The Murraba Basin: another piece of the Centralian Superbasin jigsaw puzzle falls into place

by

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The poorly exposed package of rocks currently recognized as the Murraba Basin was originally included in the Birrindudu Basin (Blake et al., 1979; Grey, 1990). It outcrops east of the Canning Basin, straddling the Western Australian – Northern Territory (WA–NT) border (Fig. 1), and is inferred to be mostly of Neoproterozoic age. Since recognition as a separate entity, the Murraba Basin has been interpreted as a component of the Centralian Superbasin (Grey et al., 2005; Tyler, 2005; Ahmad, 2013), implying syndepositional links with the Amadeus, Ngalia, Georgina, Officer, Yeneena, Wolfe, Louisa and Victoria Basins prior to separation by tectonism and erosion, or cover of connections by younger rocks (Fig. 1).

The Centralian Superbasin concept is based around the similar Neoproterozoic depositional history, stratigraphy and biostratigraphic elements shared by its components (Walter et al., 1995). This stratigraphy is subdivided into four supersequences, separated by regional unconformities related to the onset of glacial events (bases of Supersequence 2 and 3), or a local unconformity and facies change related to regional tectonism (base of Supersequence 4) (Fig. 2). However, the Murraba Basin previously proved difficult to correlate to even the nearest presumed contemporary basins.

This abstract summarizes the conclusions of a helicopter-supported reconnaissance survey of the southern Murraba Basin in early September 2015. This allowed a reassessment about which units should be included in the Murraba Basin and revised correlations to the regional Centralian Superbasin succession.

Previous interpretations

Most outcrops in the region now assigned to the Murraba Basin are mapped as Redcliff Pound Group (Blake and Yeates, 1976; Blake et al., 1979). This group was interpreted as a conformable sedimentary package dominated by siliciclastic rocks. The basal units, Munyu Sandstone (south), Lewis Range Sandstone (north) and Muriel Range Sandstone (northeast; mainly in NT), were considered lateral equivalents. The recessive Murraba Formation, and more prominent Erica Sandstone completed the group in ascending order. The local Denison, Jawilga and Boee beds in the northwest of the basin were considered potential correlatives of the Redcliff Pound Group (Blake et al., 1979; Grey, 1990). Blake et al. (1979) correlated the Redcliff Pound Group with the Heavitree Quartzite and Bitter Springs Formation of the Amadeus Basin, and inferred an 'Adelaidean' (Neoproterozoic) age. If correct, the Redcliff Pound Group is restricted to Supersequence 1 of the Centralian Superbasin, but the carbonate, siltstone and evaporite facies that characterize the Bitter Springs Formation and its correlatives elsewhere, appears poorly represented. The siliciclastic-dominated Hidden Basin beds (Blake and Yeates, 1976; Blake et al., 1979) crop out to the west of the Redcliff Pound Group in the southern Murraba Basin. On regional structural grounds, Blake et al. (1979) inferred that the Hidden Basin beds overlie the Erica Sandstone, possibly conformably, and thus are potentially a younger unit of the Redcliff Pound Group, although the only exposed contact was faulted. The age was inferred to be late 'Adelaidean'. If correct, the Hidden Basin beds could represent some or all of Supersequences 2–4 of the Centralian Superbasin, but characteristic lithofacies of that succession, such as glacial diamictites, were not described.

New observations and revised interpretations

Redcliff Pound Group

We concur with previous workers on the lithological similarity between the mineralogically mature Munyu Sandstone and the Heavitree Quartzite and its correlatives in the Amadeus Basin. In contrast, the Lewis Range Sandstone is less mineralogically mature and has a more reddish colouration due to pervasive iron oxides, suggesting that it may have been deposited under a different climatic or tectonic regime. Furthermore, available detrital zircon geochronology of these units (Wingate et al., 2008a,b; Kirkland et al., 2009) suggests a significant difference in provenance (Fig. 3). The Munyu Sandstone (Fig. 3a) contains late Paleoproterozoic and late Mesoproterozoic detrital zircons matched by age and Hf isotopes to the Arunta and Musgrave regions, respectively (Hollis et al., 2013). The age spectrum is similar to basal Centralian Superbasin proximal to the Musgrave region (Haines et al., 2016). The Lewis Range Sandstone also displays an abundant late Mesoproterozoic

