Northern Territory Government

Geology and mineral resources of the Northern Territory

Ahmad M and Munson TJ (compilers)

Northern Territory Geological Survey
Special Publication 5

Chapter 27: Wolfe Basin

BIBLIOGRAPHIC REFERENCE: Dunster JN, 2013. Chapter 27: Wolfe Basin: in Ahmad M and Munson TJ (compilers). *'Geology and mineral resources of the Northern Territory'. Northern Territory Geological Survey, Special Publicatio*n 5.

Chapter 27: WOLFE BASIN

JN Dunster

INTRODUCTION

The Wolfe Basin records the deposition of several thousand metres of Neoproterozoic glacial and fluvio-glacial sediments. It has also been referred to as the Wolfe Creek Basin (Shaw *et al* 1994, Sheppard *et al* 1999 and Dunster *et al* 2000). The shorter form of the name follows Grey and Blake (1999) and Blake *et al* (2000). The basin spans the Western Australian–Northern Territory border and is more widely distributed in the former (**Figure 27.1**). In the NT, it is mostly confined to AUVERGNE[1], where it contains the Duerdin Group (**Figure 27.2**, **Table 27.1**). In the adjacent area of Western Australia, the Wolfe Basin contains the Ruby Plains, Duerdin and Albert Edward groups (Blake *et al* 2000).

The lithostratigraphic succession of the basin and regional correlations remain problematic, because of poor outcrop, lateral equivalence and/or the lenticular nature of some units and historically different mapping across the WA/NT border. The original depositional margins of the Wolfe Basin have been mostly eroded, but small isolated outcrops are commonly preserved in present gorges or creek channels and the full extent of preserved Wolfe Basin sedimentary rocks is almost certainly underestimated. In the Northern Territory, the Wolfe Basin unconformably overlies sedimentary rocks of the Victoria Basin and older rocks. It is overlain by basalts and sedimentary rocks of the Kalkarindji Province and by Cretaceous sedimentary rocks of the onshore Carpentaria Basin (formerly Dunmarra Basin).

NEOPROTEROZOIC

Duerdin Group

The Duerdin Group contains the Elatina (formerly Marinoan) glacial succession that is common to the Centralian A Superbasin and is part of Supersequence 3 of Walter *et al* (1995; see **Centralian Superbasin**). As originally defined by Dow and Gemuts (1969) and Sweet *et al* (1974a), the Duerdin Group comprised five formations; these are the Skinner Sandstone, Fargoo Tillite, Blackfellow Creek Sandstone, Moonlight Valley Tillite and Ranford Formation. Dunster *et al* (2000) also included the previously unassigned Bullo River Sandstone and Big Knob beds in the group, because they are believed to disconformably or unconformably overlie the Auvergne Group of the Victoria Basin and they have sedimentological affinities with the Duerdin Group. Other previously assigned units, including the Uniya Formation and undifferentiated diamictite in LIMBUNYA, are included herein; these greatly extend the preserved distribution of the Wolfe Basin in the Northern Territory (**Figure 27.2**). Sweet *et al* (1974a), Dundas *et al* (1987), Edgoose *et al* (1989) and Dunster *et al* (2000) are the definitive references for the Wolfe Basin in the Northern Territory and form the basis for the following discussion.

[1] Names of 1:250 000 and 1:100 000 mapsheets are shown in large and small capital letters respectively, eg AUVERGNE, DALY RIVER .

The *Bullo River Sandstone* occupies 620 km^2 of inaccessible country in central and southwestern AUVERGNE and is not known from outside this area. It is probably in excess of 300 m thick. The Bullo River Sandstone overlies the Shoal Reach Formation (Auvergne Group) with a disconformity or low-angle unconformity. However, one possible exception is an apparent transitional contact described by Sweet *et al* (1974a). Sweet (1977) interpreted these relationships as indicative of synsedimentary uplift in the southwest. The Bullo River Sandstone is typically cross-bedded and quartzic. It is poorly sorted with a red-

