

# Neoproterozoic successions of the northwestern Officer Basin: a reappraisal

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## Abstract

Stratigraphic units previously assigned to the Savory Group of the Savory Basin are a continuation of the Officer Basin succession. Continuing to use 'Savory Basin' as a separate structural entity cannot be justified, and the area is here referred to as the northwestern Officer Basin. The Savory Group, the main fill of the former Savory Basin, comprises two main packages of sedimentary rocks separated by a 150 to 200 m.y. hiatus. The name Savory Group is, therefore, no longer tenable and is replaced by new terminology. The name Sunbeam Group is introduced for the older package, which is approximately 800 m.y. old. The name Boondawari Formation is retained for an approximately 600 m.y. old, partly glaciogenic formation. The overlying package, previously the upper Savory Group, is here named the Disappointment Group. The group excludes the Durba Sandstone, at the top of the succession.

**KEYWORDS:** Centralian Superbasin, Officer Basin, Savory Basin, Savory Group, Sunbeam Group, Boondawari Formation, Disappointment Group, Proterozoic, stratigraphy.

The northwestern part of the Officer Basin extends between the Archaean Pilbara and Yilgarn Cratons to about 100 km east of Newman (Fig. 1). The area was originally regarded as the eastern part of the Mesoproterozoic Bangemall Basin (Williams et al., 1976; Muhling and Brakel, 1985), although Grey (1978) suggested a younger age based on stromatolites. It was elevated to separate basin status, as the Savory Basin, with the discovery firstly of an unconformity apparently within the Bangemall Group, and secondly of glaciogenic sedimentary rocks that confirmed the Neoproterozoic age of the rocks above the unconformity (Williams, 1987). The basin's contents were

named the Savory Group (Williams, 1992).

Williams (1992, p. 9 and 92) suggested that the rocks in the Savory Group were deposited in a marginal sag basin that developed along the Palaeoproterozoic to Mesoproterozoic Capricorn Orogen, the site of a collision between the Archaean Pilbara and Yilgarn Cratons at c. 1.84 Ga. Biostratigraphic and lithostratigraphic similarities between the Savory, Officer, and Amadeus Basins lead to the conclusion that all are, in part, coeval and probably linked under Phanerozoic rocks (Grey, 1978, 1995; Williams, 1992, p. 9). Walter and Gorter (1994), Walter et al. (1995), and Grey (1995) have made correlations between the major

Neoproterozoic basins of central Australia and suggested that deposition commenced in a single large sag basin, the Centralian Superbasin, after about 850 Ma. The Centralian Superbasin includes the Officer, Savory, Amadeus, Ngalia, and Georgina (part only) Basins.

This intracratonic superbasin was disrupted internally by a central uplift during the Paterson Orogeny (or Petermann Ranges Orogeny of central Australia; Walter et al., 1995), between 560 and 525 Ma. Separate depocentres then formed in each of the basins. Walter and Gorter (1994) and Walter et al. (1995) recognized four major successions in the superbasin, referred to as Supersequences 1 to 4, which could be correlated between individual basins using sequence stratigraphy, biostratigraphy, isotope chemostratigraphy, seismic interpretation, magnetostratigraphy, and limited radiometric dating. Phanerozoic rocks in the Officer Basin (Table Hill Volcanics and above) were included in the Gunbarrel Basin by Hocking et al. (1994).

## Status of the Savory Basin

Bagas et al. (1995) proposed that the Tarcunyah Group, in the north-eastern part of the area (Fig. 1), is a correlative of the lower part of the Savory Group. They further proposed that the Tarcunyah and the lower Savory Groups are also equivalent to Supersequence 1 of the Centralian Superbasin (Walter et al., 1994; Walter et al., 1995), and are part of the Officer Basin, rather than components of a separate basin. Detailed seismic interpretation by Perincek (1996) improved this

