CHAPTER 3 Summary geology of South Australia

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INTRODUCTION

As a consequence of its central position within the Australian continent, South Australia has the advantage of providing rocks of a wide range of age and lithology as targets for mineral exploration. Depositional, igneous, orogenic and alteration events ranging in age from 2700 million years old (late Archaean) to the present day, and every geological period, are represented in South Australia's rock record. Consequently, its mineral potential encompasses a large diversity of commodities and associations. Rocks of Archaean to early Palaeozoic age have the greatest potential for the discovery of primary metallic mineral deposits, although younger sediments contain important concentrations of minerals reworked by sedimentary and diagenetic processes (e.g. heavy mineral sands, uranium).

In the Australian context, geological evolution until the early Mesozoic displays an overall eastward-younging trend, as successive sedimentary basins and orogenic belts were added to Archaean cratonic nuclei in the west and centre of the present-day continent. Within South Australia, an Archaean core in the centre of the state is bounded on the west, north and east by orogenic belts related to the collision and assembly of crustal fragments at intervals during the Proterozoic. By ~1000 Ma, Australia is thought to have occupied a central position within the supercontinent Rodinia, being surrounded by parts of the present Antarctica, India, Siberia, China and North America. The southern margin of the amalgamated Proterozoic core of South Australia was joined to East Antarctica as the Mawson continent until the Mesozoic.

The early Neoproterozoic (1000–750 Ma) was a period of relative crustal stability, dominated by intracratonic sedimentation over much of the Australian continent, but active rifting commenced in eastern South Australia. Break-up of Rodinia followed during the late Neoproterozoic (750–540 Ma), with sedimentation on a passive continental margin bordering the proto-Pacific Ocean terminated by Cambro-Ordovician orogeny. To the east of South Australia from the middle Palaeozoic until the early Mesozoic, a series of rifted basins developed on thinned continental and some oceanic crust and evolved through basin closure and accretionary orogenesis into an eastward-younging series of fold belts comprising the majority of the Tasman Fold Belt System; this was a component of the assembly of the supercontinent Gondwana. In contrast, South Australia's geological history during this period, and continuing until the present, is dominated in the interior by stacked intracratonic sedimentary basins, while Mesozoic to Cainozoic sedimentary basins along the southern continental margin resulted from the rifting and separation of Antarctica from Australia during the break-up of Gondwana.

A summary geological map of the State (Fig. 3.1) shows generalised features of exposed rock units (Fig. 3.2). However there are many important rock units that are completely concealed below younger sedimentary provinces, and their distribution and nature are largely determined from drillhole intersections and regional aeromagnetic (Fig. 3.3) and gravity (Fig. 3.4) surveys. The locations and boundaries of the major geological provinces are given in a series of time-slice maps (Figs 3.5–3.6), and they are highlighted in the following text in **bold** lettering. Letter symbols in **[square brackets]** refer to the summary geological map and reference (Fig. 3.1). Time–space diagrams for the Precambrian (Fig. 3.7) and for the Mesoproterozoic–Cainozoic (Fig. 3.8) place major rock units and provinces in their temporal and spatial context. Details of those provinces considered most prospective for mineral discoveries, and of key commodities, can be found in the relevant sections later in this volume.

PRECAMBRIAN

The Precambrian geological record of South Australia spans the period from late Archaean (2700 Ma) to the end of the Neoproterozoic (540 Ma). The Precambrian geological provinces are the **Gawler Craton** (including the **Ammaroodinna**, **Yoolperlunna** and **Mount Woods Inliers**), **Cariewerloo Basin**, **Itiledoo Basin**, **Musgrave Block** and part of the **Officer Basin**, **Peake and Denison Inliers**, **Arunta Block**, **Coompana Block**, **Curnamona Province** (including the **Willyama**, **Mount Painter** and **Mount Babbage Inliers** and **Benagerie Ridge**), and part of the **Adelaide Geosyncline** and **Stuart Shelf**

Figure 3.5 Archaean to Late Carboniferous geological provinces and major events of South Australia in four time slices. The general locations, but not the limits, of the various orogenic events are shown. Also shown is the possible extent of preserved Neoproterozoic sediments in South Australia.

Figure 3.7 Precambrian time–space diagram for South Australia, showing the approximate time duration of significant igneous, sedimentary and selected metamorphic events, based primarily on U–Pb zircon dating. For details of individual units, refer to relevant chapter in this guide. Units with dashed boundaries have very poor age control, or their existence or identification is conjectural.

Figure 3.8 Mesoproterozoic to Cainozoic time-space diagram for South Australia, showing the approximate time duration of deposition within sedimentary basins and other significant events. Paler colouring signifies uncertainty in age. Basins and other entities are arranged approximately from north and west at top to south and east at bottom of diagram. Age data for The Pinnacles, Giants Head and The Needles from G Teale and G Mortimer (University of Adelaide, unpublished data).