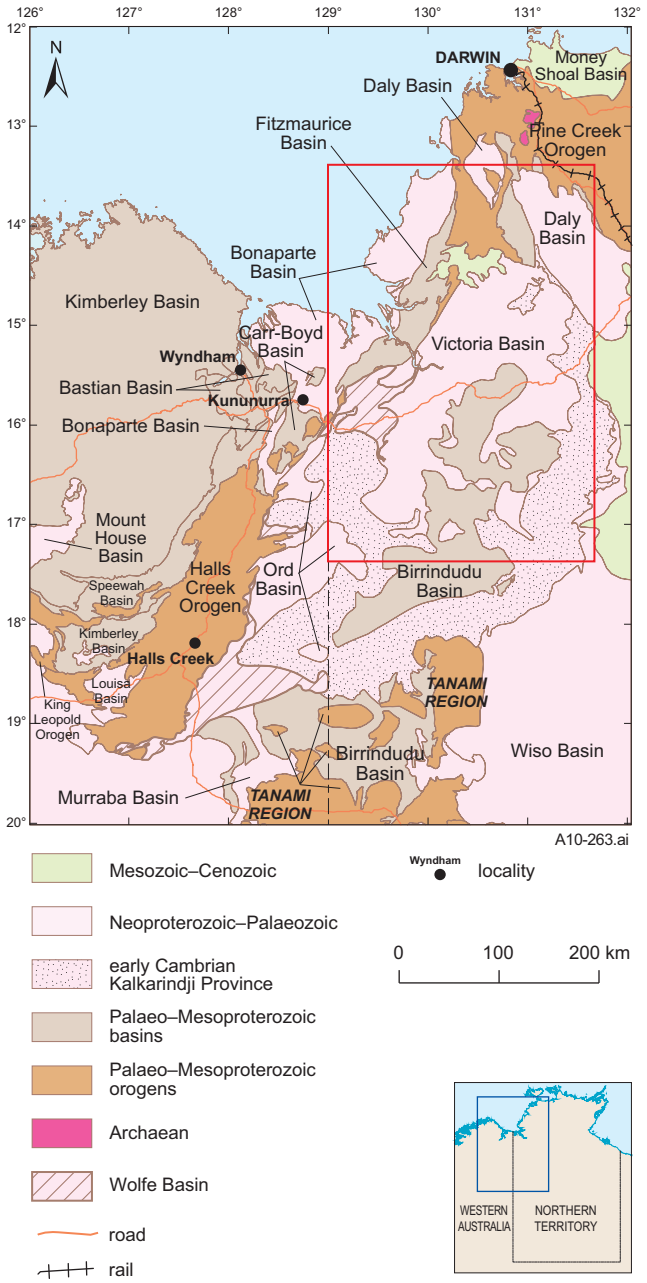

Figure 27.1. Regional geology of Wolfe Basin in NT and WA. NT geological regions from NTGS 1:2.5M geological regions GIS dataset. WA geological regions simplified and slightly modified from Tyler and Hocking (2001); some small outliers/inliers omitted. Extent of Kalkarindji Province in WA slightly modified from Glass and Phillips (2006). Red box shows location of **Figure 27.2**.

brown to maroon colour caused by disseminated haematite in the matrix/cement.

The *Black Point Sandstone Member* occurs at the base of the Bullo River Sandstone. It was differentiated from the rest of Bullo River Sandstone during mapping in the 1970s, because it has a distinct photo-pattern. It is also distinctively feldspathic, with up to 10% microcline and perthite, and tends to be less ferruginous than the remainder of the formation (Sweet *et al* 1974a). The member contains lenses of pebble conglomerate and rare cobbles, and ranges from 45 m to 70 m thick. The Bullo River Sandstone and Black Point Sandstone Member probably contain both marine and fluvial facies. Detrital zircons from the Black Point Sandstone Member indicate a maximum depositional age of 1018 ± 13 Ma (Carson 2010).

The *Skinner Sandstone* unconformably overlies several formations in the Auvergne Group, including the Angalarri Siltstone and Saddle Creek Formation near Skinner Point. It is exposed in three elongate northeast-trending ridges in AUVERGNE and is also exposed in cliff faces in WATERLOO. The Skinner Sandstone varies considerably in thickness, ranging up to 60 m in AUVERGNE and thinning to the southwest. It is absent at the southern end of Skinner Point, but is 100 m thick 7 km to the south in WATERLOO. A basal diamictite, consisting of polymictic boulders, cobbles and pebbles in green shale, is present in a number of outcrops. Above the diamictite, the bulk of the formation is a medium-grained cross-bedded dolomitic sandstone containing lenses of conglomerate. Sweet *et al* (1974a) reported palaeocurrent directions from the north and northeast. The northern ridge of the Skinner Sandstone and the mesas immediately northeast of Skinner Point are mostly of conglomerate and overlying pebbly quartz sandstone. Where the base is exposed, there is no diamictite and the lower units of the Skinner Sandstone lack discernible bedding (Sweet *et al* 1974a). The Skinner Sandstone was deposited on a land surface with a palaeo-topographic relief in excess of 120 m. Linearity of outcrop is evidence for fluvio-glacial deposition in glacially incised valleys (Pontifex and Sweet 1972, see **Figure 27.2**). These valleys parallel the direction of ice movement as determined for other tillites in the Duerdin Group, and palaeocurrents as determined from fluvial sandstones. The basal diamictite in the Skinner Sandstone may be a lateral equivalent to the Moonlight Valley or Fargoo Tillite.