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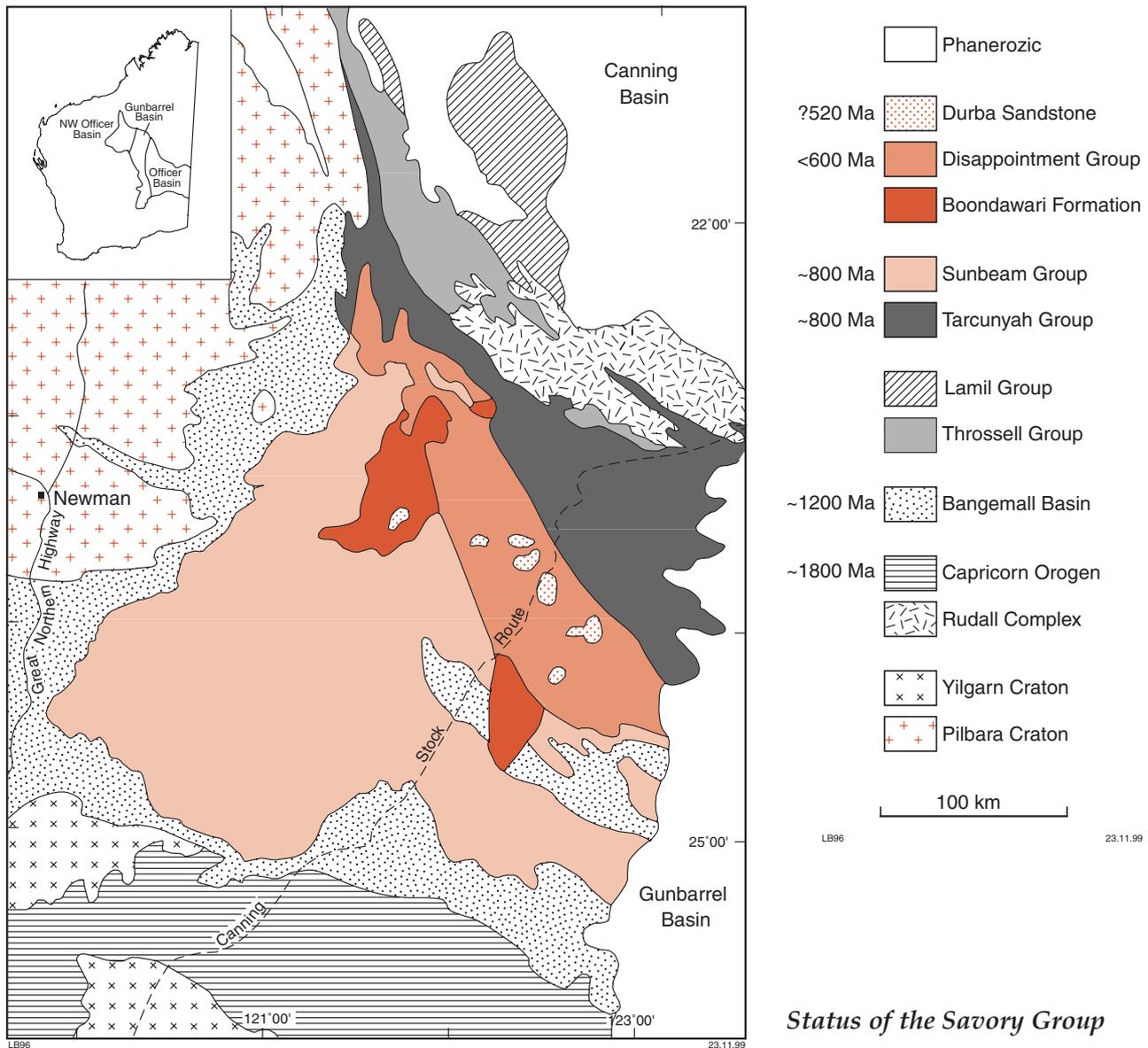


Figure 1. Regional setting of the northwestern part of the Officer Basin

correlation, which has since been further strengthened using stromatolites and palynology (Grey and Cotter, 1996; Grey and Stevens, 1997; Stevens and Grey, 1997; Grey, unpublished data).

