Guide to the sedimentary cover of the Central Gawler Craton, South Australia
(with special emphasis on the Harris Greenstone Belt region)

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INTRODUCTION

The central Gawler Craton is blanketed by thin sedimentary cover that ranges in age from Neoproterozoic to Quaternary. Locally, the cover can reach a maximum of ~500 m thickness in Permian glacial valleys or rift structures. This guide focuses on the younger Phanerozoic sediments of the central craton, which occupy four major basins — Arckaringa (latest Carboniferous – Early Permian), Eromanga (Late Jurassic – Early Cretaceous), Eucla (Middle Eocene to Quaternary, mainly palaeochannel deposits) and Billa Kalina (early to late Tertiary) basins.

Crystalline basement underlying the cover sequences described in this report reflects a long and complex history of deposition, volcanism, magmatism and orogenesis. Although not discussed in detail, the pre-Neoproterozoic basement has an influence on the nature (texture, mineralogy and metallogeny) and distribution of younger cover sequences. Note that the unmetamorphosed and undeformed Mesoproterozoic Pandurra Formation (to the northeast of the Harris Greenstone Belt (HGB) area) is traditionally excluded from the definition of crystalline basement, but is not considered further here.

The Gawler Craton is an ancient crystalline shield, comprising Archaean to Mesoproterozoic metasediments, volcanics and granites, that has been tectonically stable with the exception of minor epeirogenic movements since ~1450 Ma. The craton records crust formation and tectonothermal events in the late Archaean to early Palaeoproterozoic (Sleaford Orogeny), Palaeoproterozoic (Kimban Orogeny), and Palaeoproterozoic to Mesoproterozoic (Kararan Orogeny). Basement lithologies formed during these events include Archaean Christie Gneiss, Kenella Gneiss, Lake Harris Komatiite (and associated units), Palaeoproterozoic orogenic intrusives (formally known as Lincoln Complex), various Palaeoproterozoic metasediments of restricted areal extent (including Tarcoola Formation) and late Palaeoproterozoic orogenic intrusives (Tunkillia Suite). Important components of the basement in the study area also include late Palaeoproterozoic to earliest Mesoproterozoic collisional to anorogenic intrusives of the St Peter Suite and uraniferous Hiltaba Suite (and associated aerially extensive Gawler Range Volcanics). These units, including the Pandurra Formation, are intruded by basic dykes of the Gairdner Dyke Swarm.

The aim of this guide is to assist mineral exploration companies working in the Gawler Craton to appreciate the extent of sedimentary cover and to assist with recognition of sedimentary units that overlie basement targets. The guide also highlights the mineral potential within the sedimentary cover, including groundwater, coal, placer gold and diamond, uranium, heavy minerals, clay minerals (including palygorskite), celestite, gypsum and precious opal.

The study focuses on the HGB area but has been broadened to include the central Gawler Craton (Fig. 1). This area includes the BARTON, TARCOOLA, KINGOONYA, FOWLER, CHILDARA and GAIRDNER 1: 250 000 map areas, and the northern parts of NUYTS, STREAKY BAY and YARDEA.

SEDIMENTARY HISTORY OF THE CENTRAL GAWLER CRATON

The oldest rocks regarded as part of the sedimentary cover overlying the Gawler Craton are of Neoproterozoic to Cambrian age. They include sediments of the Stuart Shelf, a flat-lying platform sequence overlying the eastern craton margin. These are equivalents of the thicker, deformed sequence in the Adelaide Geosyncline (Fold Belt) to the east. The western and northern margins of the craton are onlapped by Neoproterozoic and Cambrian sediments of the Officer (Murnaroo Platform, Tallaringa Trough, Nullarbor Platform) and Warburton Basins.

The oldest post-Cambrian Phanerozoic sediments described in this guide are late Palaeozoic (latest Carboniferous – Early Permian) deposits of the Arckaringa Basin and adjacent structural troughs, notably the Mulgathing Trough. The Arckaringa Basin covers most of the northern Gawler Craton. These late Palaeozoic deposits are in part the result of widespread glaciogene sedimentation throughout southern and central Australia and adjacent parts of the Gondwana supercontinent when the supercontinent was in the vicinity of the South Pole (Fig. 2). Late Palaeozoic sediments were deposited on a glaciated landscape largely stripped of regolith.

