite, and carbonate pseudomorphs after gypsum.

Thickness: 220 m in the type section, 70 m in the SE Elyuah Range, where the upper part of the formation has apparently been lost by erosion during the earliest Cambrian; 80-240 m elsewhere. Thickness variations seem mostly to be due to the level of sub-Cambrian erosion.

Relationships and boundary criteria: The lower boundary is placed at the top of the ridge-forming sandstones of the Grant Bluff Formation. This is considered to be conformable. The upper boundary in the Huckitta 1:250 000 Sheet area is placed at the base of green and grey siltstone and sandstone at the base of the Mt Baldwin Formation (as redefined here) or, in the Mopunga Range, at the base of the archaeocyathan-bearing carbonates. In DDC 1 from near Mt Skinner the top is placed at the top of the highest prominent carbonate bed. The upper boundary is a disconformity in the Huckitta Sheet area, but is conformable at Mt Skinner.

Age: Adelaidean. The unit correlates with the Julie Formation and the upper Pertatataka Formation of the Amadeus Basin.

Synonymy: The upper part of the Grant Bluff Formation of Smith (1964) and part of the Central Mount Stuart Beds as shown on the Alcoota 1:250 000 Geological Series Sheet. Separation of this unit allows more precise correlations to be made.

ELYUAH FORMATION (redefinition of unit)

Proposer: M.R. Walter

The Elyuah Formation of Smith (1964) is here redefined to exclude the Oorabra Arkose Member (see discussion of the Oorabra Arkose). The base of the redefined Elyuah Formation is taken at the base of a thin but persistent sandstone or pebbly arkose underlying the shale and siltstone of which the formation is mostly composed.

GNALLAN-A-GEA ARKOSE (new name)

Proposer: M.R. Walter

Derivation of Name: Gnallan-a-gea Bore, Hay River 1:250 000 Sheet area.

Distribution: Hay River and Tobermory 1:250 000 Sheet areas.

Type Section: GE0707, Field River Syncline, Adam Special 1:100 000 Geological Sheet area.

Lithology: Light brown to grey fine to very coarse grained pebbly arkose, sandstone, siltstone and shale. The arkose and sandstone is frequently cross-stratified.

Thickness: This ranges from at least 1450 m in the Bat Hills to 10 m in the Keepera Ridges, with at least 345 m in the type section.

Relationship and boundary criteria: The lower boundary is placed at the base of the lowest pebbly arkose or sandstone above the Wonnadinna Dolomite. This is inferred to be a disconformity (see discussion under Wonnadinna Dolomite). The upper boundary is rarely exposed, but at Mt Winnecke and Mt Barrington it appears to be gradational with the Grant Bluff Formation, and in the Keepera Ridges the Elyuah Formation conformably overlies the Gnallan-a-gea Arkose. The upper boundary is placed at the top of the uppermost pebbly arkose.

Age: Adelaidean. Correlated with the lower Pertatataka Formation of the Amadeus Basin.

Synonomy: "Quartz greywacke" of the Field River Beds of Smith (1963).

GRANT BLUFF FORMATION (redefinition of unit)

Proposer: M.R. Walter

The definition of the Grant Bluff Formation of Smith (1964) is here restricted to exclude the upper, recessively weathering sequence in the type section and elsewhere; i.e. to exclude the sequence (herein named the Elkera Formation) from the 168 m level up to the base of the Mt Baldwin Formation in section 13 of the accompanying chart. The Grant Bluff Formation as redefined consists largely of thin-bedded sandstone in the Alcoota and Huckitta 1:250 000 Sheet areas; in the northeastern Hay River Sheet area it is much thicker and includes thick interbeds of siltstone.

MOUNT BALDWIN FORMATION (redefinition of unit)

Proposer: M.R. Walter

The Mount Baldwin Formation of Smith (1964) is here redefined to exclude the archaeocyathan dolomite and overlying rocks in the type section and elsewhere. The top of the formation is placed at the base of the dolomite. It is also noted that the upper sandstone of the Mount Baldwin Formation as defined by Smith (1964) is a fault repetition of the Mount Baldwin Formation sensu stricto. In many parts of the Huckitta 1:250 000 Sheet area the Elkera Formation (former upper Grant Bluff Formation) has been mis-mapped as Mount Baldwin Formation.