These correlations led recent workers to use the name Savory Sub-basin to indicate its status as a sub-component of the Officer Basin (Grey and Cotter, 1996; Grey and Stevens, 1997; Stevens and Grey, 1997; Stevens and Carlsen, 1998). However, it is not strictly a sub-basin, but simply a northwestern preserved part of the Officer Basin

where there is no Phanerozoic cover. The terms Savory Basin and Savory Sub-basin are here abandoned, although Savory region remains a useful geographic reference to the area where Neoproterozoic rocks are exposed. Its subdivisions (Wells and Blake Sub-basins, Trainor Platform) are retained as tectonic subdivisions of the Officer Basin, and have similar status to subdivisions such as the Gibson and Yowalga Sub-basins (Hocking et al., 1994). The name Wells Sub-basin is here revised from Wells Foreland Basin to remove genetic-model implications.

### Status of the Savory Group

The presently understood Savory Group (Williams, 1992) includes two major successions separated by a hiatus of 150 to 200 m.y. (million years), and the Durba Sandstone (Walter et al., 1995; Bagas et al., 1995). The recognition of this hiatus requires that the two successions be separated, and the name Savory Group be abandoned.

The stratigraphic names used for the remainder of the Officer Basin in Western Australia cannot be used in the former Savory Basin because precise correlations between constituent formations are still uncertain. Phanerozoic cover between the two areas obscures the Neoproterozoic succession. Nor can the terminology for the Tarcunyah Group, to the northeast, be extended to the lower (older)

succession in the former Savory Group because the two are geographically separated either by a younger (upper) succession, or by faulting (Williams, 1992). Consequently, separate new names are proposed for the lower succession (Sunbeam Group, after Sunbeam Creek on TRAINOR\*), and the upper succession (Disappointment Group, after Lake Disappointment on GUNANYA) of the former Savory Group. The Durba Sandstone is ungrouped, above the Disappointment Group; and the Boondawari Formation lies between the Sunbeam and Disappointment Groups. The Sunbeam Group may include an unconformity at the base of the Spearhole Formation (Fig. 2), possibly due to the marginal setting of the Savory region. If present, it is minor and is here ignored for lithostratigraphic purposes.

### Geological setting and correlation

The mid- to late-Neoproterozoic (850–544 Ma) rocks of the Savory region (northwestern Officer Basin) unconformably overlie, or are in faulted contact with, the Mesoproterozoic Bangemall Group to the west and south, and older parts of the Palaeoproterozoic to Neoproterozoic Paterson Orogen in the northeast (Williams and Bagas, in press). These Neoproterozoic rocks continue eastwards beneath Phanerozoic sedimentary and volcanic rocks of the Gunbarrel Basin (Hocking et al., 1994) into the Officer Basin of central Australia (Perincek, 1996). There are two inliers in the region, the Oldham and Ward Inliers. Rocks in these inliers may correlate with the Collier and Edmund Subgroups of the Bangemall Group, or with the Throssell Group of the Yeneena Supergroup (Hocking, Grey and Bagas, unpublished data).

The Paterson Orogen has three subdivisions: the Palaeoproterozoic Rudall Complex, the Mesoproterozoic to Neoproterozoic Yeneena Supergroup, and the Neoproterozoic Tarcunyah Group (Bagas et al., 1995). The Yeneena Supergroup is a redefinition of the 'Yeneena Group'

of Williams et al. (1976), and comprises the Mesoproterozoic to Neoproterozoic Throssell and Lamil Groups (Williams and Bagas, in press). The Karara Formation, previously regarded as younger than the Yeneena Group, was recently included in the Neoproterozoic Tarcunyah Group (Bagas et al., 1995).

