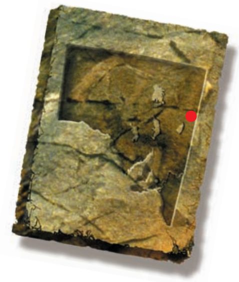

CALLABONNA 1:250 000 geological map released

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Introduction

The CALLABONNA map area, which lies adjacent to the NSW border between latitudes 29° and 30°S and longitudes 139°30´ to 141°E, includes the southern end of the Strzelecki Desert and the northeastern Flinders Ranges. Cameron Corner adjoins Queensland and NSW in the northeast. The two large ephemeral drainage sinks of Lakes Blanche and Callabonna occupy the northwest and central parts of the area. Strzelecki Creek derives from Coopers Creek and terminates in Lake Blanche.

The Flinders Ranges in this area are composed of highly deformed Palaeoproterozoic metasediment rafts and keels supported by variably deformed Mesoproterozoic granitoids and volcanics. Unconformably overlying these are the folded Neoproterozoic sedimentary rocks of the Adelaide Geosyncline. Partly overlying these and forming the surrounding plains are sediments of the Cambro-Ordovician Arrowie and Warburton Basins; the Carboniferous to Permian Cooper Basin; the Mesozoic Eromanga Basin; the Tertiary Lake Eyre Basin; and the Quaternary Callabonna Sub-basin.

Background

Early exploration of this area began with Edward J. Eyre in 1840, Captain Charles Sturt in 1845 and B.H. Babbage in 1856. All three provided the first written accounts of the region's geomorphology, climate and biology. Geological investigations began with H.Y.L. Brown (1880s) and Douglas Mawson (1912–40s) followed later by many Department of Mines geologists. Systematic Geological Atlas Series mapping began in this area with the *Moolawatana* 1 inch to 1 mile scale map in the mid 1950s. In 1969, R.P. Coats and A.H. Blissett released the more advanced regional *Mount Painter Province* map at 1:125 000 scale. Mapping at larger scales for CALLABONNA and its six 1:100 000 sheet components commenced in 1988 with R.A. Callen (to 1990) and was completed by M.J. Sheard (1989–96), with contributions from several Geological Survey geologists. A total of 102 rock units have been recognised on CALLABONNA during this survey.

Geology

The oldest rocks form part of the uplifted Flinders Ranges and belong to the Palaeoproterozoic Radium Creek Metamorphics (schists, quartzites, volcanics and epiclastics, calcsilicates, paragneiss, marble) deposited under terrigenous fluvial to ?marine conditions. Correlations between these rocks and those of the Willyama Supergroup of the Olary Province (further south) have been made by other workers. However, the link is tenuous due to stratigraphic isolation and a lack of dating. The Radium Creek Metamorphics were deformed prior to and by the emplacement of a series of granitic plutons with associated volcanics (Mount Neill Granite, 1569±14 Ma; Petermorra Volcanics, 1560±2 Ma; Moolawatana Suite, ~1556 Ma). Together, these form the ancient crustal segment of the Mount Babbage and Mount Painter Inliers in the northwest of the Curnamona Province. A long hiatus ensued, where uplift and erosion stripped away a considerable portion of this earlier crust. Mafic dykes (andesite, basalt, dolerite, gabbro) were injected into these inliers between ~1100 and ~800 Ma during a time of major crustal tension. Unconformably overlying the inliers are the Neoproterozoic Adelaide Geosyncline sediments. The oldest of these are the Willouran age Callanna Group (quartzite) followed by the terrigenous fluvioglacial to marine Umberatana Group (quartzite, diamictite, sandstone, siltstone, mudstone, dolomite, calcsilicate) of Sturtian to Marinoan age. Many unconformities have been found within this thick sequence on CALLA-BONNA.

