

CHAPTER 7 Adelaide Geosyncline and Stuart Shelf

WV Preiss and RS Robertson

ADELAIDE GEOSYNCLINE AND STUART SHELF SUMMARY	2
Age	2
Prospective commodities	2
Major exploration models	2
Summary geology	2
TECTONIC SETTING	2
STRATIGRAPHY AND GEOLOGICAL EVOLUTION	7
Delamerian Orogeny	13
Younger igneous activity	14
MINERALISATION	14
Copper	14
Copper deposit descriptions	15
Stuart Shelf	15
Adelaide Geosyncline	18
Gold	22
Gold deposit descriptions	22
Nackara Arc	22
Mount Lofty Ranges	24
Lead and zinc	24
Adelaidean	24
Cambrian	25
Industrial minerals and dimension stone	27
Construction materials	27
KEY REFERENCES AND FURTHER READING	29



ADELAIDE GEOSYNCLINE AND STUART SHELF SUMMARY

Age

Sedimentation — Neoproterozoic to Middle Cambrian

Deformation — Delamerian Orogeny, Middle Cambrian to Early Ordovician, 514–485 Ma.

Prospective commodities

Cu, Au, Pb, Zn, diamonds, barite, magnesite, talc, kaolin, carbonate for industrial use, phosphate, dimension stone and construction materials.

Major exploration models

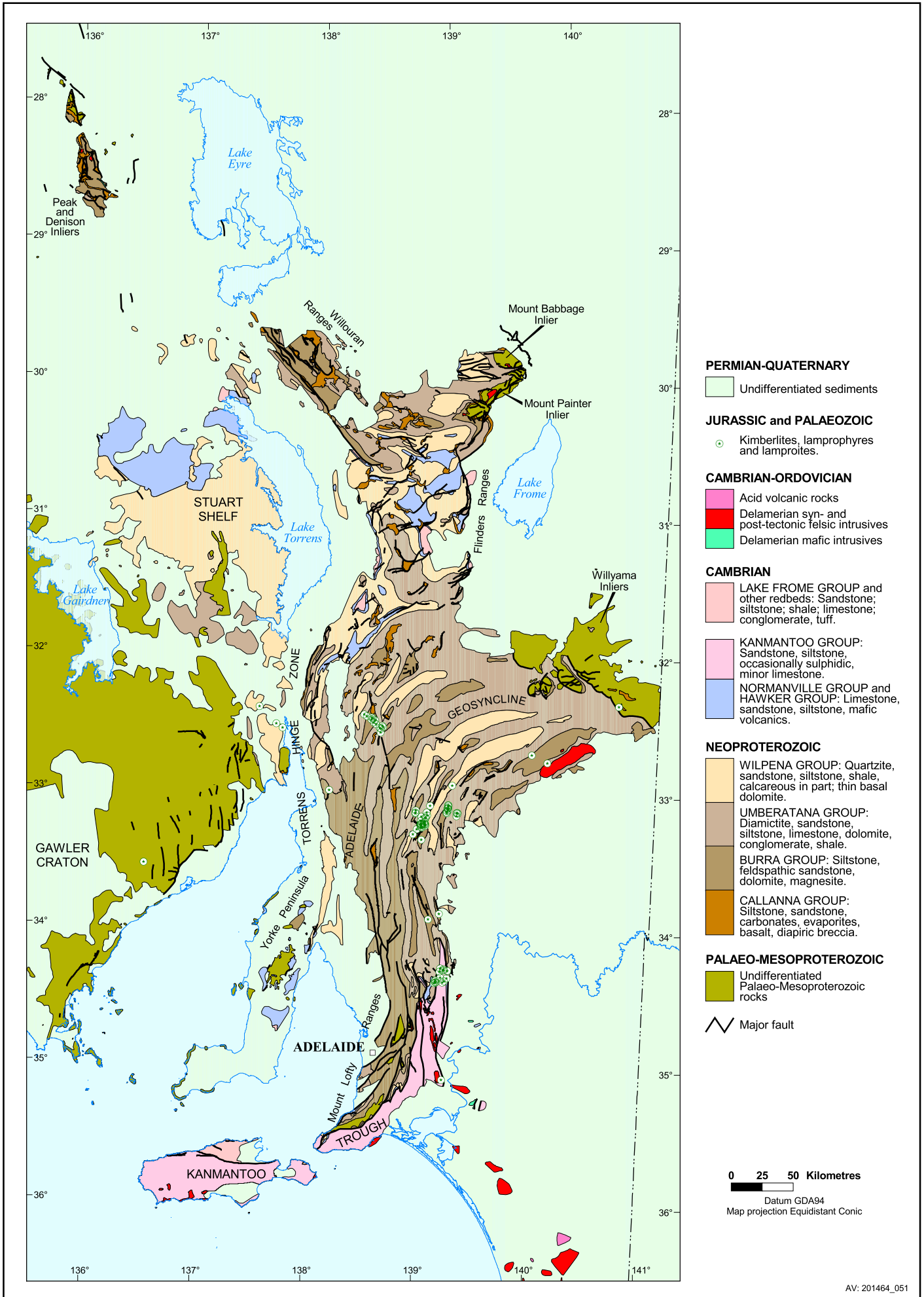
- Sediment-hosted copper (\pm cobalt)
- 'Oxide' copper (leachable)
- Mississippi Valley type (MVT) Pb–Zn
- 'Oxide' zinc (willemite, smithsonite)
- Reduced-shale-hosted Pb–Zn
- Vein gold (various styles including Telfer)
- Porphyry related Cu, Mo and Au
- Placer gold (?)
- Diamonds.