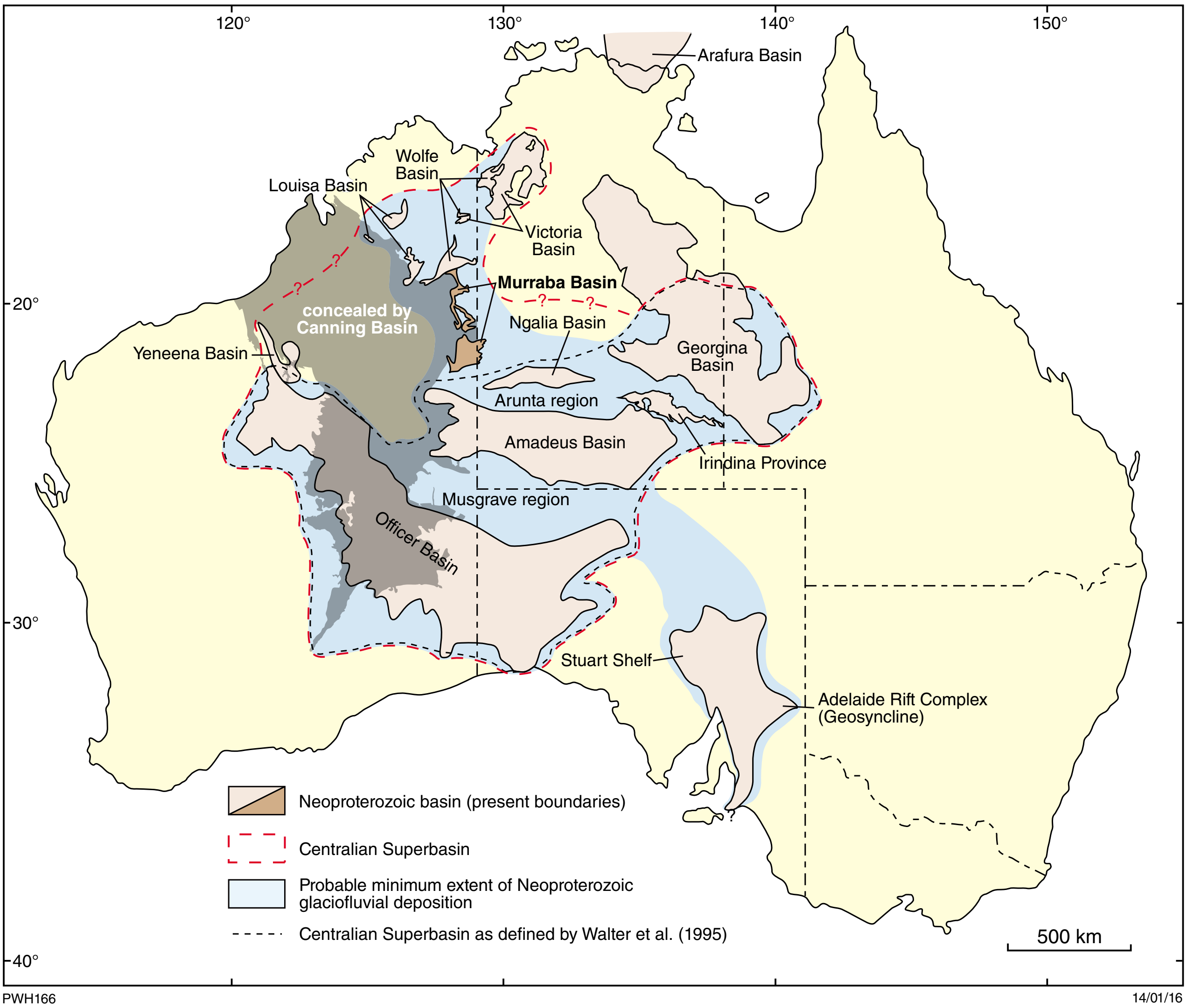

Figure 1. The Murraba Basin within the context of other basins of the Centralian Superbasin, modified after Munson et al. (2013)