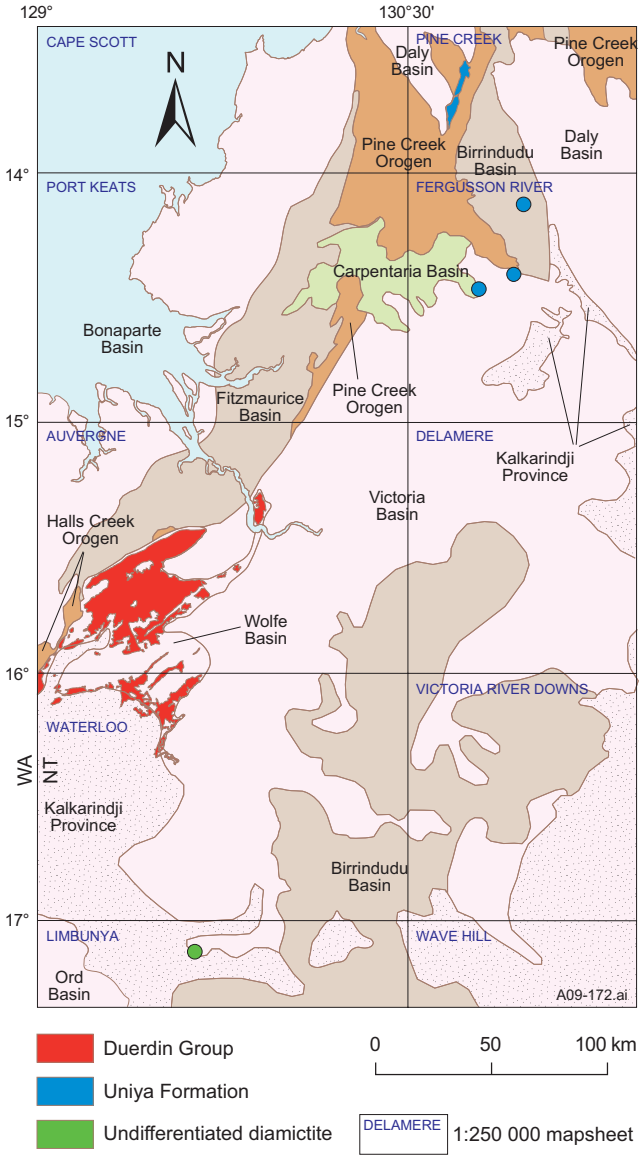

Figure 27.2. Outcrop distribution of Wolfe Basin in Northern Territory. Dots indicate locations of minor outcrops. Location shown in **Figure 27.1**. Note linearity of outcrop for parts of Duerdin Group, interpreted as evidence for fluvio-glacial deposition in glacially incised valleys. Derived from GA 1:1M geology and NTGS 1:2.5M geological regions GIS datasets; distribution of Uniya Formation in PINE CREEK after Ahmad *et al* (1993).

The *Fargoo Tillite* occurs extensively in Western Australia, where it is exposed on the eastern side of the Halls Creek Fault. In the Northern Territory, it is exposed in the Skinner Point mesa (**Figure 27.3**) and further exposures occur in southern AUVERGNE extending into northwestern WATERLOO. The tillite conformably overlies the Skinner Sandstone and may be in part laterally equivalent to it. It is over 100 m thick, and is characterised by a predominance of dolostone boulders, some of which are stromatolitic. Sweet (1977) noted that many of the boulders have a foetid odour when broken. The Fargoo Tillite is interpreted as a true glacial deposit, with only minor reworking by meltwater (Sweet *et al* 1974a).

The *Blackfellow Creek Sandstone* is exposed in the Skinner Point mesa, where Sweet *et al* (1974a) measured a minimum thickness of 32 m and recognised a low-angle unconformity on the underlying Fargoo Tillite. The Blackfellow Creek Sandstone also directly overlies the Skinner Sandstone where the Fargoo Tillite is absent. The Blackfellow Creek Sandstone is massive to thinly bedded, medium grained and quartzic, and contains abundant sole-marks and ripples. It is interpreted as a fluvial unit derived from glacial debris. The stratigraphic affinity, if any, with possible correlative sandstones in Western Australia is unknown.

The *Moonlight Valley Tillite* is poorly exposed in the Northern Territory but can be recognised by the presence of abundant erratics scattered on the residual weathering surface. It is difficult to measure thickness, but it is estimated at about 280 m in LISSADELL in Western Australia. Erratics consist of flattened, subrounded, striated, gouged and chatter-marked cobbles and boulders. The most common dropstones are orthoquartzite, sandstone, meta-siltstone, schist (Halls Creek Group), volcanic rocks, granite and dolostone. Clast counts have been reported by Sweet (1977). The Moonlight Valley Tillite unconformably overlies the Auvergne Group

