Palaeoproterozoic orogeny in Western Australia

by

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Previous models for Palaeoproterozoic orogeny have assumed that the Australian crust formed a single entity by the late Archaean, and that most tectonic and magmatic activity occurred in an intracratonic setting between 1900 and 1800 Ma (e.g. Etheridge et al., 1987). However, complex Palaeoproterozoic tectonic histories are indicated by more recent geochronological data. Remapping of the Capricorn Orogen, the Paterson Orogen, and the King Leopold and Halls Creek Orogens in Western Australia (Fig. 1), combined with geophysical and geochemical data, indicates that their Palaeoproterozoic tectonic evolution can be interpreted in terms of continental break-up, terrane accretion, and plate aggregation (Myers et al., 1996, Tyler et al., 1998).

The Capricorn Orogen (Fig. 1) formed between the Archaean Yilgarn and Pilbara Cratons. At its northern margin, rifting of the Pilbara Craton initiated the Hamersley Basin at c. 2770 Ma, followed by breakup at 2690 Ma. The upper part of the Hamersley Group may have been deposited in a collisional setting between 2470 and 2440 Ma. The Palaeoproterozoic Turee Creek Group and lower Wyloo Group were deposited in the McGrath Trough, a possible foreland basin developed in front of a northward verging fold belt during an Ophthalmian orogenic event at c. 2200 Ma (Martin et al., 1998).

At the southern margin of the orogen, the Yerrida Basin formed at c. 2175 Ma initially as a sag basin on the Yilgarn Craton, followed by an abrupt change to a rift-fill setting. To the west, in the southern part of the Gascoyne Complex, collision of a late Archaean to early Palaeoproterozoic micro-continent with the northwestern margin of the Yilgarn Craton produced extensive deformation, metamorphism and felsic magmatism during the 2000 to 1960 Ma Glenburgh Orogeny (Sheppard et al., 1999). The Bryah Group may have been deposited in a back-arc basin setting at this time.

The 1840 to 1790 Ma Capricorn Orogeny involved extensive deformation, metamorphism and felsic magmatism (Occhipinti et al., 1998) during the oblique collision and suturing of the geologically distinct Pilbara and Yilgarn Cratons to form the West Australian Craton.

The King Leopold and Halls Creek Orogens are part of the North Australian Craton (Fig. 1) and have a Palaeoproterozoic tectonic history that is distinctly different from that of the Capricorn Orogen. In the Halls Creek Orogen, rifting of a continental margin began in the Eastern zone of the Lamboo Complex at c.1910 Ma and