Similar rock types are present in the approximately 800 m.y. old Tarcunyah and Sunbeam Groups (Figs 1 and 2). Both groups contain a basal sandstone and conglomerate; the Googenhama Formation, and the Glass Spring Formation and its lateral equivalents, respectively (Fig. 2). Carbonate units of the Mundajini, Skates Hills, Waters, and Waroongunyah Formations overlie the basal sandstone succession in the Tarcunyah and Sunbeam Groups. These carbonates contain the *Acaciella australica* Stromatolite Assemblage (characteristic of the Browne Formation of the Officer Basin, the Bitter Springs Formation of the Amadeus Basin, and the Yackah beds of the Georgina Basin; Stevens and Grey, 1997; Hill et al., in press), and the *Baicalia burra* Stromatolite Assemblage (characteristic of the Kanpa Formation of the Officer Basin, and the Burra Group of the Adelaide Rift Complex; Preiss, 1987; Walter and Veevers, 1997; Hill et al., in press). The stromatolite assemblages are consistent with a Supersequence 1 age. In the Adelaide Rift Complex, the *Acaciella australica* Assemblage occurs stratigraphically below the  $802 \pm 10$  Ma Rook Tuff (Fanning et al., 1986), while the *Baicalia burra* Assemblage occurs above it. Furthermore, both the Sunbeam and Tarcunyah Groups contain red beds, siltstone, shale, and significant intervals of evaporites, intercalated with stromatolitic carbonates. This lithological association is characteristic of Supersequence 1 throughout much of the Centralian Superbasin (Walter et al., 1995).

The younger Brownrigg, Yandanunyah, Wongarlong, and Nooloo Formations in the Tarcunyah Group do not have direct correlatives in the Sunbeam Group (Fig. 2), although they may correspond to the Hussar and Kanpa Formations to the southeast. Both the Tarcunyah Group and more northerly exposures of the Sunbeam

Group underwent folding and faulting during the Paterson Orogeny prior to, or partly contemporaneous with, the deposition of the unconformably overlying Disappointment Group (Williams, 1992; Bagas et al., 1995).

Supersequence 2 is apparently absent in Western Australia, indicating a significant break in deposition of between 150 and almost 200 m.y. (Grey et al., 1999). This period marks uplift and erosion associated with firstly the Areyonga and then the Souths Range Movements in central Australia (Walter et al., 1995). It also corresponds to the Blake Movement (Williams, 1992), which affects the Sunbeam Group and, to a lesser extent, the Tarcunyah Group.

In addition to the date of c. 800 Ma inferred from stromatolite correlations, the age of deposition of the Tarcunyah and Sunbeam Groups is constrained by the unconformably overlying glaciogenic rocks of the Boondawari Formation (Supersequence 3). These are retained as a separate formation, but they may well be subdivided and raised to group status in the future. They are correlated with the Marinoan glaciation of the c. 600 Ma Supersequence 3 (Walter et al., 1994; Bagas et al., 1995; Grey, 1995).

The Boondawari Formation is unconformably overlain by the sandstone succession of the McFadden, Tchukardine, and Woorra Woorra Formations, here collectively called the Disappointment Group. The group was deposited in the Wells Sub-basin during the onset of tectonism (Williams, 1992) associated with the c. 550 Ma Paterson Orogeny (as redefined by Bagas and Smithies, 1998). This sandstone succession is a probable correlative of the c. 580–544 Ma (Walter and Veevers, 1997) latest Supersequence 3 or early Supersequence 4 of the Centralian Superbasin. The Durba Sandstone overlies the Disappointment Group, and may be separated from it by a significant disconformity.

### Conclusions

This reappraisal of the lithostratigraphy and tectonic history of the Officer Basin provides a clearer understanding of the Neoproterozoic