Unit, thickness	Lithology	Depositional environment	Stratigraphic relations
Big Knob beds >20 m	Quartzic and lithic sandstone, polyrnictic conglomerate	Possibly kames and eskers	Probably unconformable on Shoal Reach Formation and Spencer Sandstone (Auvergne Group)
Ranford Formation			
Ernie Lagoon Member <10 m	Medium-grained sandstone, conglomerate	Fluvio-glacial	Conformable on Beasly Knob Member
Beasly Knob Member >130 m	Medium-grained sandstone, conglomerate	Fluvio-glacial	Conformable on and gradational to Bucket Spring Member; conformably overlies Moonlight Valley Tillite; unconformably onlaps Saddle Creek Formation
Bucket Spring Member <55 m	Siltstone, fine-grained sandstone	Fluvial or marine glacial	Presumed to be conformable on Bullo River Sandstone; partial lateral equivalent of Moonlight Valley Tillite
Jarrad Sandstone Member >50 m	Ferruginous sandstone	Possibly fluvio-glacial	Presumed to be conformable on Moonlight Valley Tillite
Moonlight Valley Tillite >280 m in LISSADELL (WA)	Diamictite, dolostone	Glacial	Unconformably overlies Auvergne Group and older rocks
Uniya Formation Typically 60–80 m, 137 m in drillhole NTGS 83/1 (WINGATE MOUNTAINS)	Polymictic conglomerate or diamictite, subordinate interbedded sandstone, varved carbonate/ siltstone	Glacial and fluvio-glacial, glaciolacustrine	Unconformably overlies Soldiers Creek Granite, Stray Creek Sandstone, Hinde Dolostone, Saddle Creek Formation and Angalarri Siltstone; overlain by the Antrim Plateau Volcanics and Cretaceous sedimentary rocks
Blackfellow Creek Sandstone >30 m	Medium-grained sandstone	Fluvial, sourced from glacial sediments	Low-angle unconformity on Fargoo Tillite
Fargoo Tillite >100 m	Diamictite	Glacial	Conformable on Skinner Sandstone
Skinner Sandstone Highly variable thickness, 0–60 m in AUVERGNE, thicker in palaeo-valleys elsewhere	Basal diamictite, dolomitic sandstone, conglomerate	Glacial at base, upper fluvio-glacial	Unconformable on Auvergne Group
Bullo River Sandstone >320 m	Quartz sandstone, conglomerate	Not determined, possibly fluvial	Mostly dis/unconformable on Shoal Reach Formation (Auvergne Group), gradational at one location
Black Point Sandstone Member 45–70 m	Feldspathic and quartz sandstone, minor conglomerate	Not determined, possibly fluvial	1018 ± 13 Ma maximum deposition age (Carson 2010)

Table 27.1. Lithostratigraphic succession of the Wolfe Basin.

and other older rocks and it may be a partial lateral equivalent of the Bucket Spring Member of the Ranford Formation (Sweet *et al* 1974a). A striated glacial pavement of sandstone in the Saddle Creek Formation, 16 km north of Beasly Knob, has striations trending 200º (Sweet *et al* 1974a). These striations are attributed to grounded ice that also deposited the Moonlight Valley Tillite, but it is not possible to determine if the direction of ice movement was southwest or northeast. The former is consistent with directions measured elsewhere by Corkerson (2008). At least 130 m of tillite is preserved as a palaeo-valley infill near the southern end of the Spencer Range Fault, but this is almost certainly a minimum. The tillite is regarded as representing a true continental ice sheet deposit. Sweet (1977) reported a distinctive laminated dolostone capping to this unit in WATERLOO. Such dolostone was also mapped in AUVERGNE, in close proximity to glacial striae. This thin (20 cm), pink dolostone with 1–6 mm laminae is characteristic of "carbonate caps" that have been observed overlying Neoproterozoic glacial successions

Figure 27.3. Fargoo Tillite at base of cliff face on east slope of Mount Skinner (AUVERGNE, PINKERTON, precise location unknown).

worldwide (Knoll *et al* 1996). In a study of similar tillites in the Kimberley area to the west, Grey and Corkeron (1998) correlated the Fargoo and Moonlight Valley tillites with the Olympic and Elatina formations from the Amadeus Basin and Adelaide Fold Belt, respectively, suggesting an age of 635 Ma or younger for the Moonlight Valley Tillite, depending on the age of the Elatina glaciation (see **Centralian Superbasin**).

The *Ranford Formation* is widespread in Western Australia, where it ranges up to 600 m thick. It is more restricted and thinner in the Northern Territory, where it contains four members: the Jarrad Sandstone Member, Bucket Spring Member, Beasly Knob Member and Ernie Lagoon Member.

The *Jarrad Sandstone Member* occurs at the junction of AUVERGNE and WATERLOO and extends across the West Australian border. The sandstone is in excess of 50 m thick in the Northern Territory, but exceeds 100 m in Western Australia where it contains a basal cobble conglomerate. Some of the cobbles of this conglomerate have glacial striations and chatter marks. Outcrop is highly ferruginous in the Northern Territory, but is more dolomitic in Western Australia. Palaeocurrents were from a generally northerly quadrant. The Jarrad Sandstone Member may be a delta fan (Plumb 1993) and was probably deposited contemporaneously with other members of the Ranford Formation.

