DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

OPEN FILE

REPT.BK.NO. 85/10

GEOLOGY OF EYRE PENINSULA

GEOLOGICAL SURVEY

by

A.J. Parker[1]

C.M. Fanning[2]

R.B. Flint[1]

1. South Australian Department of Mines and Energy, P.O. Box 151, EASTWOOD, S.A. 5063.

2. Australian Mineral Development Laboratories, P.O. Box 114, EASTWOOD, S.A. 5063

Contribution to proposed Royal Society of S.A. publication "Natural History of Eyre Peninsula".

OCTOBER, 1984

DME.528/81

CONTENTS

TABLES

FIGURES

15. Coastal cliff exposure of the Bridgewater Formation near Elliston featuring a 12 m thick sequence of nodular calcrete (oldest horizon), an overlying aeolianite with large foresets and solution pipes (note geohammer for scale), silty clay and basal calcrete clasts, and upper aeolianite.

16. Aeolianites and calcretes of the Bridgewater Formation overlying wave-washed platform of Middle Proterozoic Blue Range Beds near Talia Caves.

17. 130 m high cliff at Cape Wiles displaying alternating cross-bedded aeolianite and calcrete horizons (Bridgewater Formation).

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT BK NO. 85/10
DME NO. 528/81
DISK NO. 33

GEOLOGY OF EYRE PENINSULA

INTRODUCTION

Early descriptions of the geology of Eyre Peninsula by Tate (1882), Brown (1908), Jack (1914, 1922), and Tilley (1920 a & b; 1921 a & b) recognised the antiquity of crystalline rocks forming the hills in the Port Lincoln, Tumby Bay, and Cowell-Cleve regions. They noted the complex geological processes to which those rocks have been subjected and Tilley's work in particular demonstrated that the rocks had once been deeply buried within the earth's crust, to depths where rock temperatures and pressures were very high. The rocks have since been uplifted at least once to form mountain chains then subsequently eroded down to form sediments which were deposited firstly in the Adelaide Geosyncline 1100-600 million years ago then later in Spencer and St Vincent Gulfs.

Numerous refinements have been made to this basic concept (Miles, 1955; Johns, 1961) but none so dramatic as those resulting in the last fifteen years from the use of structural geological and isotopic dating techniques which have allowed much more precise determination of the absolute age and evolution of the rocks.

The following account synthesises both previous and recent geological studies and presents a summary of the region's geological development. Even now, one hundred years after the first geological description of the area, many questions remain to be answered about the geological history of this fascinating region which contains some of the most ancient rocks and valuable mineral deposits in South Australia.

TECTONIC SETTING

Eyre Peninsula is part of a major tectonic province known as the Gawler Craton. The Gawler Craton takes in Yorke Peninsula, the Gawler Ranges, from which it derives its name, and that vast region of central South Australia extending west of Lake Torrens north to Marla and as far west as Ooldea. To the south the Gawler Craton includes the continental shelf. Prior to the break-up of Gondwanaland it was attached to Antarctica in the region around Commonwealth Bay, site of Sir Douglas Mawson's famous hut.

The Gawler Craton is defined as a geologically stable piece of the Earth's crust which has not in recent times been subject to major tectonic forces such as those occurring in active volcanic chains and along the fractured and earthquake-prone west coast of North America. The Gawler Craton has been tectonically stable since c. 1450 Ma (Ma=million years) and therefore its boundaries are defined by those crustal regions which have been active or deformed since that time. The Adelaide Geosyncline or Adelaide Fold Belt, represented by the Mt Lofty and Flinders Ranges, was tectonically active up until c. 460 Ma so therefore defines the eastern margin of the Gawler Craton. Likewise the Musgrave Block to the north has been active since 1450 Ma so therefore defines the northern margin, while the edge of the continental shelf, being the edge of the Australian continent, defines the southern margin.

Evolution of the Gawler Craton dates back to at least 2700 Ma. Rocks older than that are not known on Eyre Peninsula nor anywhere in the craton. The oldest gneisses were probably formed from sedimentary rocks deposited on the margin of a much older craton maybe connected to the Yilgarn Block/Kalgoorlie region in Western Australia. Subsequent evolution led to the progressive accretion of younger sediments and volcanics essentially from west to east. When the Gawler Craton was stabilised c. 1450 Ma the processes of accretion continued progressively further east; firstly in the Adelaide Geosyncline then later on further east in what is now known as the Tasman Fold Belt, constituting much of eastern Australia.

GEOLOGICAL HISTORY

The geological evolution of Eyre Peninsula (Figs 1 & 2) spans some 2700 million years and represents the most complete record of crustal evolution seen in South Australia. The oldest rocks on Eyre Peninsula are of late Archaean to earliest Proterozoic age (c. 2700-2300 Ma) and are known as the Sleaford Complex. They are similar to Archaean rocks in many parts of the world and have been through a number of complex metamorphic, igneous and deformational events which have transformed them into a series of contorted gneisses.