MOUNT CORNISH FORMATION (redefinition of unit)

Proposer: M.R. Walter

The Mount Cornish Formation is here redefined to exclude the lower 26 m in the type section; i.e. to exclude the basal sandstone and dolomite, which are here assigned to the Yackah beds.

OORABRA ARKOSE (variation of name)

Proposer: M.R. Walter

The Oorabra Arkose as named by Joklik (1955) and formalised by Smith (1964) as a member of the Elyuah Formation is now considered to lie disconformably and locally with slight angular unconformity beneath the former upper member of the Elyuah Formation. The angular unconformity has been recognised by photointerpretation of the eastern Mopunga Range, in the newly named Mopunga Trough. The base of the redefined Elyuah Formation is marked by a sandstone and pebbly arkose.

The Oorabra Arkose is here raised to the status of a formation. It is discontinuous between depositional troughs, but for convenience the same name is applied in each trough in the Huckitta area. The name is not used for the arkose at Poomingie Waterhole on the Alcoota 1:250 000 Sheet area because of some uncertainty about the correlation of that unit.

WONNADINNA DOLOMITE (new name)

Proposer: M.R. Walter

Derivation of name: Wonnadinna Waterhole, Field River, Hay River 1:250 000 Sheet area.

Distribution: Hay River and Tobermory 1:250 000 Sheet areas.

Type Section: A composite section composed of measured section GEO708, BMR Hay River No. 8 drill hole, and outcrops N and NNE of Gnallan-a-gea Bore; the thickness of the lower part was measured from aerial photographs (all localities shown on the Adam Special 1:100 000 Geological Sheet).

Lithology: Purple-brown, red-brown and green-grey dolomite; sandy in some sections, and with abundant oncolites, and with structures resembling columnar branching stromatolites, but not clearly biogenic. Interbedded with rarely outcropping red-brown, purple and green-grey arkose, siltstone and shale, some of which is dolomitic. In the Keepera Ridges and at Limestone Creek boulders of granite occur in the dolomite.

Thickness: 460 m in the type section, about 450 m on the southern limb of the Desert Syncline (measured from aerial photographs) and a minimum of 380 m north of Boat Hill and in the Keepera Ridges (Tobermory 1:250 000 Sheet area).

Relationships and boundary criteria: The lower boundary is considered to be gradational with the Black Stump Arkose and is placed at the base of the first prominent dolomite bed, 4.7 km NNE of Gnallan-a-gea Bore. The upper boundary is placed at the base of the lowest pebbly arkose of the Gnallan-a-gea Arkose. Regional correlations suggest that the upper boundary is a disconformity, because a slight angular unconformity occurs at this position in the Mopunga Trough, and because of the abrupt change of lithology.

Age: Adelaidean. The unit is correlated with the cap dolomites above the upper of the two major late Proterozoic tillites.

Synonomy: The dolomite of the Field River Beds of Smith (1963).

YACKAH BEDS* (new name)

Proposer: M.R. Walter

Derivation of name: Yackah Waterhole, Field River, Hay River 1:250 000 Sheet area.

Distribution: The formation is exposed on the Hay River and Huckitta 1:250 000 Sheet areas.

Type section: Because of extremely poor outcrop, no type section has been nominated. The outcrops flanking the northern and eastern margins of the Mt Dobbie Granite (Adam Special 1:100 000 Geological Sheet) are considered to be typical.

Lithology: Interbedded fine to very coarse felspathic grey sandstone and laminated shale apparently overlain by medium grey siliceous dolomite with the columnar branching stromatolite Acaciella australica (Howchin) Walter.

Thickness: It is estimated that in the type area the siliciclastic unit is about 140 m thick and the dolomite unit is 100 m thick. A similar total thickness is interpreted at depth in seismic traverse 3 (Adam Special). Near Mt Cornish on the Huckitta Sheet the unit is 26 m thick.