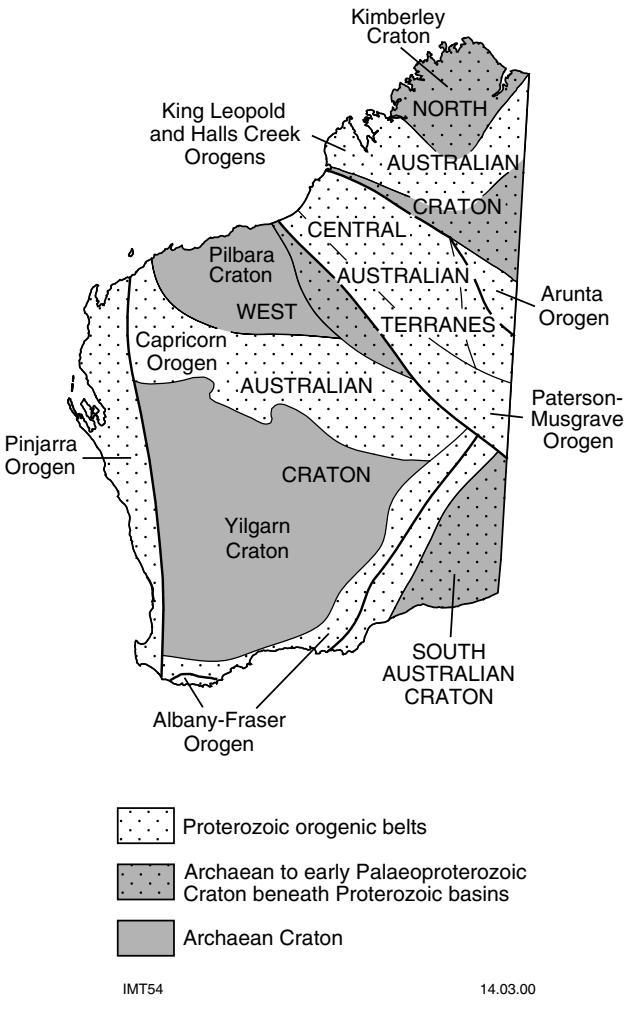

Figure 1. The main components of the Western Australian crust

continued with deposition of the lower Halls Creek Group at c. 1880 Ma.

In the Western zone of the Lamboo Complex and in the Hooper Complex of the King Leopold Orogen accretion of continental fragments to the eastern edge of the Kimberley Craton occurred before c. 1900 Ma. Turbidites derived from late Archaean and early Palaeoproterozoic crust forming the Kimberley Craton were deposited at c. 1870 Ma (Tyler et al., 1999). Deformation, metamorphism and extensive felsic and mafic magmatism occurrred during the 1865 to 1850 Ma Hooper Orogeny (Griffin et al., in press)

The Central zone of the Lamboo Complex formed at c. 1865 Ma either as an island arc (subduction to the southeast) or an ensialic basin marginal to the Kimberley Craton (subduction to the northwest) (Sheppard et al., 1999). Deformation and metamorphism to high grade at c. 1845 Ma (Bodorkos et al., 1999) followed intrusion of numerous felsic, and basic to intermediate sheet-like bodies during convergence and collision of the Central zone with the Western zone. Layered mafic–ultramafic intrusions were emplaced into both the Western and Central zones of the Lamboo Complex at c. 1855 Ma.

Further rifting along the eastern continental margin was marked by alkaline volcanism in the Eastern zone of the Lamboo Complex between 1870 and 1850 Ma. Turbiditic rocks of the upper Halls Creek Group were deposited parallel to the continental margin as a submarine fan.

Eruption of felsic and mafic volcanic rocks during rifting of the Central zone at c. 1840 Ma was accompanied by the emplacement of layered mafic–ultramafic intrusions. Continued subduction of oceanic crust to the northwest led to collision and suturing of the Kimberley Craton with the rest of the North Australian Craton by c. 1820 Ma during the Halls Creek Orogeny. Folding and thrusting accompanied metamorphism in the Central zone of the Lamboo Complex. During and immediately following collision, plutons of granite and gabbro were intruded to form the Sally Downs supersuite at the same time as the intrusion of large layered mafic–ultramafic bodies.

As the Sally Downs supersuite was being intruded into the Lamboo Complex the Speewah Group was deposited on the Kimberley Craton at c. 1835 Ma. The Kimberley Group oversteps the Speewah Group onto the Lamboo Complex, and both sedimentary groups were derived from the north. The intrusion of the Hart Dolerite at c. 1800 Ma may be related to continental break-up centred to the north, at the same time as granite intruded into the southern part of the Lamboo Complex, and into the Granites–Tanami Complex farther to the south.

The Central Australian Terranes have developed between the West Australian Craton and the North Australian Craton (Fig. 1). In the Rudall Complex of the Paterson Orogen a foreland basin may have developed prior to c. 1800 Ma. Granite intrusion took place at c. 1800 Ma, followed by deformation, metamorphism and further granite intrusion between 1790 and 1760 Ma during the Yapungku Orogeny. West-verging thrusting and high-P metamorphism accompanied collision of the West Australian Craton with the North Australian Craton. This event may be represented in the Arunta Orogen by the Strangways Orogeny (Bagas and Smithies, 1997).

The Earaheedy Basin overlies the c. 2175 Ma Yerrida Basin at the northeastern margin of the Yilgarn Craton, but was not affected by the Capricorn Orogeny. Large-scale dextral strike-slip faulting developed along the southern margin of the Pilbara Craton after c. 1790 Ma and extends to the southeast into the Stanley Fold Belt, which deformed the northeastern margin of the Earaheedy Basin. This event represents an intracratonic response to the Yapungku Orogeny.

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