These gneisses are overlain by a sequence of iron-bearing sediments known collectively as the Hutchison Group (Table 1). Iron ore has long been derived from these rocks in the Middleback Range but the rocks are also prospective for many other minerals and metals including jade, marble, copper, lead, zinc, silver, uranium and manganese.

Stratigraphic relationships between the Hutchison Group and volcanics in the immediate vicinity of Iron Baron, the Myola Volcanics, are not known. However, the Myola Volcanics are likely equivalent to the Moonta Porphyry which hosts the formerly large copper deposits of Yorke Peninsula.

Like the Sleaford Complex, the Hutchison Group and Myola Volcanics have been complexly deformed and metamorphosed and the events to which this deformation and metamorphism are ascribed are known as the Kimban Orogeny. Zones of extremely high strain were produced by the Kimban Orogeny and these contain mylonitic rocks; rocks that form due to relatively rapid, severe movements within the earth's crust.

Granites which were emplaced both during the Kimban Orogeny and shortly thereafter are numerous throughout Eyre Peninsula. Apart from their value as building stone, these granites contain traces of metals including tungsten and uranium. Those granites intruded during the orogeny belong to the Lincoln Complex, a series of granitic and gneissic rocks of rather nebulous origin and including now unrecognizeable remnants of the Sleaford Complex and Hutchison Group.

The early Middle Proterozoic era (c. 1600-1400 Ma) was a period of extensive volcanism on northern Eyre Peninsula accompanied by widespread, predominantly fluvial sedimentation. Volcanics occur at Moonabie, Mt Cooper, the Nuyts Archipelago and throughout the Gawler Ranges - one of the largest acid volcanic complexes known anywhere in the world. Volcanism occurred contemporaneously with fluvial (and locally lacustrine and shallow marine) sedimentation and volcaniclastic grits at Moonabie and tuffaceous beds at Corunna atest to this.

There was a local, relatively weak deformation event following deposition of the Corunna Conglomerate and extrusion of the Gawler Range Volcanics, but this heralded a change in the tectonic environment of Eyre Peninsula leading to formation of the Gawler Craton.

Ensuing sedimentation on the Gawler Craton to the end of the Precambrian (c. 570 Ma) was largely controlled by epeirogenic (or fault) movements and the relative rising and falling of sealevels. On Eyre Peninsula the record of this sedimentation was restricted principally to the northeastern area between Whyalla and Port Augusta.

Palaeozoic tectonic events which moulded the Adelaide Geosyncline into the fold belt as we now know it did not affect Eyre Peninsula. Possible Cambrian red beds and evaporites have been deposited in the Polda Basin and Permian glacials certainly occur in the subsurface of the Polda Basin, but elsewhere on Eyre Peninsula there is no record of Palaeozoic sedimentation. The same is also true of Mesozoic sedimentation since the Jurassic coal-bearing formations near Lock in the Polda Basin are the only record of such sedimentation on Eyre Peninsula. However, initial separation of the Australian continent from Antarctica occurred during the Mesozoic era, and Mesozoic sediments are more extensive offshore along the continental shelf.

During the Cainozoic era Eyre Peninsula was blanketed by fairly thin, largely alluvial sediments. Several small basins developed around the margins of the peninsula and these locally contain uraniferous lignites below marginal marine sands and limestones. However, the aerially most extensive deposits that we now see today, the surficial deposits, were formed during the last one million years of earth history. Extensive aeolian sand dunes, alluvial sands, silts and conglomerates, and thin but often very hard, calcareous layers form a thin veneer rarely more than a few metres thick covering almost the entire peninsula.

EARLY PRECAMBRIAN RECORD

Ancient Archaean to very Early Proterozoic crystalline rocks of Eyre Peninsula, the Sleaford Complex, are exposed mainly around the southern and southwestern coastlines. They are more sporadic in inland areas west and northwest of Kimba, and between Kimba and Cowell, are interfolded with Hutchison Group rocks (Parker, 1983).

Along the southern coastline the Sleaford Complex is composed of two distinct elements, a highly metamorphosed, supracrustal sequence (the Carnot Gneisses, Fanning et al., 1981), and a slightly younger, higher crustal-level suite of granitoids known as the Dutton Suite (Parker et al., 1981).

The Carnot Gneisses (Table 2) form an extensive layered sequence consisting dominantly of thinly layered, garnetiferous quartzofeldspathic gneisses (Fig. 3). These are often intimately intercalated with thin layers of leucogneiss, biotite-garnet gneiss, hypersthene-bearing felsic gneiss and basic granulite. Other less abundant but noteworthy felsic lithologies include augen gneiss, plagioclase gneiss, cordierite-garnet gneiss and coarse to medium, even-grained, garnetiferous granite gneiss. Minor calc-silicate gneiss is also present.