\* Capitalized names refer to standard 1:250 000 map sheets

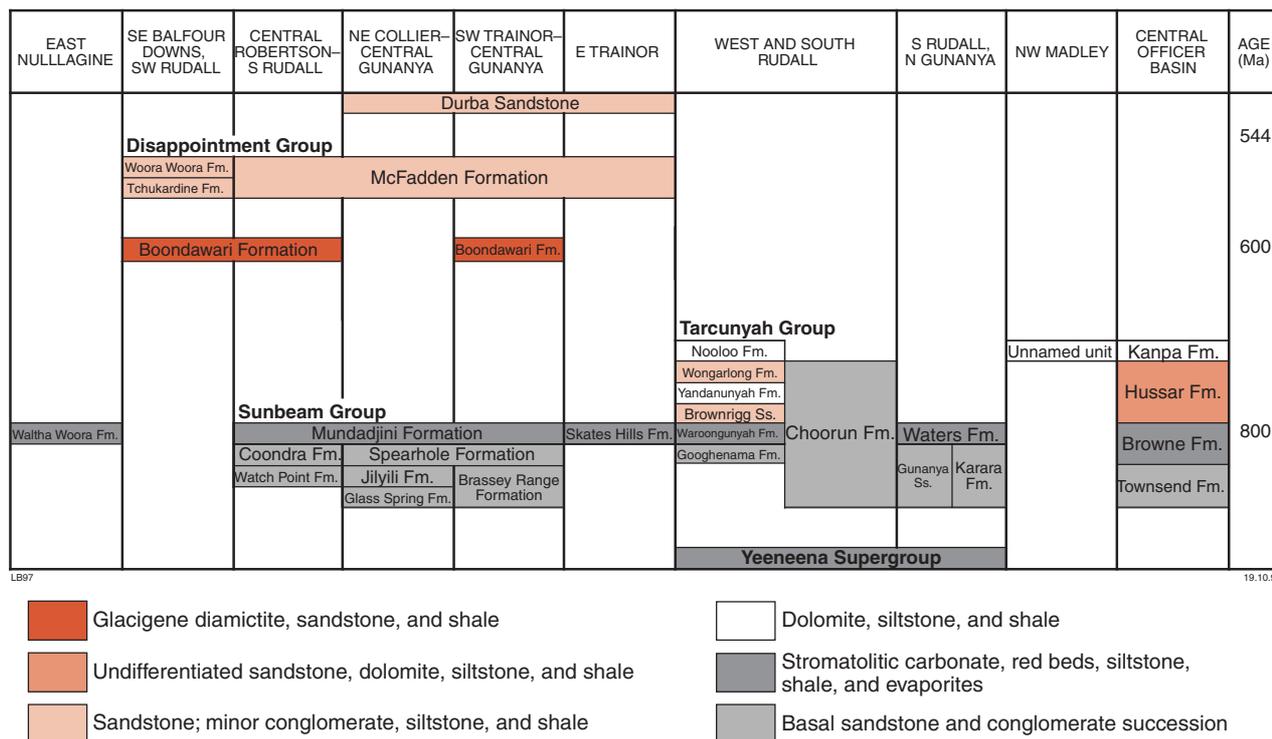


Figure 2. Generalized stratigraphic correlations between the Tarcunyah and Sunbeam Groups of the northwestern Officer Basin, and parts of the central Officer Basin. Column headings are areas within standard 1:250 000 map sheets, except for the more general central Officer Basin

history of Western Australia. Firstly, the former Savory Basin is subsumed within the Officer Basin, and the name Savory Sub-basin is dropped entirely. Secondly, a significant unconformity is recognized within the ‘Savory Group’, so that the name is abandoned and replaced by the names Sunbeam and Disappointment Groups, with the Boondawari Formation and Durba Sandstone as ungrouped units. The Sunbeam Group is part of Supersequence 1 of the Centralian Superbasin. The Boondawari Formation is part of Supersequence 3 and has lateral equivalents ranging from the Olympic Formation/Pioneer Sandstone to the Julie Formation in the Amadeus Basin. The Disappointment Group is part of latest Supersequence 3 or earliest Supersequence 4, as tentatively suggested by Walter and Gorter (1994), and is a probable lateral equivalent of the Arumbera Sandstone of the Amadeus Basin. Furthermore, the Sunbeam Group is here correlated with part of the former Yeneena Group (the Tarcunyah Group; Fig. 2), making the Tarcunyah Group part of the Officer Basin. This in turn allows correlation with the

Centralian Superbasin. The Centralian Superbasin is thus extended to the northwest to include the areas covered by the Tarcunyah Group and former Savory Group.

### Appendix 1

#### Sunbeam Group (new name)

*Derivation of name:* After Sunbeam Creek (Lat. 24°55'S, Long. 122°18'E) on TRAINOR.