Relationships and boundary criteria: Nonconformably overlies granite basement. Upper boundary not exposed on the Hay River Sheet area, but it is probably a disconformity with the Yardida Tillite. The upper boundary near Mt Cornish is formed by the base of the Mt Cornish Formation; the two units are structurally conformable, but on regional grounds the units are considered probably to be disconformable (an unconformity at this level is ubiquitous in the nearby Amadeus Basin).

* The term BEDS is used here informally and, in accordance with the International Stratigraphic Guide (Hedberg, 1976), should, in normal use, be spelt with a lower case 'b'.

Age: The stratigraphic position and presence of the stromatolite Acaciella australica indicate correlation with the Bitter Springs Formation and probably also the Heavitree Quartzite of the Amadeus Basin. These units are Adelaidean.

Synonomy: This is the lowermost unit of the Field River Beds of Smith (1963) and subsequent authors.

YARDIDA TILLITE (new name)

Proposer: M.R. Walter

Derivation of name: Yardida Bore, Hay River 1:250 000 Sheet area.

Distribution: The formation is exposed on the Hay River, Tobermory and Mt Whelan 1:250 000 Sheet areas.

Type section: A composite section comprising section GEO709, BMR Hay River Nos 5 & 6, the area 6 km SSE of Aroota Bore, and the section at depth at the end of seismic traverse 3 - all these are on the Field River Anticline, Adam Special 1:100 000 Geological Sheet.

Lithology: Light to dark green-grey diamictite and laminated siltstone with infrequent fine to very coarse grained brown to grey sandstone and arkose, rarely pebbly. Locally at the top there is at least 102 m of dark grey, laminated, dolomitic shale with, in its lower half, abundant lenses of dolomite (in BMR Hay River No. 10).

Thickness: 2900 m measured and estimated in the type section, apparently thinning to about 650 m in the Desert Syncline (where very poor outcrop and faulting preclude an accurate estimate).

Relationships and boundary criteria: The unit overlies the Yackah beds with inferred disconformity and is disconformably overlain by red arkose, siltstone and shale of the Black Stump Arkose. The top of the unit is taken at the base of the overlying red-brown sequence; this can be difficult to locate precisely, as in BMR Hay River No. 7. The lower boundary is not exposed; at the W end of seismic traverse 3 (Adam

Special 1:100 000 Geological Sheet) it is placed at a prominent reflector at a depth of about 1400 m.

Age: This is the lower of the two late Proterozoic tillites of central Australia (Preiss & others, 1978). It is Adelaidean.

Synonomy: This is the glacial unit of the Field River Beds of Smith (1963) and subsequent authors.

FIELD RIVER BEDS (superseding of name)

The name Field River Beds of Smith (1963) is here superseded by the following formations and groups: Yackah beds, Yardida Tillite; Black Stump Arkose and Wonnadinna Dolomite (Keepera Group); Gnallan-a-gea Arkose (Mopunga Group).

KEEPERA GROUP (new name)

Proposer: M.R. Walter

This new group is defined to include the Black Stump Arkose, Wonnadinna Dolomite and Oorabra Arkose of the Mt Whelan, Hay River, Tobermory, Huckitta and probably Alcoota 1:250 000 Sheet areas. The name is derived from the Keepera Ridges, Tobermory 1:250 000 Sheet area.

MOPUNGA GROUP (redefinition of unit)

Proposer: M.R. Walter

The Mopunga Group of Noakes (1957) as redefined by Smith (1964) is here redefined. In Smith's definition it comprised the Elyuah, Grant Bluff and Mt Baldwin Formations. Unconformities are now recognised between the Eluyah Formation sensu stricto and its former member, the Oorabra Arkose, and between the Elkera Formation (former upper Grant Bluff Formation) and the Mount Baldwin Formation.