Although they occur in equivalent supracrustals northwest of Tarcoola (Daly et al., 1978), banded iron formations are notably absent from the Carnot Gneisses. However near Kyancutta in Warramboo WD1 drill hole, magnetite-bearing horizons do occur within a sequence of layered garnetiferous quartzofeldspathic gneisses which might represent more northerly occurrences of the Carnot Gneisses (Fig. 4).

High-level granitoids of the Sleaford Complex, the Dutton Suite, crop out in the southwest of Eyre Peninsula and offshore in the Whidbey Islands (Fig. 5). These granitoids are intrusive into layered quartzofeldspathic gneisses (Wangary Gneisses) on Coffin Bay Peninsula and west of Lake Hamilton, however relationships with the Carnot Gneisses have not been observed.

It is suggested that the Wangary Gneisses represent less-metamorphosed equivalents of the Carnot Gneisses.

The Sleaford Complex is represented in the Cowell-Cleve-Kimba region by the Miltalie Gneiss, a variably migmatized, grey, medium-grained gneiss of granodioritic composition containing numerous concordant amphibolites. In the Plug Range area, the Miltalie Gneiss is structurally overlain by the Warrow Quartzite and although it has an isochron age of 1697 ± 65 Ma, it is considered to be the northern equivalent of the Wangary Gneisses or Carnot Gneisses. The Rb-Sr age in this case reflects isotopic resetting during the Kimban Orogeny.

EARLY PROTEROZOIC RECORD

Hutchison Group

The Hutchison Group is a mixed clastic (sand, silt, shale) and chemical (limestone, iron formation) sedimentary sequence consisting of a basal quartzite unit, the Warrow Quartzite, interlayered clastic, carbonate and iron formation facies (Middleback Subgroup), and an upper psammopelitic unit, the Yadnarie Schist (Table 3).

At Marble Range and Coles Point on southern Eyre Peninsula and at Caralue Bluff and Darke Peak on central Eyre Peninsula, Warrow Quartzite unconformably overlies gneisses of the Sleaford Complex. Contacts are for the most part obscured by scree, nevertheless, cross bedding and quartz-pebble beds at or near the base confirm structural relationships.

To the east in the Tumby Bay and Cowell-Cleve region sedimentary features have not be observed. More intense deformation and metamorphism may be responsible for the apparent lack of these observations, but it is considered more likely that their absence reflects a change in sedimentary palaeoenvironments. At the base of the Warrow Quartzite northwest of Cowell, there are local calc-silicate/dolomite/podded sillimanite gneisses while in the upper Warrow Quartzite there are a number of pelitic schist interbeds. This led Parker and Lemon (1982) to believe that the Warrow Quartzite represents a fluvial to marginal marine, sandy arkose sequence with fluvial sediments represented in the west and more distal, progradational marine sediments represented in the east.

Mixed chemical and clastic metasediments of the Middleback Subgroup represent a number of cyclic transgressions and regressions of the sea either across a continental shelf or within a major basin deepening to the east. Pelitic schist interbeds (formerly shales) (Fig. 6) at the top of the Warrow Quartzite represent the first transgression. Local sequences from quartzite into pelitic schist, dolomite, carbonate facies iron formation, silicate facies iron formation and oxide facies iron formation (Table 3) are believed to represent progressively deepening water and more distal sedimentary facies. These facies variations within the Katunga Dolomite and Lower Middleback Jaspilite at any one locality can also be traced across the former shelf or basin and may indicate more distal facies to the east in the Middleback Range. In the Cleve region for example, both the Lower and Upper Middleback Jaspilites are relatively depleted in iron but enriched in carbonate by comparison with classical sections in the Middleback Range. Furthermore graphitic quartzites which were originally carbonaceous cherts before metamorphism, occur north of Cleve at the same stratigraphic level as iron-rich jaspilites in the Middleback Range.

A major influx of clastic sediments seen as the Cook Gap Schist followed deposition of the Lower Middleback Jaspilite. Parker and Lemon (1982) suggested that this represented regression of the shoreline perhaps back across the shelf or basin eastwards. Alternatively however, the influx of clastics may represent a change in the source region reflecting either renewed tectonic uplift or volcanism.

Deposition of the Upper Middleback Jaspilite occurred in almost identical sedimentary environments to those in which the lower iron formation was deposited. This might represent a second major transgressive cycle while the overlying Yadnarie Schist represents a return to clastic sedimentation similar to that which formed the Cook Gap Schist.

Minor local perturbations superimposed on these macroscopic facies variations are clearly evident by the "meso-banding" so well developed in the Upper Middleback Jaspilite at Mangalo Creek northwest of Cleve. Here alternating dolomite and jaspilitic chert bands several millimetres thick represent minor cyclic pulses superimposed on the regional cycle. This "mesobanding" may be analogous to mesobanding in classical Hamersley Group and Lake Superior-type iron formations (eg. Trendall, 1976). Such mesobanding has been taken to represent annual or seasonal perturbations in sedimentation and diagenesis.