age component, but relatively few Paleoproterozoic detrital zircons (Fig. 3b). However, many of the zircon ages fall between the major late Mesoproterozoic events of the Musgrave region (Musgrave Orogeny and Giles Event) and Hf data is similarly not supportive of a Musgrave region provenance. The best detrital zircon match with contemporaneous units is with the basal Throssell Range and Lamil Groups (host of Telfer mineralization) of the Yeneena Basin (see data in Bagas and Nelson, 2007). Although correlations between the Yeneena Basin and other components of the Centralian Superbasin are uncertain, its base is generally inferred to be younger than the base of Supersequence 1 elsewhere (Grey et al., 2005). Thus the Munyu Sandstone and Lewis Range Sandstone may not be direct correlatives, with the latter possibly a little younger, consistent with maximum depositional ages from the youngest concordant detrital zircons in the respective units.

A folded, cherty, recrystallized, stromatolitic dolomite unit resembling the Gillen Member (basal Bitter Springs Formation, Amadeus Basin) was observed in fault contact with the Munyu Sandstone at one locality. This occurrence was previously reported as a ‘limestone’ interbedded within the Munyu Sandstone (Blake et al., 1979), but if it actually overlies the Munyu Sandstone, the correlation with basal Supersequence 1 in the Amadeus Basin is strengthened.

Although the Murraba Formation was previously inferred to be conformable on the Munyu Sandstone and Lewis Range Sandstone, the contact is not exposed; there is a considerable gap between the closest mapped outcrops of the older and younger units (7.5 km and 2.3 km, respectively), allowing for a significant thickness of concealed strata. An examination of regolith below the lowest mapped Murraba Formation reveals hints to the nature of underlying bedrock in this concealed interval.