Summary geology

Deeply subsident sedimentary basin with at least four main phases of rifting in the Adelaidean (Neoproterozoic) and one in the Early Cambrian; 12 major transgressive–regressive cycles (sequence sets) in the Adelaidean, three in the Early to Middle Cambrian. Dominant lithologies are, in order of decreasing abundance, siltstone, sandstone (both mature and feldspathic), dolomite, limestone, diamictite, magnesite and conglomerate. Mafic lavas occur in the early Adelaidean and Early Cambrian. Relatively immature sandstone characterises the Cambrian Kanmantoo Group. Deformation occurred at ~500 Ma in the Delamerian Orogeny, and was strongest in the Fleurieu Arc, with granitoid intrusions in the eastern Nackara and Fleurieu Arcs, and in basement inliers of the northern Flinders Ranges. Metamorphic grade varies from sub-greenschist to mid-amphibolite facies.

TECTONIC SETTING

The Adelaide Geosyncline (Fig. 7.1) is a Neoproterozoic to Middle Cambrian complex of rift and sag basins flanking the eastern margin of the Gawler Craton (Parker, 1990), and containing very thick epicontinental, mostly marine sediments (Preiss, 1987, 1990, 1993, 2000). The area of sedimentation extended from near Oodnadatta in the north to at least Kangaroo Island in the south, but is likely to



AV: 201464_051

Adelaide Geosyncline and Stuart Shelf



Adelaide Geosyncline and Stuart Shelf

have continued into the then contiguous Antarctica where Neoproterozoic to Cambrian sediments occur in the Ross Orogen. The Torrens Hinge Zone is a meridional zone of synsedimentary faulting and flexuring which separates the Gawler Craton (unattenuated Precambrian crust) from the rifted basins of the geosyncline to the east. Thin platformal equivalents of the upper part of the Adelaide Geosyncline succession extend westwards onto the Gawler Craton, forming the Stuart and Spencer Shelves.

Despite the general continuity of sedimentation throughout the Adelaide Geosyncline, subdivision into a number of tectonic domains is possible on the basis of sedimentary facies and styles of deformation in the subsequent Delamerian Orogeny at ~500 Ma (Rutland et al., 1981; Preiss, 1993). The North Flinders Zone, an arcuate fold belt that is concave towards the north, contains mostly deeper water facies and is separated from the analogous Nackara Arc in the south (concave towards the southeast) by the Central Flinders Zone of generally open, dome-and-basin style folds and mostly shallower facies. The Curnamona Province, lying to the east of the Central Flinders Zone, was a high during much of the Neoproterozoic; the basement to the Central Flinders Zone appears to have been more stable and less attenuated than that to the north and south, and formed a link between the Gawler Craton and Curnamona Province. The southeastward convex Fleurieu Arc in the south underwent far greater crustal shortening than other domains, the dominant northwest tectonic transport suggesting strong plate convergence from the southeast during the Delamerian Orogeny; deformation was mildest in the Central Flinders Zone. The aeromagnetic image of the region (Fig. 7.2) gives an indication of shallow, intermediate depth and deep basement, characterised respectively by discrete high-frequency magnetic anomalies (e.g. Stuart Shelf), broad diffuse anomalies (e.g. Central Flinders Zone), and no visible basement anomalies (e.g. Nackara Arc, where high-frequency anomalies originate from Adelaidean rocks). Gravity data (Fig. 7.3) also help to define the deeper sedimentary troughs, although the reasons for major gravity highs within the Adelaide Geosyncline are at present poorly understood.

According to a number of published continental reconstructions, Australia–Antarctica was contiguous with western North America until ~700 Ma, when continental separation followed initial rifting at ~800 Ma (Powell et al., 1994). The Adelaide Geosyncline thus records the formation of the eastern margin of the Australian continent, to which juvenile crustal elements were subsequently accreted during the Palaeozoic in the Tasman orogenic system. The North Flinders Zone and Nackara Arc may have faced an opening ocean at least during the later stages of evolution, but continental crust is likely to have extended at least as far east as the South Australia – Victoria border.