Definite volcanics are absent in the Hutchison Group but there are numerous conformable amphibolites in the Cook Gap Schist. These are of quartz tholeiite composition and probably represent either mafic volcanic extrusions or mafic sills intruded very early before deformation. Similar amphibolites occur in the Willyama Supergroup at Broken Hill and Olary. Acid gneisses of possible volcanic origin like the Potosi Gneiss at Broken Hill (Laing et al., 1984) are however absent which may account for an apparent lack of Broken Hill-style silver + lead + zinc mineralization. Instead, most of the silver + zinc mineralization on Eyre Peninsula is intimately associated with dolomitic carbonates and calc-silicates such as the Katunga Dolomite, carbonate and graphitic facies of the Lower and Upper Middleback Jaspilites, and calc-silicates at the base of the Warrow Quartzite.

Myola Volcanics and associated rocks

While acid volcanics have not been identified within typical Hutchison Group sequences anywhere on Eyre Peninsula, east of the Middleback Range there is a prominent sequence of weakly metamorphosed rhyolites and rhyodacites known as the Myola Volcanics (Table 3). These are associated with gabbroic amphibolites, fine-grained laminated quartzites, and slaty schists, the Broadview Schist unit. There is no obvious connection between these units and the Hutchison Group, but because of the absence of acid volcanics elsewhere from the Hutchison Group and because of their lower metamorphic grade, the Myola Volcanics and Broadview Schist are believed to represent a younger volcanosedimentary sequence perhaps formed early during the Kimban Orogeny. Texturally the rhyolites/rhyodacites resemble acid porphyries from the Moonta district, inviting direct correlation (NB. the classical association of Moonta

Porphyry with the c. 1510 Ma Gawler Range Volcanics is not valid in terms of textural and fabric evidence and furthermore Rb-Sr dating of deformed acid volcanics from Wardang Island gives an age c. 1735 Ma (Fanning, in press)).

Deformation

Two major periods of complex deformation, metamorphism and plutonism have been recognized in the southern Gawler Craton. They are the Sleafordian Orogeny which culminated c. 2300 Ma and the Kimban Orogeny which extended from c. 1820 Ma to c. 1580 Ma (Webb et al., in press). The Sleafordian Orogeny affected Archaean rocks throughout Eyre Peninsula and was a high-metamorphic-grade gneiss-forming event(s) accompanied by both mafic (early) and acid (late) plutonism. Because of overprinting by the subsequent Kimban Orogeny, resolution of the exact nature of the Sleafordian Orogeny has not yet been possible, although some specific plutonic events forming the Dutton Suite granitoids have been dated (Table 2).

The Kimban Orogeny locally affected western Eyre Peninsula, but was most intense in eastern Eyre Peninsula. In the Cowell-Cleve region, the Tumby Bay-Cummins region and the Middleback Range, three main tectonic events can be identified (Fig. 2): an early high-grade upper amphibolite to locally granulite facies metamorphic event, M_1; a high-grade, isoclinal fold event possibly with associated thrusting, D_2; and a lower-grade, open fold event, D_3, with associated development of major mylonite zones, D_M. Principal structural characteristics of each of these events are outlined by Glen et al. (1977) and Parker and Lemon (1982) but briefly they are as follows:

Event 1 (M_1) - a high-grade fabric-forming event not obviously related to folding but producing a layer parallel foliation, S_1, defined by the crystallographic alignment of mica and sillimanite, and by inclusion trails in garnet and andalusite porphyroblasts. S_1 is commonly only observed in the hinge zones of F_2 folds; elsewhere it is parallel to and indistinguishable from S_2 (see below).

Event 2 (D_2) - a high-grade deformation/metamorphic event characterized by very tight to isoclinal folds F_2 with pervasive axial planar fabrics S_2 developed. These fabrics include a strong mica (or amphibole) schistosity, a local segregation schistosity or metamorphically differentiated layering, the platy alignment of elongate or discoid sillimanite aggregates, garnet, feldspar and quartz, and an often quite strong, quartz-rod lineation. Transposition on a mesoscopic scale is frequent and may also be important on a macroscopic scale.

Event 3 (D_3) - a lower-grade, retrogressive, deformational event characterized by broad, tight to open folds F_3 and crenulations, and local, highly-strained, mylonite zones. By contrast to F_2, D_3 folds generally lack a strong axial planar schistosity but within the mylonite zones variable fabric development from weak (incipient mica orientatin) to strong (slaty ultramylonite) is evident (Figs 10 & 11) (Parker, 1980).

The macroscopic tectonic effects that these combined events had on shaping Eyre Peninsula were enormous. It is estimated that the shelf region upon which the Hutchison Group was deposited was originally very wide: that is, a conservative estimate from unfolding D_3 folds would suggest that Cowell and Cleve would have been at least 1.5x further apart and that unfolding of D_2 folds would at least double that figure. Therefore the former continental shelf represented now by the Cowell and Cleve region may have been originally more than 100 km wide.