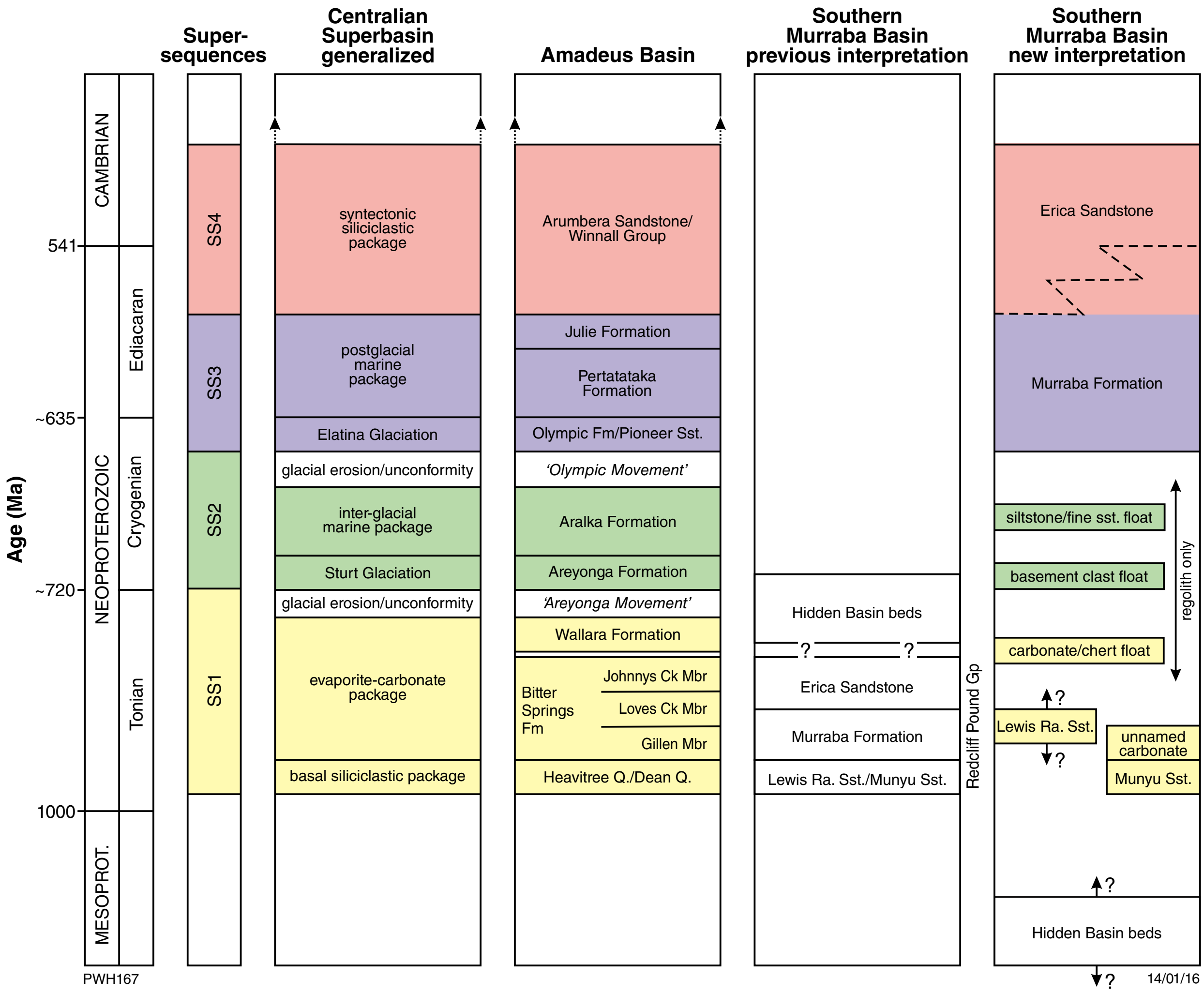

Figure 2. Previous and current interpretations of the southern Murraba Basin with respect to the Neoproterozoic to lower Cambrian stratigraphy of the Amadeus Basin and generalized Centralian Superbasin

In one area float clasts associated with calcrete include grey limestone, dolomite, ooid-bearing carbonate, and microbial and ooid chert similar to lithologies found in the carbonate-bearing upper parts of Supersequence 1 in the Amadeus Basin. This is succeeded by an interval containing scattered clasts of diverse lithologies, notably fresh basement clasts, possibly representing the weathered remnant of a subcropping glacial diamictite. The uppermost part of this covered interval displays float of weathered siltstone and thin-bedded, fine-grained sandstone. Taken in order, the regolith succession is consistent with the presence of upper Supersequence 1 to Supersequence 2 in the subsurface, although this cannot be confirmed without the discovery of actual outcrop, or future drilling.

The Murraba Formation and Erica Sandstone are both dominated by siliciclastic facies, ranging from shallow marine in the lower part, through fluvio-deltaic to eolian in the upper part. Using the presence or absence of chert granule conglomerate to distinguish the Murraba Formation from Erica Sandstone, as was done previously, is not considered a viable way to map the boundary between these units due to the lenticular nature of such beds and local changes in the abundance of coarse detritus. We consider the boundary thus mapped to be strongly time transgressive (as suggested by the dashed boundary in Figure 2) and in need of revision. Fine-grained sandstone in the lower part of the package is relatively mineralogically mature, with a shift to red-brown, mineralogically immature, deltaic and fluvial facies inferred to mark the onset of regional tectonism. Based on lithostratigraphic comparisons with the Amadeus and western Georgina Basins, the combined Murraba Formation – Erica Sandstone package is considered to represent Supersequence 3 and 4, and thus the upper Redcliff Pound Group is inferred to be much younger (Ediacaran to early Cambrian) than previously thought. An age no older than late Ediacaran for part of the package is supported by the discovery of simple cylindrical trace fossils (*Planolites*) in red deltaic facies at a number of localities. Also present are abundant microbially induced sedimentary structures, and the problematic organic structure *Arumberia*, common in the late Ediacaran in