The 55 m thick *Bucket Spring Member* overlies the Bullo River Sandstone with presumed conformity and may be a partial lateral equivalent of the Moonlight Valley Tillite. The Bucket Spring Member comprises interbedded siltstone and fine-grained micaceous sandstone. Various ripple forms (**Figure 27.4**) are abundant at the top.

The *Beasly Knob Member* conformably overlies the Moonlight Valley Tillite and unconformably onlaps the Saddle Creek Formation. Dunster *et al* (2000) showed that it is conformable on, and gradational to the Bucket Spring Member. The Beasly Knob Member is both laterally and vertically variable from medium-grained sandstone and pebble conglomerate to siltstone. Sandstone dominates exposures and ranges from quartzic to feldspathic and ferruginous. Large-scale cross-beds (**Figure 27.5**) are locally common. Sweet *et al* (1974a) suggested that the basal Beasly Knob Member may be equivalent to the Jarrad Sandstone Member.

Figure 27.4. Megaripples with planed tops in upper Bucket Spring Member, Ranford Formation in AUVERGNE (precise location unknown, after Dunster *et al* 2000: figure 18).

The *Ernie Lagoon Member* conformably overlies the Beasly Knob Member and has a more restricted distribution. The most common lithology is medium-grained sandstone; subordinate conglomerate occurs as interbeds and lenses. Less than 10 m thickness is preserved in the Northern Territory.

The informally named *Big Knob beds* outcrop as clusters of knolls and short whaleback ridges up to 20 m high with near vertical relief (**Figure 27.6**). Sweet *et al* (1974a) mapped at least 130 separate knobby exposures in three regional clusters to the southwest of Pinkerton Range. The Big Knob beds consist of poorly sorted ferruginous sandstone and polymictic conglomerate/diamictite

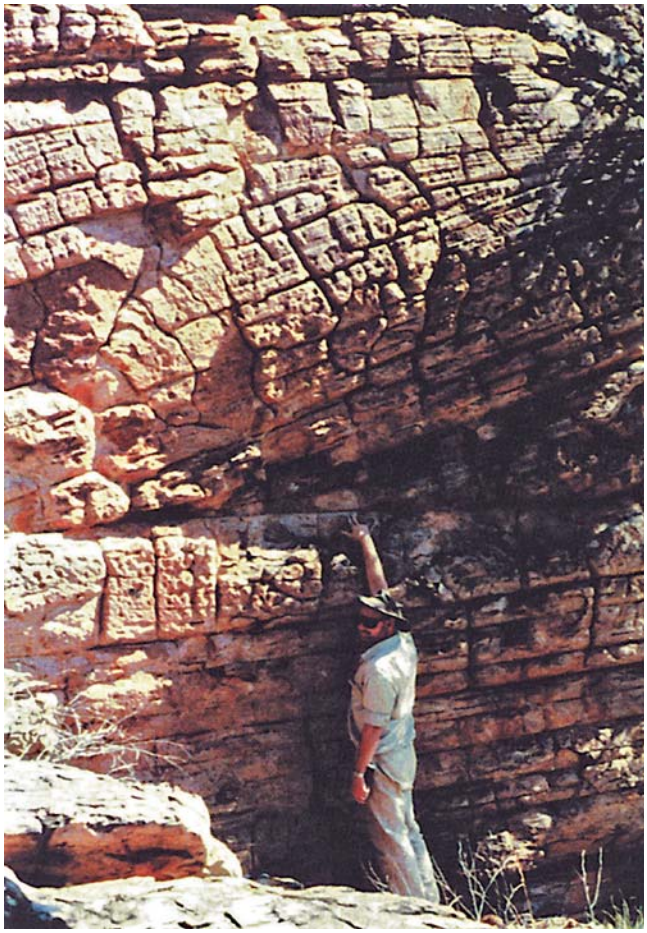

Figure 27.5. Large-scale cross-beds in Beasly Knob Member, Ranford Formation. JD is indicating top of main bedding plane (52K 524428mE 8239939mN, after Dunster *et al* 2000: figure 19).

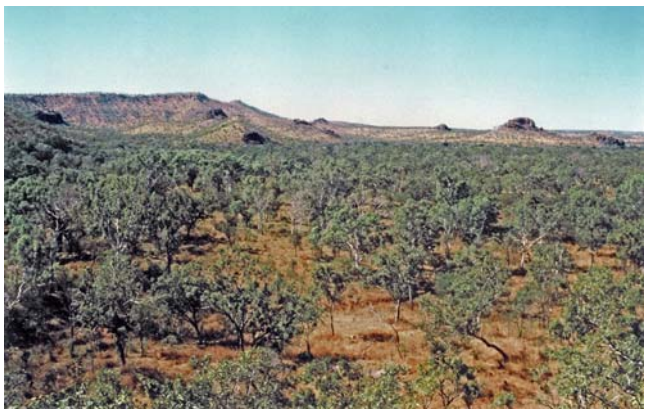

Figure 27.6. Isolated outcrops of Big Knob beds in AUVERGNE (precise location unknown, after Dunster 1998).