The name Mopunga Group is here applied to the tectosome comprising the following formations: Gnallan-a-gea Arkose, Elyuah Formation, Grant Bluff Formation, Elkera Formation and Central Mount Stuart Formation (excluding the basal diamictite). This definition retains the name for the bulk of the units previously included, and extends its use laterally from the Huckitta Sheet onto the Tobermory, Hay River, Mt Whelan, Alcoota, Barrow Creek and Mt Peake 1:250 000 Sheet areas.

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References

BUREK, P.J., WALTER, M.R., & WELLS, A.T., 1979 - Magnetostratigraphic tests of lithostratigraphic correlations between latest Proterozoic sequences in the Ngalia, Georgina and Amadeus Basins. BMR Journal of Australian Geology & Geophysics 4, 47-55.

DAILY, B., 1972 - The base of the Cambrian and the first Cambrian faunas. University of Adelaide, Centre for Precambrian Research, Special Paper 1, 13-37.

DAILY, B., 1974 - The Precambrian-Cambrian boundary in Australia. Geological Society of Australia, Specialist Group in biostratigraphy & palaeontology, symposium "Precision in correlation", Programmes and abstracts, 4-8 (unpublished).

DAILY, B., 1976 - The base of the Cambrian in Australia. International Geological Congress, 25th, Abstracts vol. 3, 857.

HARRISON, P.L., 1979 - Recent seismic studies upgrade the petroleum potential of the Toko Syncline, Georgina Basin. APEA Journal, 19(1), 30-42.

HARRISON, P.L., & SCHMIDT, D.L., 1978 - Seismic and detailed gravity survey in the Toko Syncline, Georgina Basin, 1977 - Operational report. Bureau of Mineral Resources, Australia, Record 1978/34 (unpublished).

HEDBERG, H.D. (Editor), 1976 - International Stratigraphic Guide: a guide to stratigraphic classification, terminology, and procedure. Wiley, New York.

JOKLIK, G.F., 1955 - The geology and mica-fields of the Harts Range, central Australia. Bureau of Mineral Resources, Australia, Bulletin 26.

KRUSE, P.J., & WEST, P.W., in press - Early Cambrian Archaeocyatha of the Amadeus and Georgina Basins - an interbasin connection.

NOAKES, L.C., 1957 - Upper Proterozoic and sub-Cambrian rocks in Australia. Bureau of Mineral Resources, Australia, Bulletin 49, 213-238.

PREISS, W.V., WALTER, M.R., COATS, R.P., & WELLS, A.T., 1978 - Lithological correlations of Adelaidean glaciogenic rocks in parts of the Amadeus, Ngalia and Georgina Basins. BMR Journal of Australian Geology & Geophysics 3, 43-53.

SHAW, R.D., WARREN, R.G., SENIOR, B.R., & YEATES, A.N., 1979 - Geology of the Alcoota 1:250 000 Sheet area, N.T. Bureau of Mineral Resources, Australia, Record 1975/100; BMR Microform MF107 (unpublished).

SHERGOLD, J.H., & DRUCE, E.C., in press - Upper Proterozoic and lower Palaeozoic rocks, Georgina Basin. In HENDERSON, R.A., & STEPHENSON, P.J. (Editors) - GEOLOGY AND GEOPHYSICS OF NORTHEASTERN AUSTRALIA. Geological Society of Australia (Queensland Division), Brisbane.

SHERGOLD, J.H., & WALTER, M.R., 1979 - BMR stratigraphic drilling in the Georgina Basin, 1977 and 1978. Bureau of Mineral Resources, Australia, Record 1979/36 (unpublished).

SMITH, K.G., 1963 - Hay River, N.T. Bureau of Mineral Resources, Australia, Explanatory Notes SF/53-16.

SMITH, K.G., 1964 - Progress report on the geology of the Huckitta 1:250 000 Sheet, Northern Territory. Bureau of Mineral Resources, Australia, Report 67.

SMITH, K.G., 1972 - Stratigraphy of the Georgina Basin. Bureau of Mineral Resources, Australia, Bulletin 111.

SMITH, K.G., VINE, R.R., & WOOLEY, D.R.G., 1960 - Geology of the Huckitta area: second progress report. Bureau of Mineral Resources, Australia, Record 1960/66 (unpublished).