*Distribution:* The constituent formations are the Glass Spring, Jilyili, Brassey Range, Watch Point, Coondra, Spearhole, Mundadjini, and Skates Hills Formations. The group is exposed on southeast BALFOUR DOWNS, eastern ROBERTSON, southwest GUNANYA and TRAINOR, western MADLEY, northeast BULLEN and NABBERU, northern STANLEY, and northwest HERBERT.

*Lithology:* Sandstone, siltstone, conglomerate, shale, mudstone, dolomite, stromatolitic dolomite, and evaporite.

*Thickness:* About 5500–6000 m.

*Relationships and boundary criteria:* The Sunbeam Group unconformably overlies, or is in faulted contact with, various Mesoproterozoic units of the Bangemall Basin (Martin et al., 1999), including the Scorpion, Collier, and Manganese Groups around the northwestern, western, and southern margins, and the rocks in the Oldham and Ward Inliers. It is a lateral equivalent of the oldest part of the Officer Basin succession (Supersequence 1) to the east, and the Tarcunyah Group to the northeast of the Disappointment Group as defined here. In the northeast, it is unconformably overlain or in faulted contact with the Boondawari Formation and the Disappointment Group, as defined here. Permian rocks along the eastern margin unconformably overlie it.

*Age and evidence:* The main evidence for the age of the Sunbeam Group is the presence of the *Acaciella australica* Stromatolite Assemblage in the Skates Hills Formation. By correlation with other parts of the Centralian Superbasin, the Sunbeam Group has an age of slightly older than 800 Ma (Grey, 1995; Grey and Stevens, 1997). Palynological

samples support the age of the group (Grey and Stevens, 1997). It is older than the overlying Boondawari Formation, which contains diamictite and cap dolomite of Marinoan age (Walter et al., 1995).

*Synonymy:* The Sunbeam Group was previously the older part of the Savory Group.

*References:* Williams (1987, 1992, 1994); Williams and Tyler (1991); Grey (1995); Grey and Stevens (1997).

*Notes:* The recognition of a 150 to 200 m.y. hiatus between the Skates Hills Formation and the Boondawari Formation necessitates the abandonment of the former Savory Group. The Sunbeam Group includes stratigraphic units below the Boondawari Formation that are equivalent in age to Supersequence 1 of the Centralian Superbasin.

#### **Disappointment Group (new name)**

*Derivation of name:* After Lake Disappointment (Lat. 23°30'S, Long. 122°40'E) on GUNANYA.

*Distribution:* The constituent formations are the McFadden, Tchukardine, and Woorra Woorra Formations. The group is exposed on southeast BALFOUR DOWNS, southwest RUDALL, TRAINOR, and western MADLEY.

*Lithology:* Sandstone, siltstone, and conglomerate

*Thickness:* About 1500–1800 m.

*Relationships and boundary criteria:* The group overlies, or is in faulted contact with, the Mesoproterozoic Manganese Group of the Bangemall Basin, the Sunbeam Group, and the Boondawari Formation. In the northeast, it is in faulted contact with, or unconformably overlies, the Tarcunyah Group.

*Age and evidence:* There is no direct evidence for the age of the Disappointment Group, but it overlies the Marinoan diamictite and cap dolomite of the Boondawari Formation and is therefore probably a lateral equivalent of either upper Supersequence 3 or Supersequence 4 of the Centralian Superbasin. It is associated with the onset of tectonism (Williams, 1992) during

the c. 550 Ma Paterson Orogeny (Bagas and Smithies, 1998).

*Synonymy:* The Disappointment Group was previously the youngest part of the Savory Group.

*References:* Williams (1987, 1992, 1994); Williams and Tyler (1991); Bagas et al. (1995); Bagas and Smithies (1998).

*Notes:* The Disappointment Group includes most younger units of the former Savory Group that unconformably overly both the Sunbeam Group and the Boondawari Formation. They are equivalent in age to the upper part of Supersequence 3 or to Supersequence 4 of the Centralian Superbasin, but may be separated from the Durba Sandstone by a significant hiatus.

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