(**Figure 27.7**). Sandstone is variable in composition from quartzic to lithic. Up to 10% muscovite is present locally. Bedding is poorly defined or absent. The unit overlies either the Shoal Reach Formation or Spencer Sandstone and this suggests an erosional base. However, extensive colluvium and scree invariably mask the actual contact. As noted by Sweet *et al* (1974a), the Big Knob beds have some lithological similarity to the Bullo River Sandstone and Beasly Knob Member of the Ranford Formation. However, a correlation with the northernmost outcrops of the lower Skinner Sandstone is also lithologically consistent and is supported by the similarity of stratigraphic relationships and the present geographic distribution of both units. Dunster *et al* (2000) interpreted the Big Knob beds as glacial deposits, possibly remnants of eskers or kames, preserved in areas of lowest palaeo-topographic relief.

The glaciogenic *Uniya Formation* (Dundas *et al* 1987, Edgoose *et al* 1989) includes and supersedes the former 'Uniya Tillite' and the enigmatic 'Jarong Conglomerate' described by Pontifex and Mendum (1972) and Sweet *et al* (1974b). It is only known from FERGUSSON RIVER and DALY RIVER (PINE CREEK). It typically ranges up to 60 m to 80 m thick in outcrop, but Edgoose *et al* (1989) reported that 137 m has been intersected in drillhole NTGS 83/1 in WINGATE MOUNTAINS (FERGUSSON RIVER). It unconformably overlies the Soldiers Creek Granite, Stray Creek Sandstone, Hinde Dolostone, Saddle Creek Formation and Angalarri Siltstone, and is overlain by the early Cambrian Antrim Plateau Volcanics and by Cretaceous sedimentary rocks. This indicates that it should be included as a lithostratigraphic component of the Wolfe Basin. It is a dominantly a true tillite, variously described as polymictic conglomerate or diamictite with subordinate interbedded sandstone, varved carbonate/siltstone (possibly a "cap carbonate"). The erratics are up to several metres in diameter and vary in composition from one location to another. Overall, boulders, cobbles and pebbles of quartzite, sandstone, schist, dolostone, granite, basement volcanic rocks and chert dominate. A few carbonate clasts are present. At least some of these erratics are demonstrably dropstones (**Figure 27.8**) and some have chatter-marks and glacial gouges. Striated pavements (**Figure 27.9**), first recognised by Mobil Energy Minerals Australia Inc, are described by Dundas *et al* (1987) as indicating a south-southwest direction of ice flow. Dundas *et al* (1987) also documented polygonal structures caused by ice-cracking in soft sediment. The Uniya Formation is correlated with the Moonlight Valley Tillite.

Undifferentiated diamictite was discovered by Stockdale Prospecting in LIMBUNYA during a stream sediment survey in 1998 and was mapped by Cutovinos *et al* (2002). It is preserved as a small bench, which is approximately 0.5 km in area and 20 m thick. The massive diamictite unconformably overlies the Angalarri Siltstone and is overlain by the Antrim Plateau Volcanics. It contains scattered clasts

Figure 27.7. Typical polymictic conglomerate of Big Knob beds in AUVERGNE, precise location unknown (after Dunster *et al* 2000: figure 21).

Figure 27.8. Uniya Formation in FERGUSSON RIVER, WINGATE MOUNTAINS, precise location unknown (photos C Edgoose NTGS). (**a**) Bedded exposure showing dropstones. Height of cliff face about 3 m. (**b**) Glacial tillite.

in an olive-purple clay matrix. Sedimentary dropstones (**Figure 27.10**) provide unequivocal evidence of a glacial origin. Other abundant erratics up to 40 cm in diameter, which are flattened, subrounded and glacially-striated (**Figure 27.11**), are scattered on the residual weathering surface and in the adjacent creek bed. Sandstone, dolostone, siltstone, meta-siltstone, schist, possible volcanic rocks and granite are represented amongst the erratics. Up to 90% of clasts are of sandstone, siltstone or dolostone; igneous and metamorphic rocks make up the remainder. Cutovinos *et al* (2002) considered this diamictite to be equivalent to either the Moonlight Valley Tillite or Fargoo Tillite.

Figure 27.9. Striated pavement on Stray Creek Sandstone at base of Uniya Formation, indicating south to southwest direction of ice flow (FERGUSSON RIVER, WINGATE MOUNTAINS, precise location unknown, photo C Edgoose NTGS).