TUCKER, D.H., WYATT, B.W., DRUCE, E.C., MATHUR, S.P., & HARRISON, P.L., 1979 - The upper crustal geology of the Georgina Basin region. BMR Journal of Australian Geology & Geophysics, 4(3), 209-26.

WALTER, M.R., 1972 - Stromatolites and the biostratigraphy of the Australian Precambrian and Cambrian. Palaeontological Association, London, Special Papers in Palaeontology 11.

WALTER, M.R., KRYLOV, I.N., & PREISS, W.V., 1979 a - Stromatolites from Adelaidean (Late Proterozoic) sequences in central and South Australia. Alcheringa, 3(4), 287-305.

WALTER, M.R., SHERGOLD, J.H., MUIR, M.D., & KRUSE, P.D., 1979 b - Early Cambrian and latest Proterozoic stratigraphy, Desert Syncline, southern Georgina Basin. Journal of the Geological Society of Australia, 26(6), 305-312.

WELLS, A.T., & MOSS, F.J., in prep. - The Ngalia Basin, Northern Territory: stratigraphy and structure. Bureau of Mineral Resources, Australia, Bulletin.

WELLS, A.T., FORMAN, D.J., RANFORD, L.C., & COOK, P.J., 1970 - Geology of the Amadeus Basin, central Australia. Bureau of Mineral Resources, Australia, Bulletin 100.

ADELAIDEAN AND EARLY CAMBRIAN STRATIGRAPHY, SW GEORGINA BASIN

Bibliographic reference: Walter, M.R., 1980 – Adelaidean and Early Cambrian stratigraphy of the southwestern Georgina Basin: correlation chart and explanatory notes. Bureau of Mineral Resources, Australia, Report 214, BMR Microform MF92.

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1
CENTRAL MOUNT STUART
Sections S0-X and S-X,Mt Peake
1:250 000 Geological Series Sheet

