The Neoproterozoic Centralian Superbasin

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In Neoproterozoic times 2 000 000 km^2 of Australia were occupied by a single depositional system, the Centralian Superbasin. The Superbasin was disrupted 590–530 Ma by a central uplift, and then dismembered by Late Palaeozoic tectonism to form numerous structural basins, including the Amadeus, Georgina, Ngalia, Officer and Savory Basins. Recognition of the integrity of the original depositional system allows the stratigraphy of relatively well-known areas to be extrapolated to predict that of those that are poorly known. New advances in acritarch biostratigraphy and isotope chemostratigraphy, in conjunction with conventional lithostratigraphy and sequence analysis, allow a fresh assessment of the Neoproterozoic ('Late Proterozoic') stratigraphy and tectonic development of the Superbasin. In addition, key units in the recently discovered Savory Basin have been examined enabling firm correlations with the much better known Amadeus Basin to the east.

The basement of the central part of the Centralian Superbasin consists of the 1200–1100 Ma Musgrave Block succeeded by the 1075–1000 Ma Bentley Volcanic Province of bimodal volcanic rifts, dolerite dyke swarms and sills. A regional lacuna at 1000–800 Ma, interpreted as reflecting a central post-volcanic (underplated) upland, was followed at 800 Ma by a second swarm of dykes in the Musgrave Block, intrusion of which may have been associated with the crustal sagging that initiated the Centralian Superbasin.

Filling of the Superbasin began with the deposition of hundreds of metres of marine and fluvial sands. These formed a uniform sheet over much of the Superbasin, wedging out against granitic basement in the northeast (Georgina Basin) and apparently thickening greatly in the west (Savory Basin). An overlying kilometre of marine and lacustrine carbonates, evaporites and fine siliciclastics completed the first major depositional Supersequence (1). Faulting during and after deposition of Supersequence 1 localised subsequent Sturtian glacigene sediments and overlying marine shales and carbonates (Supersequence 2).

Supersequence 3 began with renewed glacial sedimentation (Marinoan), perhaps at about 600–610 Ma. This glaciation may have been global, and post-glacial transgression was extensive, depositing turbiditic and pelagic sands and shales, and then carbonates, over most of the Superbasin. Evaporites are present locally. Systematic acritarch biostratigraphy and isotope chemostratigraphy in this post-glacial succession have produced a high-resolution correlation scheme for the central Australian basins and the Adelaide Geosyncline. In the latest Proterozoic, marine sands and silts (Supersequence 4) were widespread, and continental flood basalts were erupted, following compression in the Officer Basin and southern Amadeus Basin. The upper (Cambrian) part of this Supersequence has more marine sands and silts, followed by carbonates and evaporites.

A significant gas show was discovered in the Proterozoic of the Amadeus Basin in 1963. This was shortly after the first major petroleum discoveries in the Neoproterozoic and Cambrian of the Siberian Platform, where subsequently at least 50 oil and gas fields and major discoveries including giants were proven in a succession closely comparable with that of the Centralian Superbasin. Comparison with prospects of similar age in Siberia, Oman and China suggests many plays, mostly untested. The Dingo gas discovery in Supersequence 4 of the Amadeus Basin is the largest accumulation of hydrocarbons to be found in the Proterozoic of Australia to date, and a significant gas flow was recently achieved from Supersequence 1 in the same basin.