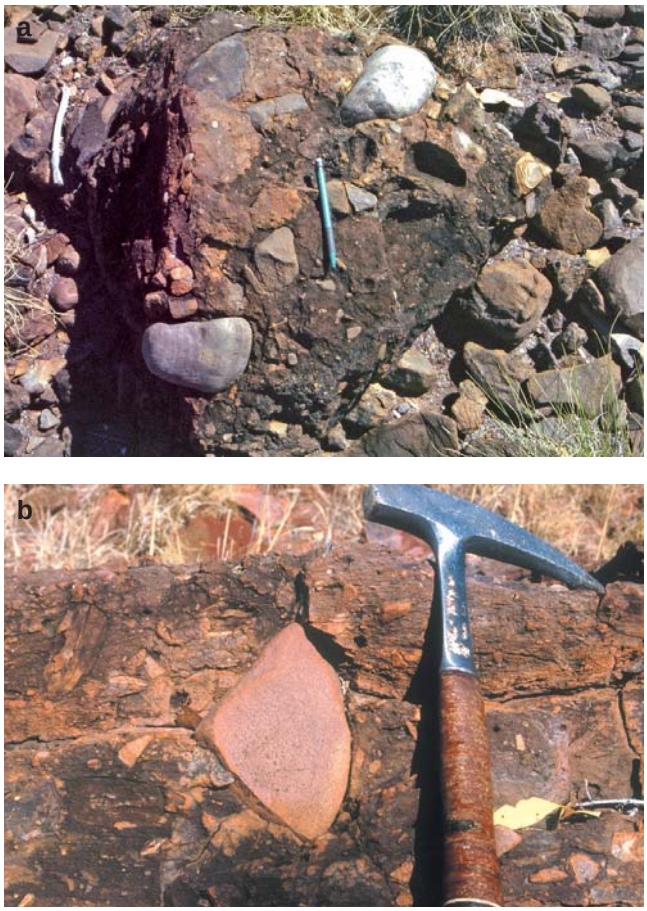

Figure 27.10. Undifferentiated diamictite of Duerdin Group in LIMBUNYA, precise location unknown. (**a**) Typical dropstones in section of bed (after Cutovinos *et al* 2002). (**b**) Bedding surface with dropstones.

Kinevans Sandstone

The undated Kinevans Sandstone was mapped in the First Edition WATERLOO, but not assigned to any group or basin (Sweet 1973). Based on Second Edition mapping by NTGS (Dunster *et al* 2010), the Kinevans Sandstone may be equivalent to the Mount Forster Sandstone (Albert Edward Group) of the Wolfe Basin in Western Australia. The Kinevans Sandstone consists of red-brown medium-grained sandstone with subordinate calcareous cement locally.

STRUCTURE

The sedimentary rocks of the Wolfe Basin are flat-lying or gently dipping. The most conspicuous exceptions are open synclines and anticlines developed to the southwest of the Halls Creek–Victoria River Fault Zone. There is also some folding adjacent to the Spencer Range Fault, but the Moonlight Valley Tillite was deposited after the last major movement on this fault. All of the Duerdin Group is affected by near-vertical north-northwest-trending faults. Some of these have had several hundred metres of sinistral movement.

MINERAL RESOURCES

Diamonds

The Wolfe Basin has been included in regional diamond exploration programs by Stockdale Prospecting Ltd. However, the Duerdin Group has not been specifically targeted.

Ornamental stone

The Ranford Formation contains a leached white siltstone that locally develops distinctive red to black Fe-oxide stripes. It been commercially exploited as an ornamental stone in Western Australia, where it is marketed as 'zebrastone'. Some of the best areas were flooded by the

Figure 27.11. Glacial striae on dropstone in undifferentiated diamictite of Duerdin Group in LIMBUNYA, precise location unknown.

Ord River Dam. Poor quality zebrastone also occurs in the Northern Territory and has been collected by fossickers and quarried on a small scale.

Barite

A small uneconomic vein of barite, 1.5 m wide and over 100 m long, occurs in a minor fault in the Fargoo Tillite at Newry prospect (Sweet 1973). A resource of 0.475 Mt barite was estimated for this prospect by Cornish and associates (1993).

REFERENCES

Ahmad M, Wygralak AS, Ferenczi PA and Bajwah ZU, 1993. *Pine Creek, Northern Territory. 1:250 000 metallogenic map series, SD 52-08.* Northern Territory Geological Survey, Darwin.

Blake DH, Tyler IM and Warren RG, 2000. *Gordon Downs, Western Australia. (Second Edition). 1:250 000 geological map series explanatory notes, SE 52-10.* Australian Geological Survey Organisation and Geological Survey of Western Australia.

Carson CJ, 2010. The Victoria and Birrindudu basins: A U-Pb SHRIMP study and review of resource potential: in *'Annual Geoscience Exploration Seminar (AGES) 2010. Record of Abstracts'. Northern Territory Geological Survey, Record* 2010-002.

Corkerson M, 2008. Deposition and palaeogeography of a glacigenic Neoproterozoic succession in the east Kimberley, Australia. *Sedimentary Geology* 204(3–4), 61–82.