The mylonite zones also had a significant effect on shaping Eyre Peninsula (Fig. 1). The Kalinjala Mylonite Zone which extends from just west of Port Lincoln north through Port Neill to just west of the Middleback Range is locally over 2 km wide yet is only one of many: there being at least three such zones between Whyalla and Kimba. If lateral movement along these zones was important in their formation then the rocks in the Middleback Range may have been formed much further south relative to their present position eg. towards Cowell or even Port Lincoln.

East of the Middleback Range and in the zone extending under Spencer Gulf to upper Yorke Peninsula, the various units record varying degrees of deformation. The Broadview Schist and Myola Volcanics are clearly deformed by D_3 folds and crenulations, but while D_3 deforms a strong layer-parallel slaty schistosity, there is no obvious evidence of D_2 or M_1. It is considered however that the slaty schistosity is probably related to D_2. McGregor Volcanics and Moonabie Formation grits are locally deformed (open folds) suggesting that they may have been deformed by D_3 but not D_2.

Metamorphism

As discussed above, two main periods of complex deformation and metamorphism have been recognized on Eyre Peninsula; the Sleafordian Orogeny and the Kimban Orogeny. It is difficult to ascertain the specific nature of the Sleafordian Orogeny, since for the most part the inferred metamorphic conditions bear close resemblance to those induced by the younger Kimban Orogeny.

In southernmost Eyre Peninsula, the Carnot Gneisses have been subjected to a prograde granulite facies event at c. 2400 Ma (Fanning et al., 1981). Pressure-temperature estimates for this Sleafordian event are 800-900°C at a total pressure of 7-9 kb. The Wangary Gneisses in southwestern Eyre Peninsula perhaps reached low to middle amphibolite facies during this time, but this is uncertain due to the extent of Kimban overprinting, in particular shearing during D_3.

The metamorphic conditions that prevailed in the Cowell-Cleve area during the Sleafordian Orogeny are similarly uncertain. However, one could suggest similar metamorphic conditions to those proposed for the Wangary Gneisses. Carnot Gneiss equivalents at Waddikee Rocks by contrast reached upper amphibolite to granulite metamorphic facies.

The metamorphic development of the Kimban Orogeny is far better preserved due to the stabilization of the Gawler Craton not long after the orogeny. Parker (1978) established the structural and metamorphic history in the Cowell-Cleve region where M_1 and M_2 were both high-grade, pervasive metamorphic events of upper amphibolite facies and estimated P-T conditions c. 600-700°C at a total pressure of 5-7 Kb. M_3 and M_4 were retrograde events and lower P-T conditions c. 450-550°C at a total pressure of 2-4 Kb are evident.

The peak, prograde, metamorphic conditions in southern Eyre Peninsula particularly east of the Kalinjala Mylonite Zone tend to be higher for the M_{1-2} events of the Kimban Orogeny. Mortimer et al., (1980) propose that primary crystallisation of the Donington Granitoid Suite took place at c. 900°C and c. 8Kb, conditions very similar to those estimated for the Carnot Gneisses. However, it is more likely that most of southern Eyre Peninsula was subjected to somewhat lower P-T conditions early in the Kimban Orogeny, say c. 650-750°C and c. 4-6 Kb as suggested by Flook (1975). Retrogression during the M_3 and M_4 events is similar to that proposed for the Cowell-Cleve region although P-T conditions may be locally higher adjacent to the syn-to late-tectonic granite intrusives eg. the Moody Suite (Coin, 1976).

Granitoids

Even during the early days of geological mapping on Eyre Peninsula, a complex plutonic history was recognized. Lockhart Jack (1914) on central Eyre Peninsula and Tilley (1921) on southern Eyre Peninsula both identified multiple granite intrusions but only in recent times, through the application of isotopic dating techniques, have temporal relationships been established (Table 4).

On southern and central Eyre Peninsula four temporally distinct granitoid suites have been identified: the Late Archaean/Early Proterozoic Dutton Suite; the Early Proterozoic Donington Granitoid Suite; and the Early to Middle Proterozoic Spilsby and Moody Suites. The Dutton Suite granitoids form part of the Sleaford Complex (see Table 1) whereas the Donington, Spilsby and Moody suites are collectively known as the Lincoln Complex (NB. for ease of regional geological mapping the Lincoln Complex also contains some other non plutonic units such as migmatized and now indistinguishable remnants of Sleaford Complex and Hutchison Group).

The Donington Granitoid Suite is comprised of a broad spectrum of "I"-type granitoids ranging from quartz gabbronorite, through hypersthene granite and late-stage leucogranite (Figs 7 & 9). Mortimer et al. (1980) consider that these granitoids evolved through a crystal fractionation process at c. 1810 Ma during the first tectonic event of the Kimban Orogeny. The deformation has resulted in the development of a folded gneissic fabric and variable retrogression of the primary pyroxenes to hornblendes.