6
MOUNT SKINNER
Bore hole localities on Alcoota
1:250 000 Geological Series Sheet

2
12 km S E of NEUTRAL JUNCTION HOMESTEAD

3
25 km S E of NEUTRAL JUNCTION HOMESTEAD

4
MOUNT TOPS

5
MT OCTY and ADNERA GAP
1.2 km S - 3.2 km SSW, & 3.9 km NE of Mt Octy

20
DESERT SYNCLINE
Section localities on Adam Special 1:100 000 Geological Sheet

25
G S Q MOUNT WHELAN No 1
16.5 km N of Mt Whelan.Modified after P.M. Green and P.E. Balfe

21
FIELD RIVER ANTICLINE
Section localities on Adam Special 1:100 000 Geological Sheet

7
4.5 km N by E of MT MICHAEL

8
MT MICHAEL

9
5.8 km W of NEW MACDONALD DOWNS

10
MOPUNGA RANGE
9.3 km SW of Old Huckitta Homestead

11
E MOPUNGA RANGE
12 km SSW and SW of Old Huckitta Homestead

12
MAPPATA WATERHOLES
10.5 km SSE of Old Huckitta Homestead

13
SE ELYUAH RANGE
Sections 3,4 & 4a of Smith (1964)

14
THRING CREEK
Section 17 of Smith (1964)

15
SW JERVOIS RANGE
Section 10 of Smith (1964) and observations on a section through Valley Bore

16
NE JERVOIS RANGE
Sections 15 & 15a of Smith (1964) and sections 10.6 & 15.8 km S by E of Lucy Creek Homestead

17
MT CORNISH
4 km WSW — 4.8 km SSW of Mt Cornish

18
KEEPERA RIDGES
9.5 km N by W of Junction Bore

19
NORTH OF BOAT HILL
7 km NW of Craigie Dam

22
BAT HILLS
Mt Knuckey

23
TYPE SECTION
WONNADINNA DOLOMITE
GEO 708, BMR HAY RIVER No 8
and outcrops N & NNE of Gnallan-a-gea Bore

24
TYPE SECTION
GNALLAN—A—GEA ARKOSE
GEO 707 - FIELD RIVER SYNCLINE

LOCATIONS OF SECTIONS 20-24 ARE INDICATED ON ADAM SPECIAL 1:100 000 GEOLOGICAL SHEET

PALINSPASTIC SECTIONS—EARLY CAMBRIAN TIME

V:H=1:1 4 5 6 7,8 9 10 11 12 13 15 16 17 18 20 21 25
V:H=1:50

DULCIE TROUGH · TARLTON RIDGE · ADAM TROUGH · TOKO TROUGH · BONYA RIDGE · TOOMBA RIDGE · WHELAN RIDGE · MOPUNGA TROUGH · KEEPERA TROUGH

TECTOSOMES (See Chronostratigraphic chart)
Early Cambrian
4 Mopunga Group
3 Keepera Group
2
1
Adelaidean

10km UPPER SECTION 100km · 1000m LOWER SECTION

No outcrop · Seismic and gravity data only

REFERENCE

Fault · Diamictite · Arkose · Sandstone · Siltstone · Shale · Dolomite · Limestone

Rare · Abundant · Bouldery · Pebbly · Dolomitic · Cherty · Oolite · Oncolite · Carbonate intraclast, claystone pebble · Stratiform stromatolite · Columnar stromatolite · Trace fossil · Desiccation crack · Fluid escape structure

Thickness Scale 100m

Bedding: Ripple marks · Convolute bedding · Current direction (N to the top) · Laminated · Cross-laminated · Cross-bedded · Thin 1-10 cm · Medium 10-30 cm · Thick 30-100 cm · Very thick >100cm

fe Ferruginous · fs Felspathic · mi Micaceous · py Pyritic

Palaeomagnetic samples (indicates sampled interval, not number of samples)

Grain size (Wentworth): vf Very fine · f Fine · m Medium · c Coarse · vc Very coarse

Colour (fresh surface): blk Black · bl Blue · brn Brown · gn Green · gy Grey · pk Pink · purp Purple · red Red · wh White · yel Yellow · lt Light · m Medium · dk Dark

CHRONOSTRATIGRAPHIC CHART

SECTIONS	1	2-5	6-9	10, 12	11	13-16	18-22	25	NE AMADEUS BASIN
EARLY CAMBRIAN		Donkey Creek Beds		archaeocyathan dolomite	archaeocyathan dolomite	archaeocyathan dolomite ?	Red Heart Dolomite	limestone arkose	Todd River Dolomite
						Mount Baldwin Formation	Adam Shale		Arumbera Sandstone III
		H I A T U S 5?							Arumbera Sandstone II
			H I A T U S 4 — H U C K I T T A M O V E M E N T						
	Central Mount Stuart Formation	Central Mount Stuart Formation	Central Mount Stuart Formation						Arumbera Sandstone I
TECTOSOMES 4			Elkera Formation	Elkera Formation	Elkera Formation	Elkera Formation	Grant Bluff Formation		Julie Formation
			Grant Bluff Formation	Grant Bluff Formation	Grant Bluff Formation	Grant Bluff Formation	Grant Bluff Formation		Pertatataka Formation
			Elyuah Formation	Elyuah Formation	Elyuah Formation	MOPUNGA GROUP	Elyuah Formation		Cyclops Member
						Elyuah Fm	Gnallan-a-gea Arkose		Waldo Pedlar Member
			H I A T U S 3 — T O O M B A M O V E M E N T						
3			arkose at Poomingie Waterhole		Oorabra Arkose	KEEPERA GROUP Oorabra Arkose	Wonnadinna Dolomite / Black Stump Arkose		Pioneer Sandstone / Olympic Formation
			H I A T U S 2 — R I N K A B E E N A M O V E M E N T						
2									Aralka Formation: Limbla Member, Ringwood Member
	Formation				Mt Cornish Fm		Yardida Tillite	tillite	Areyonga Formation
			H I A T U S 1 — A R E Y O N G A M O V E M E N T				Yackah Beds		Bitter Springs Formation / Heavitree Quartzite
1									

ADELAIDEAN

LOCALITY MAPS