Cornish and Associates, 1993. Mineral lease N741-747, Barite deposits Limbunya locality, Kirrimbie Yard, Inverway Station. Cornish BE and Associates Pty Ltd. *Northern Territory Geological Survey, Open File Company Report* CR1993-0730.

Cutovinos A, Beier PR, Kruse PD, Abbott ST, Dunster JN and Brescianini RF, 2002. *Limbunya, Northern Territory (Second Edition). 1:250 000 geological map series explanatory notes, SE 52-07.* Northern Territory Geological Survey, Darwin.

Dow DB and Gemuts I, 1969. Precambrian geology of the Kimberley Region: The East Kimberley. *Bureau of Mineral Resources, Australia, Bulletin* 106.

Dundas DL, Edgoose CJ, Fahey GM and Fahey JE, 1987. *Daly River, Northern Territory (First Edition). 1:100 000 geological map series explanatory notes, 5070.* Northern Territory Geological Survey, Darwin.

Dunster JN, 1998. Reconnaissance of the Proterozoic rocks of the Victoria River region. Report No QB98/261. North Ltd. *Northern Territory Geological Survey, Open File Company Report* CR1998-0082.

Dunster JN, Beier PR, Burgess JM and Cutovinos A, 2000. *Auvergne, Northern Territory (Second Edition). 1:250 000 geological map series explanatory notes, SE 52-15.* Northern Territory Geological Survey, Darwin.

Dunster JN, Beier PR and Cutovinos A, 2010. *Waterloo, Northern Territory (Second Edition). 1:250 000 geological map series, SE 53-03.* Northern Territory Geological Survey, Darwin.

Edgoose CJ, Fahey GM and Fahey JE, 1989. *Wingate Mountains, Northern Territory (First Edition). 1:100 000 geological map series explanatory notes, 5069.* Northern Territory Geological Survey, Darwin.

Glass LM and Phillips D, 2006. The Kalkarindji Continental Flood Basalt Province. A new Cambrian Large Igneous Province in Australia with possible links to mass extinction. *Geology* 34(6), 461–464.

Grey K and Blake DH, 1999. Neoproterozoic (Cryogenian) stromatolites from the Wolfe Basin, east Kimberley, Western Australia: correlation with the Centralian Superbasin. *Australian Journal of Earth Sciences* 46(3), 329–341.

Grey K and Corkeron M, 1998. Late Neoproterozoic stromatolites in glacigenic successions of the Kimberley region, Western Australia: evidence for a younger Marinoan glaciation. *Precambrian Research* 92, 65–87.

Knoll AH, Bambach RK, Canfield DE and Grotzinger JP, 1996. Comparative Earth history and Late Permian mass extinction. *Science* 273, 452–457.

Plumb KA, 1993. *Note on revised correlations of Neoproterozoic glacigene sequences of the Kimberley, northern Australia*. IUGS Working Group on the terminal Proterozoic system, Field Conference, Adelaide, May 1993 (unpublished).

Pontifex IR and Mendum JR, 1972. *Fergusson River, Northern Territory (First Edition). 1:250 000 geological map commentary, SD 52-12.* Bureau of Mineral Resources, Australia, Canberra.

Pontifex IR and Sweet IP, 1972. *Auvergne, Northern Territory (First Edition). 1:250 000 geological map commentary, SD 52-15.* Bureau of Mineral Resources, Australia, Canberra.

Shaw RD, Sexton MJ and Zeilinger I, 1994. The tectonic framework of the Canning Basin, WA, including the 1:2 million structural elements map of the Canning Basin. *Australian Geological Survey Organisation, Record* 1994/48.

Sheppard S, Thorne AM and Tyler IM, 1999. *Geology of the Bow 1:100 000 sheet*. Geological Survey of Western Australia, Perth.

Sweet, IP, 1973. *Waterloo, Northern Territory. 1:250 000 geological map series explanatory notes, SE 52-03.* Bureau of Mineral Resources, Australia, Canberra.

Sweet IP, 1977. The Precambrian geology of the Victoria River region, Northern Territory. *Bureau of Mineral Resources, Australia, Bulletin* 168.

Sweet IP, Mendum JR, Bultitude RJ and Morgan CM, 1974a. The geology of the southern Victoria River region, Northern Territory. *Bureau of Mineral Resources, Australia, Report* 167.

Sweet IP, Mendum JR, Morgan CM and Pontifex IR, 1974b. The geology of the northern Victoria River region, Northern Territory. *Bureau of Mineral Resources, Australia, Report* 166.

Tyler IM and Hocking RM, 2001. A revision of the tectonic units of Western Australia. *Geological Survey of Western Australia, 2000–01 Annual Review*, 33–44.

Walter MJ, Veevers JJ, Calver CR and Grey K, 1995. Late Proterozoic stratigraphy of the Centralian Superbasin, Australia. *Precambrian Research* 73, 173–195.