In the Cowell region and west of the Middleback Range in the Secret Rocks region, the Donington Granitoid Suite is represented by early tectonic granites known as the Minbrie Gneiss. The Minbrie Gneiss likewise is composed of a broad spectrum of granitoids but many of the migmatitic gneissic granites are believed to have formed largely in situ, and as such to represent "S" type granitoids albeit now complexly deformed.

Spilsby Suite granitoids outcrop in the Sir Joseph Banks Group of islands located in Spencer Gulf east of Port Lincoln and in the Cowell-Cleve region where they are represented by the foliated Middle Camp Granite. In the Sir Joseph Banks Group of islands the Spilsby Suite is composed of massive to foliated hornblende granite and tabular feldspar granite which intrude more deformed, megacrystic granites of the Donington Granitoid Suite. The Middle Camp Granite is folded by D_3 folds which implies emplacement possibly during the D_2 tectonic event but certainly prior to the D_3 tectonic event of the Kimban Orogeny; a date c. 1700 Ma is envisaged.

Granite, porphyritic granite (with tabular feldspars), adamellite, leucogranite and syenite comprise the Moody Suite. These granitoids crop out northwest of Tumby Bay (eg. at Moody Tank), in the Cowell-Cleve region (Carpa Granite), in the Middleback Range area (Wertigo Granite and Cooyerdoo Granite) and along the coast and coastal islands of western Eyre Peninsula (eg. foliated granites of Smooth Pool (Fig. 8) and Point Brown). The granitoids form a series of related plutons that vary from massive at Moody Tank to weakly foliated with aligned tabular feldspar phenocrysts. The Moody Suite is characterised by xenoliths or schlieren of gneissic material and garnet is common. Intrusion of these late-Kimban Orogeny granitoids spans an interval of time c. 1670-1600 Ma and encompasses, at least locally, the D_3 tectonic event.

MIDDLE PROTEROZOIC RECORD

Stratigraphy

For the purpose of this discussion the Middle Proterozoic sediments and volcanics on Eyre Peninsula are taken as those formed during the period c. 1615-1300 Ma. They include the McGregor Volcanics, Moonabie Formation, Corunna Conglomerate, Gawler Range Volcanics, Pandurra Formation and lateral equivalents of these units (Table 1).

The McGregor Volcanics (formerly referred to as Moonabie Volcanics and Moonabie Porphyry) occur as a steeply-dipping sequence in Moonabie Range southwest of Whyalla, and were formed at c. 1615 Ma (Webb et al., in press). They are bimodal, consisting of acidic, welded, ashflow tuffs derived from melting of a lower crustal source and basaltic lava flows derived from a mantle source (Giles et al., 1980).

Interlayered with, but mostly overlying the McGregor Volcanics, are volcaniclastic grits of the Moonabie Formation (formerly Moonabie Grit). The volcaniclastic grits contain a mixture of volcanic and chert clasts in an immature matrix and indicate rapid erosion of the underlying volcanic pile. Rare heavy mineral beds are locally preserved (eg. at Mt Young).

Overlying the Moonabie Formation is the Corunna Conglomerate which is thought to have been deposited synchronously with the Gawler Range Volcanics. The conglomerate contains acid volcanic clasts similar to the Gawler Range Volcanics yet is intruded by plugs and dykes representing the final phase of Gawler Range Volcanics. In the Tarcoola region further northwest there is evidence of extensive syn-depositional volcanism.

The Corunna Conglomerate is composed mainly of fluvio-deltaic conglomerates and sandstones (Fig. 12). However in Moonabie Range, basal fluvial conglomerates are overlain by a marine sandstone (Nilgenee Member) which intertongues to the east with a rapidly deposited talus breccia (Cowleds Member). The breccia coarsens eastwards, containing angular clasts up to 0.5 m in diameter, and was probably deposited off an ancient escarpment perhaps coinciding with the present day Moonabie Scarp.

Equivalent to the Corunna Conglomerate are the Blue Range Beds which outcrop from Gibbon Point on Spencer Gulf, through Blue Range and the "Ningana" area on central Eyre Peninsula to Mount Wedge and Talia Caves on the west coast. This chain of outcrops suggests an east-west oriented depositional basin.

Also equivalent to the Corunna Conglomerate is a sequence of grey, laminated carbonaceous siltstones and sandstones encountered during drilling in the Uno region. These appear to correlate with similar carbonaceous siltstones in the Tarcoola region and are of likely lacustrine origin.

The depositional age of the Corunna Conglomerate is not clearly defined: a minimum age is given by the intrusive rhyolite dykes (1457 ± 22 Ma, Webb et al., in press) whereas a maximum age is given by the underlying McGregor Volcanics in the Moonabie Range (c. 1615 Ma). Isotopic ages derived for the Corunna Conglomerate fit within these constraints but are too young relative to the disputed age of the Charleston Granite (viz. 1556 Ma after Compston et al., 1966) which intrudes the conglomerates near Moonabie.