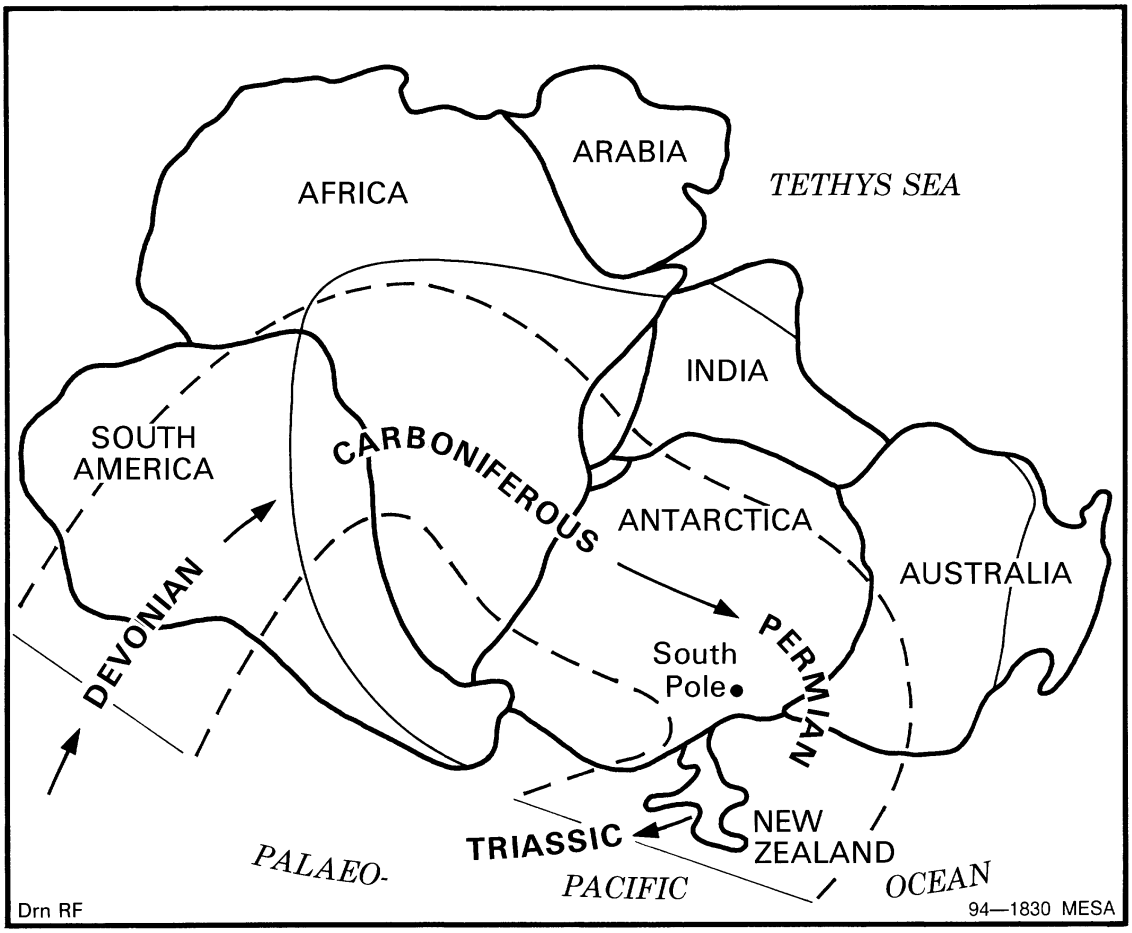

Figure 2 Glaciogenic deposition in the Gondwana Supercontinent

Following the late Palaeozoic sedimentation, a prolonged period of weathering and erosion resulted in deep weathering profiles and widespread erosional peneplain surfaces. Remnants of the latter occur in South Australia; a notable example in the central Gawler Craton is the summit surface of Mt Finke.

The next phase of sedimentation is represented by Late Jurassic to Early Cretaceous deposits of the southwestern Eromanga Basin which covers most of the Arckaringa Basin and northern Gawler Craton. The oldest of the Eromanga Basin units is Algebuckina

Sandstone, a widespread fluvial unit with a predominantly quartz and kaolinite composition reflecting erosion of a deeply weathered landscape. At some locations, fluvial sediments extend upstream in palaeochannels incised into pre-Mesozoic sediments and basement (e.g. Mulgathing Palaeochannel). Rising sea level in the Early Cretaceous resulted in deposition of coastal sediments of the Cadna-owie Formation, and fluvial sandstone and conglomerate (Mount Anna Sandstone Member). Widespread marine shale (Bulldog Shale) was deposited during later marine transgressions in the Early Cretaceous.

The overlying Billa Kalina Basin is a shallow, interior Tertiary basin in the northeastern central Gawler Craton. The basin contains mainly fluvial–lacustrine deposits, i.e. the Watchie and Willalinchina Sandstone in the east and Mirikata Formation in the western regions, and may be up to 20 m thick in depocentres. In the west, palaeodrainage was westwards to the marine Eucla Basin that extended much further inland than the present coastline. Eocene fluvial sandy fills in the upper reaches of the palaeochannel give way to marginal marine fine sand and lignite in the lower reaches where swamps developed behind extensive beach barrier dunes of the Ooldea and Barton Ranges. Higher sea levels in the Miocene–Pliocene resulted in deposition of marine sediments further up the palaeochannels, and lacustrine Garford Formation clay and dolomite in the upper reaches.

The study region is covered extensively by Quaternary sand dunes and alluvial–fluvial–aeolian–lacustrine complexes that record increased aridity in the region, which persists to the present.