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THE ADELAIDE GEOSYNCLINE -
Sedimentation and Tectonics
in the late Proterozoic of
South Australia

GEOLOGICAL SURVEY

by

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THE ADELAIDE GEOSYNCLINE - Sedimentation and tectonics in the late Proterozoic of South Australia

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The purpose of this article is to draw attention to a new geological map of the Adelaide Geosyncline and Stuart Shelf produced by the South Australian Department of Mines and Energy (a reduction is illustrated in Fig. 1). It is a compilation and revision of existing 1:250 000 scale geological maps produced by the Department over the last three decades, and is published at a scale of 1:600 000, as a compromise between detail and portability as a single map sheet measuring 888 x 1 258 mm. At a price of A$10.00 plus postage the map is available from the

South Australian Department of Mines and Energy,
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The Adelaide Geosyncline contains one of the thickest and most complete stratigraphic records of Adelaidean (late Proterozoic) to Early Cambrian sedimentation and tectonics anywhere in the world (Thomson, 1969; Rutland *et al.*, 1981). It is situated adjacent to the eastern margin of the older Precambrian Gawler Craton (Thomson, 1970), whose history spans the period from Archaean to mid Proterozoic. The thin flat-lying Adelaidean to Early Cambrian platform cover of the eastern Gawler Craton, deposited on the Stuart Shelf, thickens across the meridional Torrens Hinge Zone into the much more complete and folded succession of the Adelaide Geosyncline, exposed magnificently in the semi-arid Flinders Ranges (northern part of the map area, maximum elevation 1190 m) and moderately well in the temperate Mount Lofty Ranges in the south (maximum elevation 920 m). The Stuart Shelf sequence is known mainly from drillholes provided in recent years by base-metal exploration companies, and summary logs of some of the more informative of these holes are shown on the face of the map. A smaller but almost as stable platform, the Curnamona Cratonic Nucleus occurs to the east of the Flinders Ranges largely obscured by Tertiary and Mesozoic deposits.

The succession in the Adelaide Geosyncline has an aggregate maximum thickness of the order of 20 km, but since depocentres shifted laterally during sedimentation, no single section shows the maximum total thickness. The succession is almost entirely sedimentary, the only significant volcanics being basalts, tentatively dated at about 1080 Ma, that were extruded in the very early stages of rifting (Coats and Blissett, 1971; Mason et al., 1978), and very local andesite and basalt in the Early Cambrian (Forbes et al., 1972).

The lower Adelaidean part of the succession is essentially restricted to the now folded Adelaide Geosyncline. This region is interpreted to have been a rift system in the early stages of its evolution. Nevertheless, the early Adelaidean basic volcanics extend a little west of the Torrens Hinge Zone, and northwest trending basic dykes on the Stuart Shelf (Mason et al., 1978) suggest that this part of the Gawler Craton was also under tension. The lower Adelaidean sequence comprises the Callanna Group of basal clastics, carbonates, and basic volcanics followed by a cyclic, evaporitic clastic-carbonate succession (Forbes et al., 1981) and the younger Burra Group of deltaic clastics and intercalated less evaporitic carbonates. However, most contacts between these two groups are tectonic, and their original relationships are poorly understood. After deposition of the Burra Group, sedimentation ceased over the whole rifted basin and there was local tectonism which caused faulting of the Burra Group and diapirism of the evaporitic Callanna Group.

The upper Adelaidean deposits were not confined to the original rift, although syndepositional faulting did continue. They record a broad downwarping phase of basin development. The Umberatana Group contains records of two major glaciations (Sturtian and Marinoan) at its base and top respectively, in the form of laterally persistent diamictites and associated fluvioglacial and dropstone facies (Coats, 1981). In each case the glacials are followed by transgressive shaly and silty basinal deposits and succeeding upward-shallowing sequences. These units display a progressive westward and eastward onlap on to the adjacent platforms. In the Umberatana Group the regressive phases were associated with carbonate deposition (oolitic, sandy and stromatolitic) in marginal parts of the basin (Preiss, 1973).

The post-Marinoan glacial transgressive-regressive cycle is almost entirely clastic, and includes some flysch-like deeper shelf deposits; together with another overlying transgressive (including calcareous flysch-like deposits) and regressive (redbed and orthoquartzite) cycle, these make up the uppermost Adelaidean Wilpena Group. This second cycle contains the well known Ediacara assemblage of soft-bodied Metazoa, and is preserved only in the Flinders Ranges (Jenkins et al., 1983).

Sedimentation of the Wilpena Group was terminated by a regional hiatus and erosion (with local minor faulting only in the south), and resumed with a renewed marine transgression in the Early Cambrian over the Stuart Shelf, Adelaide Geosyncline and Curnamona Cratonic Nucleus (Cambrian sediments in the latter two areas are sometimes referred to as having been deposited in the Arrowie Basin; Wopfner, 1970). The coeval Hawker and Normanville Groups (respectively in the north and south) are carbonate-dominated, with both shelf and more basinal facies. Toward the end of the Early Cambrian, redbed clastic deposition became dominant in the Flinders Ranges, while very thick, partly deeper-water clastics were deposited in the south (Kanmantoo Group).

The youngest palaeontologically dated sediments are Middle Cambrian, but sedimentation may have persisted till the onset of the Cambro-Ordovician Delamerian Orogeny, which commenced with regional heating and granite intrusion in the south at about 510 Ma (Milnes et al., 1977). Three phases of folding affected rocks of the Mount Lofty Ranges (Offler and Fleming, 1968), where there is a strong westerly vergence. Folds in the Flinders Ranges are more upright. Dome and basin style folds in the central Flinders Ranges may reflect two interfering fold phases, and diapric breccias derived from disrupted Callanna Group sediments were intruded during or after folding (Mount, 1980). Sediments of the central Flinders Ranges have suffered little metamorphism but the sigmoidal fold arcs to the north and south (Fig. 1) show prominent cleavage development and greenschist facies metamorphism, grading in the southern arc from lower greenschist in the west to upper greenschist in the east. A zone of amphibolite facies metamorphism cuts slightly obliquely across the fold trends of the eastern Mount Lofty Ranges (Offler and

Fleming, 1968), and an arc of Delamerian granitoids rims the eastern boundary of the exposed southern fold arc. The present topography of the Delamerian fold belt results from Cainozoic rejuvenation of Delamerian faults and consequent uplift of the highland chain.

The map deals mainly with the stratigraphy of the Adelaidean rocks, and only these have been subdivided in detail. Despite facies variations between different regions of the Adelaide Geosyncline and a historical legacy of diverse and sometimes confusing stratigraphic nomenclature, it was possible to compile a single stratigraphic legend for the map, indicating synonymies and equivalences. Some of the more significant known economic mineral occurrences as well as stratigraphic drillholes are located on the map.

Bibliographic reference for Adelaide Geosyncline map:

Preiss, W.V. (compiler), 1983. Adelaide Geosyncline and Stuart Shelf: Precambrian and Palaeozoic geology (with special reference to the Adelaidean). 1:600 000 scale. South Australian Department of Mines and Energy.

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ADELAIDE GEOSYNCLINE AND STUART SHELF
PRECAMBRIAN AND PALAEOZOIC GEOLOGY
(with special reference to the Adelaidean)
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