For the purposes of this discussion the Gawler Ranges are excluded from Eyre Peninsula. However there are isolated outliers of Gawler Range Volcanics scattered throughout northern Eyre Peninsula. In the Corunna area and west of Iron Baron there are north-northwest trending rhyolite dykes which intrude the Corunna Conglomerate and Hutchison Group respectively but which represent the very latest phase of Gawler Range volcanism. Similar dykes occur elsewhere around the southern margin of the Gawler Ranges and also in the Mt Sturt-Buckleboo region where there are also outliers of both the lower Gawler Range Volcanics (porphyritic dacites and flow-banded porphyritic rhyolites) and the lowermost unit of the upper Gawler Range Volcanics (the highly porphyritic dacite of Mt Sturt). Other outliers of Gawler Range Volcanics or equivalents thereof, occur at Mt Cooper (porphyritic and locally flow-banded rhyolites) and in the St Francis Isles of the Nuyts Archipelago. The latter include porphyritic rhyolites and rhyodacites and dykes of flow-banded rhyolite and black dacite. The porphyritic rhyolites are most likely equivalent to the lower Gawler Range Volcanics.

At Roopena northwest of Whyalla, a different problem exists. A sequence of amygdaloidal basalts interbedded with conglomerate, volcaniclastic sandstone and laminated siltstone overlies acid volcanics, brecciated siltstone, and volcaniclastic sandstone of the Moonabie Formation. Previous workers have correlated the basalts with basal Adelaidean volcanics but recent work (Mason et al., 1978; Giles and Teale, 1979) suggests that the Roopena Volcanics are analogous to basalts from the Gawler Range Volcanics.

Deposition of the Corunna Conglomerate, extrusion of the Gawler Range Volcanics, postorogenic granitic intrusion (see below), and local deformation (D_4), represent the final events leading to cratonization of the Gawler Craton.

The Pandurra Formation is generally regarded as the final pulse of intracontinental sedimentation on the Gawler Craton. It unconformably overlies the Roopena Volcanics and is, in turn, disconformably overlain by the Beda Volcanics and Backy Point Beds. The Pandurra Formation is a fluvial sequence of sandstones, commonly feldspathic, kaolinitic and exhibiting characteristic fossil liesegang weathering bands. It was deposited in a series of northwest-trending grabens or fault-bounded troughs, reaches a maximum thickness exceeding 600 m and was possibly deposited c. 1420 Ma (Fanning et al, 1983 & in press).

Granitoids

Middle Proterozic post-tectonic granitoids, the Hiltaba Suite, are extensively developed throughout northern Eyre Peninsula and form some of the very prominent landforms in that region (eg. Mt Wudinna). In and adjacent to the Gawler Ranges and in the Nuyts Archipelago, the granitic intrusives are mainly shallow, flat-roofed leucogranites rich in alkalis and occurring in close spatial relationship with rhyolites and rhyodacites. The granites represent high-level intrusions derived essentially from S-type magma sources in the lower crust and except for the older pink leucogranite of Nuyts Archipelago and maybe the Charleston Granite (Fig. 13), were intruded mainly in the period 1500-1450 Ma (Table 4).

Deformation

Throughout Eyre Peninsula there is local evidence for minor post-Kimban Orogeny tectonism in the form of cross folding, fracturing and the development of major lineaments and/or shear zones. This event (D_4) is known as the Wartakan Event and affected not only basement (Sleaford Complex) but also the Corunna Conglomerate. The latter is well displayed at Mt Laura where folding of quartzites believed to represent Corunna Conglomerate occurs about northwest-southeast trending axes. In the Middleback Ranges and the Cowell-Cleve region major, often quartz-veined lineaments are associated with cross-folding about east-west and northwest-southeast trending axes. Nephrite jade at Cowell was formed during this event (Parker, 1981).

Subsequent tectonism on the southern Gawler Craton is largely restricted to local tensional tectonics such as graben development during the Pandurra Formation, dolerite dyke intrusion probably during the Late Proterozic, and block faulting or graben development periodically during the Phanerozoic. Cratonization of the Gawler Craton is believed to have occurred ca 1450 Ma so these later tensional effects were intracratonic.

ADELAIDEAN (LATE PROTEROZOIC) RECORD

The only known Adelaidean or Late Proterozic rocks on Eyre Peninsula occur north of Whyalla. Around the Cultana Inlier and in bores on the southernmost Stuart Shelf (Mason et al., 1978) the very basal Adelaidean of this region is represented by partially hematised, pink to buff-coloured quartzofeldspathic sandstones and conglomerates (Backy Point Beds) interbedded with hematised and sericitised amygdaloidal basalts (Beda Volcanics). The basaltic lavas are of spilitic association and at least fourteen flows (1-55 m thick) have locally been identified (Mason et al., 1978). Isotopic dating of the volcanics infers an age of 1076 ± 33 Ma (Webb et al., 1983).