Easterly view towards Mount Babbage (322 m AHD), a silicified outlier of Cretaceous Parabarana Sandstone unconformably overlying early Mesozoic Bopeechee Regolith developed in Mesoproterozoic Terrapinna Granite. Benches of Parabarana Sandstone (centre) mark the edge of a down-thrown basement block adjacent to the Babbage Thrust Fault. (Photo 47757)

Drilling and high-resolution seismic profiling have revealed Cambrian to Ordovician sediments of the Arrowie and Warburton Basins (redbeds, sandstone, ?limestone, ?shale) unconformably overlying the Adelaide Geosyncline sequence around the basement outcrop and underlying the surrounding plains. During the ~500 Ma Delamerian Orogeny, the Neoproterozoic and Cambrian Adelaide Geosyncline succession was folded into moderate to tight anticlines and synclines by a north–south compressional regime. A strongly developed east–west to southwest–northeast-aligned mica cleavage developed throughout the basement and geosynclinal rocks during this episode. The Cambro-Ordovician rock sequence of the Warburton Basin was not deformed by this orogenic process. Granitoid plutons were injected into the basement and geosynclinal metasediments towards the waning phase of the Delamerian (Mudnawatana Tonalite, 427±133 Ma). Abundant very coarse-grained pegmatites (tourmaline bearing) from these extend well out into the host country rock.

Post-Cambro-Ordovician cover has been revealed by petroleum exploration deep drilling and seismic work in the northern part of CALLABONNA (Cherri 1, Fortville 3, Gurra 1, Paxton 1, Tinga Tinga 1, Weena 1). The drillholes have intersected the Early Carboniferous to Early Permian Cooper Basin (terrigenous, glacial, fluvial, lacustrine) sequence of conglomerate, diamictite, sandstone, siltstone, mudstone, claystone, coal and carbonaceous equivalents. Between the Mount Babbage Inlier and Lake Blanche, an isolated unnamed basin containing presumed Cooper Basin equivalents has been revealed by gravity and high-resolution seismic profiling (shown on the Tectonic Sketch and Cross-section). Although no hydrocarbons have been intersected by exploration, several structures and potential traps remain to be investigated and tested.

Mesozoic Eromanga Basin sediments are volumetrically by far the most abundant in this area. They unconformably overly the Bopeechee Regolith surface, a deep chemical weathering profile formed during the time range of latest Permian to earliest Cretaceous. The lower part of the Eromanga Basin includes a Jurassic to Early Cretaceous sequence of terrigenous, fluvial and lacustrine sediments of an unnamed group (sandstone, siltstone, mudstone, coal, calcareous and carbonaceous equivalents). The middle and upper components belong to the Cretaceous Neales River Group of terrigenous, fluvial, periglacial, lacustrine and marine sediments (sandstone, siltstone, mudstone with lonestones, diamictite, minor coal). Remnants of these rocks also occur on the uplifted Mount Babbage Inlier, indicating a much larger depositional range than the currently exposed basin edge indicates.

Beginning in the early Tertiary and then sporadically from then on, rocks of the Flinders Ranges were uplifted predominantly by block faulting to elevations of 100–>400 m above the surrounding plains. Cainozoic rocks cover most of the Eromanga Basin sequence and are all terrigenous in origin. Between these two sequences lies a deep chemical weathering profile surface designated as the Mulligan Dam Regolith (new name) of presumed Paleocene age. The overlying Tertiary sequence includes Paleocene–Eocene Eyre Formation (fluvial gravel, sand, silt), Oligocene–Pliocene Namba Formation (lacustrine dolomite; fluvio-paludal mud and sand) and Miocene–Pleistocene Yandruwantha Sand (fluvial). Cementing many of the upper surfaces of these units are a series of armouring silcrete zones of ?late Eocene and ?Miocene to ?Pliocene age. Over 25 units comprise the Quaternary lithostratigraphic subdivision. Most important of these are the Pleistocene Willawortina, Millyera, Coombe Springs, Eurinilla and Coonarbine Formations. Extensive Pleistocene–Holocene units include the Simpson Sand, Tingana Clay, unnamed lacustrine deposits, alluvial fan sequences and mound spring deposits.

