

Adelaide Superbasin

Subjects: Geology

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The Adelaide Superbasin is a series of geologically related rift to passive margin sedimentary basins formed during the Neoproterozoic to Cambrian. They are located at the south-eastern margin of Proterozoic Australia.

Keywords: Adelaide Superbasin ; rift basin ; Neoproterozoic ; Cambrian ; South Australia ; sedimentary basin

1. Introduction

The Adelaide Superbasin^[1] is one of the largest and best-preserved rift to passive-margin successions to form during the Neoproterozoic breakup of Rodinia, which included large continental rifts between the Australia, Amazonia, Baltica, Kalahari, Laurentia, and Siberia cratons^{[2][3][4]}. The Adelaide Superbasin is thought to have formed the conjugate margin to western Laurentia in Rodinia^{[5][6][7][8][9][10][11]}, although other configurations for Rodinia have been suggested, e.g.,^{[4][12][13][14]}

2. Geologic History

The Adelaide Superbasin^[1] is a large, Neoproterozoic to middle Cambrian sedimentary system at the southeast margin of Proterozoic Australia which formed as a result of the breakup of the supercontinent Rodinia. The Adelaide Superbasin consists of several named basins and sub-basins that span from the Neoproterozoic to early Cambrian. The largest and oldest of these is the Adelaide Rift Complex, which is contiguous with the relatively undeformed rocks of the Torrens Hinge Zone, Stuart Shelf^[15], and Coombalarnie Platform^[16]. Two Cambrian basins, the Arrowie Basin and Stansbury Basin, are also considered part of the Adelaide Superbasin^{[1][17]} (**Figure 1**). Whereas present-day exposure of the sedimentary basin is approximately 600 km from north to south, the basin spans over 1100 km from central Australia to Kangaroo Island. Deposition within the Adelaide Superbasin spans over 300 million years of Earth's history and stretches from the northernmost regions of South Australia, narrowing in the South Mount Lofty Ranges at the Fleurieu Peninsula and extending onto Kangaroo Island. Further south, links with coeval sequences in Antarctica and eastern Tasmania are unclear, but possible^[18]. The Archaean to Mesoproterozoic Gawler Craton lies to the west of the Adelaide Superbasin, and the late Palaeoproterozoic to early Mesoproterozoic Curnamona Province lies to the east. Laurentia is thought to have lain to the east/southeast of the Adelaide Superbasin within Rodinia, and East Antarctica is understood to have been joined to the south of the Gawler Craton as the Mawson Continent (e.g.,^[1] and references therein). The Adelaide Superbasin began as an intracontinental rift system that successfully progressed to a passive margin basin in its southeast region yet remained a failed rift in the north. Deposition within the basin ceased during the Delamerian orogeny c. 514–490 Ma^{[19][20][21][22]}. The timing of rift termination is not well established. However, evidence of large-scale normal faulting is not seen after the early Cryogenian^[19].

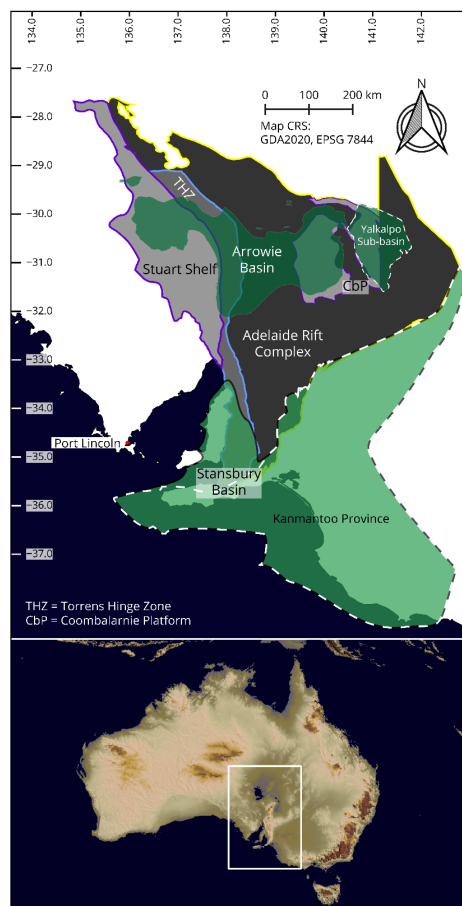


Figure 1. Map of the known Adelaide Superbasin extent and basin subdivisions, derived from [1].

