CHAPTER 4 Gawler Craton

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GAWLER CRATON SUMMARY

Age

Sedimentation — late Archaean to early Mesoproterozoic.
Felsic and mafic volcanism — late Archaean to early Mesoproterozoic.
Felsic and mafic intrusions — late Archaean to early Mesoproterozoic.
Sleafordian Orogeny — late Archaean.
Miltalie Event — Palaeoproterozoic.
Neill Event — Palaeoproterozoic.
Kimban Orogeny — Palaeoproterozoic to Mesoproterozoic.
Kararan Orogeny — Palaeoproterozoic to Mesoproterozoic.

Prospective commodities

Cu, Au, Ni, Ag, Pb, Zn, U, Pt, Pd, REE, Sn, Cr, iron ore.

Major exploration models

Archaean gold, Archaean greenstone (Ni–Au), Archaean VHMS (Zn–Cu–Au), Proterozoic intrusive hosted Ni–Cr–PGEs, Broken Hill (Pb–Zn–Ag–Au), Mount Isa (Pb–Zn), FeO–Cu–Au (Olympic Dam), Hiltaba Suite-associated Au–Ag–Cu–Pb–Zn–As.

Geological summary

The Gawler Craton (Fig. 4.1) is an ancient crystalline shield comprising Archaean to Mesoproterozoic metasediments, volcanics and igneous intrusives, which has been tectonically stable, with the exception of minor epeirogenic movements, since ~1450 Ma (Thomson, 1975; Parker, 1990, 1993). Due to very sparse basement outcrop, the geology of the Gawler Craton is poorly constrained, compared to other cratonic areas within Australia. The craton records crust formation and tectonothermal events in the late Archaean to early Palaeoproterozoic (Sleafordian Orogeny), Palaeoproterozoic (Kimban Orogeny), and Palaeoproterozoic to Mesoproterozoic (Kararan Orogeny).

The Archaean includes greenstone belts, very high-grade metamorphic belts, and felsic volcanics. Palaeoproterozoic supracrustal successions are variably affected by late Palaeoproterozoic deformation and intrusive magmatism. Early Mesoproterozoic anorogenic felsic magmatism is widespread. Subsequent tectonic movements have been of epeirogenic character, including downwarping of epicratonic basins (e.g. the Mesoproterozoic Cariewerloo Basin) and minor block faulting.

The boundaries of the Gawler Craton are entirely subsurface and have been interpreted from total magnetic intensity and gravity data combined with regional geological outcrop information and drill hole data to determine the outermost limit of rock types known to be of Gawler Craton affinity. The eastern limit of the craton is relatively well defined by the western edge of the Torrens Hinge Zone (THZ), a zone of Neoproterozoic rifting during development of the Adelaide Geosyncline, in which the basement rocks became attenuated by extensional faulting. Later deformation during the Delamerian Orogeny reworked this eastern extension of Gawler Craton rocks within and east of the THZ; these now form a separate domain (the basement to the THZ) and define the extent of this reworking.

The northern and western extent of the craton is less well defined. Neoproterozoic and Palaeozoic sediments of the Officer Basin increase in thickness to the north and west across the faulted margins of the basin. The Ammaroodinna and Yoolperlunna Inliers are the only exposed part of the Gawler Craton in this region. A semi-coincident, linear, magnetic and gravity anomaly is interpreted to mark the northwestern limit of the known extent of the Gawler Craton. Beyond this feature, the nature of the basement is unknown. Within the western and northwestern parts of the Gawler Craton, the Palaeoproterozoic–Mesoproterozoic Kararan Orogeny has created similar features with the same trend, including the Karari and Coorabie Shear Zones.

The southern margin of the Gawler Craton is also poorly defined. It occurs offshore from the southern coast of South Australia and lacks definition from outcrop or drillhole data. It is presently placed close to the edge of the continental shelf along prominent gravity and magnetic features which probably indicate mafic intrusives associated with rifting during the Jurassic, which eventually led to the separation of Australia from Antarctica, mostly during Tertiary time.

DEFORMATION HISTORY OF THE GAWLER CRATON

Three major tectonic events have fundamentally affected the formation of the Gawler Craton:

1. ?2700–2300 Ma — late Archaean sedimentation and volcanism followed by early Palaeoproterozoic plutonism and metamorphism (Sleafordian Orogeny).
2. 2000–1700 Ma — initial basin–platform sedimentation followed by widespread plutonism, metamorphism and deformation (Kimban Orogeny) with local volcanism and continental sedimentation.
3. 1690–1450 Ma — development of spatially separated granulite and amphibolite-facies rocks during the Kararan Orogeny (1690–1540 Ma) in the northern and western portion of the craton. This was accompanied by syntectonic intrusion of acid, ultramafic and mafic plutons with associated development of major ductile shear zones encroaching on the central