Fossils

Fossils found on CALLABONNA include poorly preserved Neoproterozoic stromatolites, and Cambro-Ordovician trace fossils. Trace fossils, shelly fauna, carbonaceous flora and coal have been recovered from the Cooper and Eromanga Basin sequences. The Neales River Group often contains abundant shells, calcified wood and animal burrows. Leaf impressions and some small animal burrows occur within the early to middle Tertiary units, but are not common. Quaternary units have yielded some spectacular bones from the once common Australian Mega Fauna. These finds came mostly from the Lake Callabonna Fossil Reserve and include *Diprotodon* sp. and the giant Emu *Genyornis newtoni*.

Economic minerals

Copper was discovered in the 1880s at Parabarana Hill, and mining took place for several years. Many other small copper prospects were subsequently worked ('alphabet mines' — H, I and J; Con Bore and Brindana) or recorded as occurrences (Prospect Hill, Yerila Creek). Exploration over the last three decades has indicated Ag, As, Co, Mo, Pb, Sn, U, W, Zn, REE and trace Au mineralisation in basement hosts; the Prospect Hill 'Southern Prospect' is the most significant. Minor uranium and REE have been reported from sediments surrounding the ranges.

Talc, discovered in 1944 near Mount Fitton and mined since the late 1940s, is

Diprotodon from the Lake Callabonna Fossil Reserve. (Photo 47758)