The stratigraphy of the Adelaide Superbasin is divided into three supergroups [19], two for the Neoproterozoic sequences and the third for the Cambrian sequences, with numerous group- and subgroup-level divisions. In the Neoproterozoic, the Warrina Supergroup is comprised of the Callanna, Burra, and Poolamacca Groups, and the Heysen Supergroup contains the Umberatana, Wilpena, Torrowangee, and Farnell Groups. Each of these groups are further divided into numerous subgroups, as described by the authors of [1]. The Warrina Supergroup encompasses the Tonian early rift sequences that are largely restricted to fault-bound depositional troughs, and the Heysen Supergroup is comprised of the Cryogenian and Ediacaran glacial, interglacial, and postglacial sedimentary rocks, with a greater area of deposition within a passive margin setting.

3. Basin Hierarchy

3.1. Adelaide Rift Complex

The Adelaide Rift Complex is the oldest and most central part of the Adelaide Superbasin. It is a series of rift troughs and passive margin depocentres that have a protracted development from c. 890 Ma to c. 550 Ma. The Warrina and Heysen Supergroups form the rocks of this part of the basin, being separated from the Cambrian Morolana Supergroup by a basin wide unconformity.

3.2. Stuart Shelf

The Stuart Shelf is a region of platform deposits in the western portion of the Adelaide Superbasin that overlie the Gawler Craton. Limited deposition occurred during the early development of the Adelaide Superbasin, with a significant hiatus until the late Neoproterozoic when a period of marine transgression occurred. The rocks of the Stuart Shelf remain relatively undeformed to this day.

3.3. Coomalarie Platform

The Coomalarie Platform is a second region of platformal deposits that lie in the north-east of the Adelaide Superbasin, overlying the Curnamona Province. This region only experienced deposition after a transgression occurring in the late Neoproterozoic.

3.4. Stansbury Basin

The Stansbury Basin is one of the two known Cambrian basins of the Adelaide Superbasin. It is exposed in the south of the superbasin, extending from Kangaroo Island and the Mount Lofty Ranges toward Victoria underneath the Murray Basin. The true eastward extent of this basin is not well understood and is a focus of current geological research in South Australia. It is likely that deposition was continuous with the Arrowie Basin to the north ^[17]. The **Kanmantoo Province** is a subdivision of the Stansbury Basin forming its southern and eastern areas.

3.5. Arrowie Basin

The Arrowie Basin is the second of the two known Cambrian basins of the Adelaide Superbasin. It extends from the Stuart Shelf in the west of the superbasin, across the Flinders Ranges to western New South Wales. The **Yalkalpo Sub-basin** is in the easternmost areas of the Arrowie Basin, bound to its west by the Benagerie Ridge of the Curnamona Province.

4. Lithostratigraphic Division

The lithostratigraphy of the Adelaide Superbasin is divided into three supergroups, with numerous group and subgroup level divisions. The lowermost and oldest supergroup is the **Warrina Supergroup** ^[19], this is further divided into the *Callanna Group* and *Burra Group* which have numerous subgroup divisions. The rocks of the Callanna Group are mostly coarse siliclastic rocks to cyclic, evaporitic mixed carbonate and siliclastic rocks with pulses of mafic igneous rocks, and minor bimodal igneous rocks. The Burra Group is made of mostly siliciclastic and carbonate rocks with minor bimodal igneous rocks in the lower portions of the group. The **Heysen Supergroup** ^[19] overlies the Warrina Supergroup, and is separated by a basin wide erosional unconformity caused by the *Sturtian glaciation*. The Heysen Supergroup is divided into the *Umberatana Group* and *Wilpena Group*, with numerous subgroup divisions. The Umberatana Group is mostly made of siliciclastic rocks, with several carbonate rocks as well. These rocks represent two glacial periods and a corresponding interglacial period. The overlying Wilpena Group is primarily made of siliciclastic rocks with an overall regressive base level trend. The **Moralana Supergroup** ^[19] is the uppermost high-level stratigraphic division of the Adelaide Superbasin and is comprised of all the Cambrian rocks within the superbasin.

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