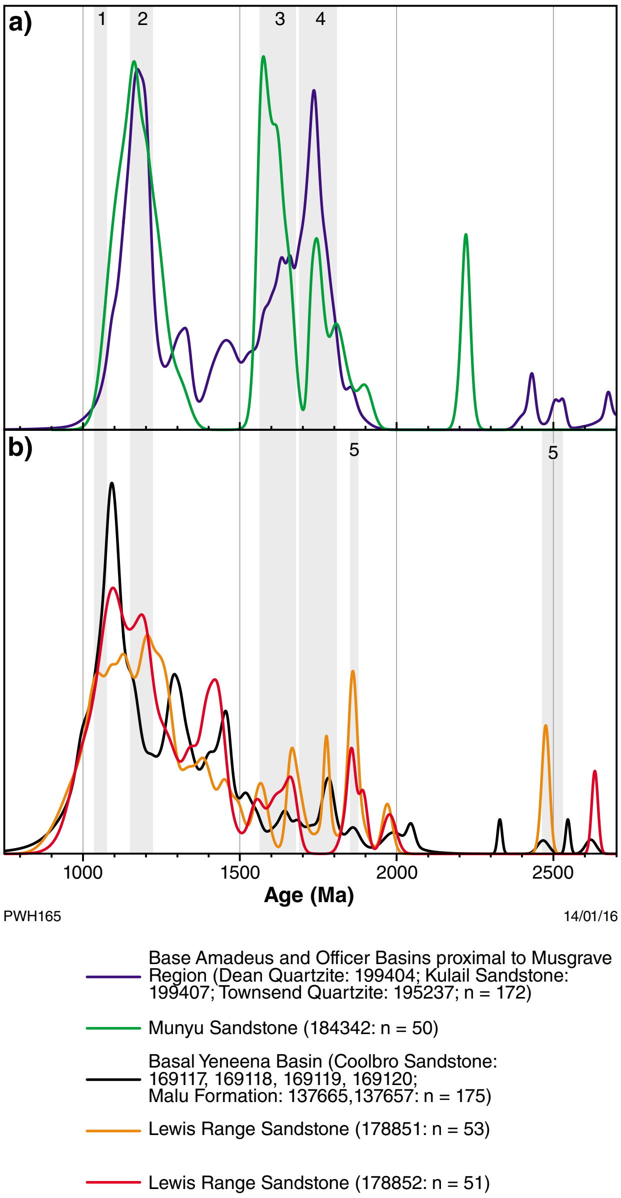

Figure 3. Detrital zircon geochronology: a) comparison of Munyu Sandstone with basal Amadeus and Officer Basin proximal to the Musgrave region; b) comparison of Lewis Range Sandstone with basal Yeneena Basin. Vertical bars indicate age of adjacent basement events or detrital populations: 1. Giles Event (1090–1040 Ma); 2. Musgrave Orogeny (1220–1150 Ma); 3. Warumpi Province and Chewings Orogeny (1680–1560 Ma); 4. Aileron Province (1810–1690 Ma); 5. Tanami Basin (c. 2500, 1864–1844 Ma detrital populations)

the Amadeus and Georgina Basins, and elsewhere. The base of the red syntectonic package is taken to mark the base of Supersequence 4; in some places this corresponds with the mapped Murraba Formation – Erica Sandstone boundary, but elsewhere it is as low as the middle Murraba Formation, due to the boundary definition problems indicated above. The tectonism is inferred to be broadly synchronous with the Petermann, Paterson and King Leopold Orogenies, tectonism of which was likely contiguous beneath the region now covered by the Canning Basin. Cross-beds in fluvio-deltaic facies indicate paleocurrents consistently from the west.

Including the inferred covered component, the Redcliff Pound Group now appears to contain a relatively complete Centralian Superbasin succession, but details will remain incomplete until subsurface information is available. The greatly increased depositional timespan of the revised Redcliff Pound Group, and the likelihood of internal unconformities, means that the use of a single group name for this succession is now untenable, and needs revision.

Hidden Basin beds

The age of the Hidden Basin beds remains uncertain, but should be better constrained after detrital zircon dating of collected samples. In the interim, we note that the Hidden Basin beds appear more indurated and generally more deformed than the upper Redcliff Pound Group, making the relationship suggested by Blake et al. (1979) unlikely, and gravity and aeromagnetic data do not support a thick basin succession beneath the Hidden Basin beds. It is likely that the unit is older than the Redcliff Pound Group and may belong to the Birrindudu Basin with which it shares lithostratigraphic similarities. Other possible correlatives include the Lake Mackay Quartzite or the Kiwirrkurra Formation in the Arunta region to the south. If such interpretations are correct, the Hidden Basin beds are much older than the Redcliff Pound Group, and should be removed from the Murraba Basin.

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