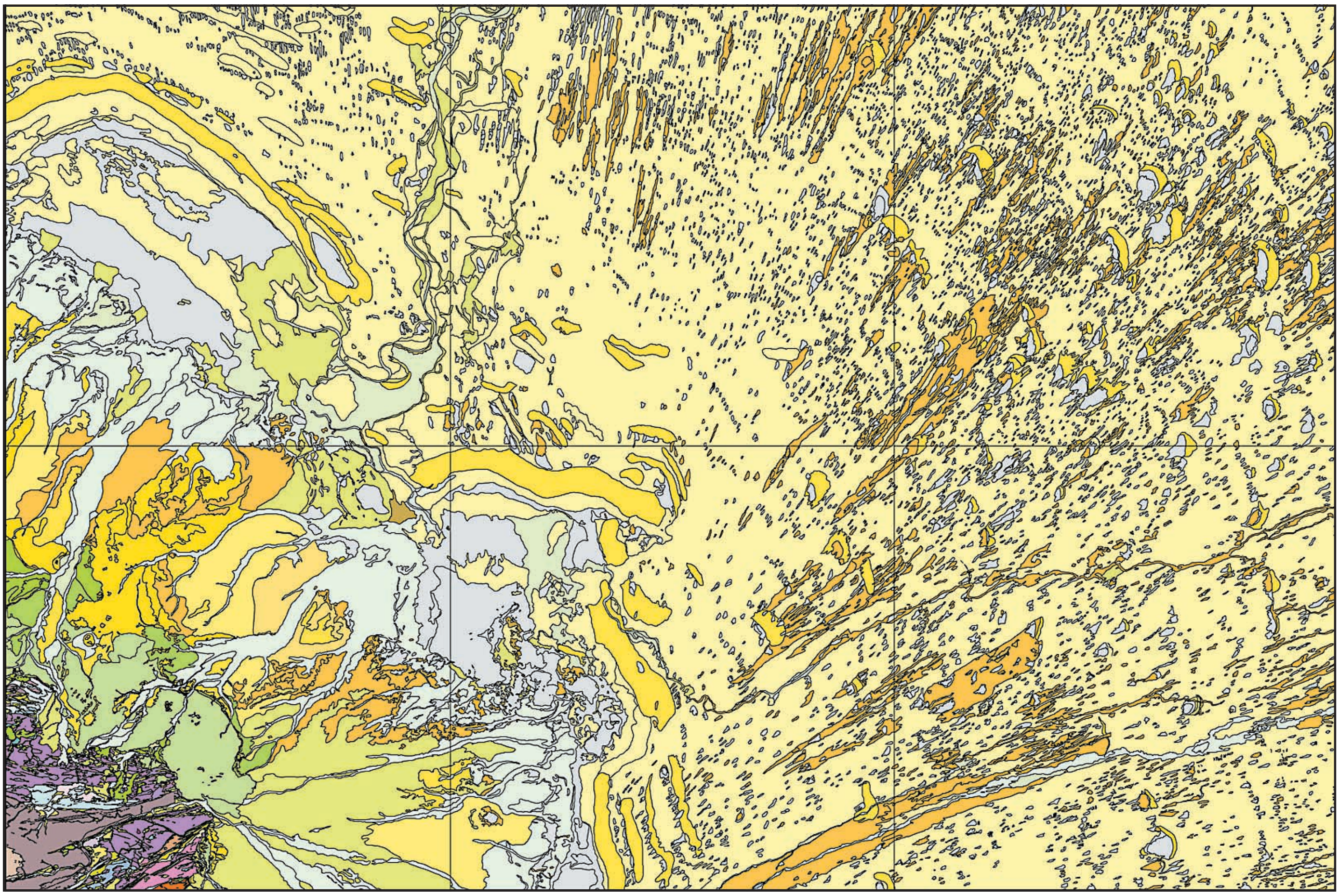

Fig. 1 Reduced image of the CALLABONNA 1:250 000 geological map.

currently the most important mineral export from this area. Other mineral occurrences of note are muscovite books, celestite, fluorite, dolomite and magnesite.

Groundwater is a valuable and widely used pastoral commodity. A significant amount is drawn from the Eromanga Basin artesian and sub-artesian aquifers via bores drilled mostly between 1897 and 1960.

Economic potential

The exposed basement inliers remain highly prospective for base metals (Cu, Mo, Pb, Sn, W, Zn) plus Ag and Au. Buried easterly extensions of this outcrop form the northern Benagerie Ridge which is similarly prospective. Many of the basement granitoids carry very elevated REE signatures; these have provided sources to elevated U, Th and REE signatures within Tertiary sediments of the surrounding plains. Sedimentary uranium deposits (roll fronts) are a prospective target in this area. Hydrocarbons remain a potential target within the Cooper and Eromanga Basin sequences; the unnamed ?Carboniferous–Permian basin north of Mount Babbage has not been drilled or tested.

The CALLABONNA map

The CALLABONNA geological map (by M.J. Sheard and R.A. Callen, Fig. 1) is part of the 1:250 000 Geological Atlas Series of lithographic prints depicting surface geology. The map includes a geological reference, cross-section, rock-relation diagrams, tectonic sketch and geophysical image. It was produced by cartographers in the PIRSA Spatial Information Services Branch using cartographic options from ArcInfo software to achieve the high standard required for publication. A further benefit from this process is the availability of digital geological data for the area, and is the fifth map in the 1:250 000 series produced by the digital method. For maximum clarity, ease of production and lowest cost, the map has been printed on an offset press (500 copies).

CALLABONNA is the first in a new folded format that will appeal to travellers and geologists alike. It is bound with a durable outer cover and will comfortably fit in a bushwalker's back pocket, geologist's rucksack or tourist's vehicle glove compartment. The cover is printed with information on a range of interesting topics, including an index to key geographic features, geomorphology and geology, flora and fauna, fossils and local history.

The map, priced at $11 (inc. GST), will be available from relevant tourist outlets and bookshops, as well as PIRSA Customer Services, 101 Grenfell Street, Adelaide. It is proposed to add a mini CD to this new format by late 2001 or early 2002, which will contain Explanatory Notes, photos and a GIS version of the printed map. Digital copies in flat format are also available on request.

For further information contact Malcolm Sheard (geology, ph. 08 8338 0073) or John Ragless, Spatial Information Services (cartography, ph. 08 8463 3302).