Overlying the Beda Volcanics but rarely exposed is the Tapley Hill Formation, a sequence of dark grey, laminated, carbonaceous and dolomitic siltstones and slates. Deeply weathered, kaolinized siltstones occur in dams and a small quarry north of Whyalla but occur predominantly in drillholes throughout the Myall Creek-Port Augusta region where they attain a thickness

c. 140-210 m and where they locally contain anomalous lead-zinc mineralization.

The presence of Tapley Hill Formation directly overlying Beda Volcanics represents a major break in sedimentation from c. 1050 Ma to c. 750 Ma (Webb et al., 1983), the period of time during which the Burra Group and Sturtian glacials were deposited in the Adelaide Geosyncline only a few tens of kilometres east. The line across which this dramatic change in early Adelaidean sedimentation takes place is the Torrens Hinge Zone. This extends from the western side of Gulf St Vincent through the Cultana area just northeast of Whyalla, northwards to and along the length of the western side of Lake Torrens.

In the Pt Augusta-Myall Creek region the Tapley Hill Formation is overlain by very thin and patchy beds of Brighton Limestone and pink to maroon-coloured, dolomitic shales and sandstones of the Willochra Subgroup. These are in turn overlain by the pink, feldspathic Whyalla Sandstone which is characterized by well-rounded, frosted quartz grains. The Whyalla Sandstone in this region is c. 20-60 m thick. It correlates with Elatina Formation sandstones and glacials of the Adelaide Geosyncline.

Overlying the Whyalla Sandstone and forming the base of the very prominent mesas in the Port Augusta-Whyalla region is the Tregolana (or Woomera) Shale Member of the Tent Hill Formation. This unit and the overlying Corraberra Sandstone Member are equivalent to the Brachina Formation and consist of red and to a lesser extent green, laminated shales with thin sandy interbeds grading up into maroon, flaggy to thickbedded, sandy siltstone and sandstone of the Corraberra Sandstone Member. Together these two members attain a thickness c. 150-200 m in the Port Augusta area.

The Corraberra Sandstone Member is overlain by the Simmens Quartzite Member which consists of massive, white, thin-bedded, cross-bedded sandstones and quartzites forming the "Arcoona Plateau" (Johns, 1968) capping the mesas. Just south of Port Augusta the Simmens Quartzite Member has been intruded by relatively young (?Jurassic) kimberlite pipes, that may be related to diamond-bearing kimberlites in the Adelaide Geosyncline.

PALAEOZOIC RECORD

Early Palaeozoic

Early Palaeozoic units are restricted to the Polda Basin - a narrow east-west graben less than 25 km wide but extending for 350 km from Rudall in the east to 220 km offshore from Elliston. It is an intracratonic graben flanked by Archaean-Middle Proterozoic rocks and is totally veneered by Tertiary and Quaternary sediments. One of the Quaternary units (Bridgewater Formation) is a major freshwater aquifer which was originally used by J.I. Miller (E. & W.S.) in 1928 to define the Polda Basin. Since then, the term has also incorporated older sedimentary sequences, even though ideally these infra-basins represent distinct and separate cycles of sedimentation.

Early Palaeozoic sediments have been intersected only in two drillholes, Mercury No. 1 and Columbia No. 1 (Fig. 14 & Table 5); both were drilled by Australian Occidental Pty Ltd in 1981-1982 when evaluating the hydrocarbon potential of offshore portions of the Polda Basin.

Mercury No. 1 intersected 2 375 m of pre-Permian sediments and three sequences were identified (McClure, 1982a & Fig. 14). The basal unit (Sequence I) is >151 m thick and consists of interlayered white quartzose sandstone, reddish-brown siltstone and silicified sandy siltstone. The overlying Sequence II is 1 707 m thick and consists predominantly of massive rock salt. The clear to milky-coloured salt had been predicted from seismic profiling and the drillhole was located on the crest of an interpreted salt dome with an upper areal closure of 24 km^2. Interbedded with the salt are red-brown shale, siltstone, medium to coarse-grained sandstone and carbonate-cemented fine sandstone which contain abundant euhedral dolomite and anhydrite crystals. Within this sequence are 11 m of black stylolitic limestone and black shale, from which was recorded the only gas show to date from the Polda Basin. Unfortunately, it was a very minor 40 ppm of methane and source rock analysis indicated a very low total organic carbon content of 0.06%. Upper unit (Sequence III) consists of red beds, similar to those in Sequence I & II.

Columbia No. 1 intersected 1 397 m of reddish-brown shale, siltstone, sandstone and minor limestone-dolomite similar to those in Mercury No. 1, 35 km ESE. The sequence has been subdivided into four units (McClure, 1982b & Fig. 14). Although the thick salt sequence is absent, silicified siltstone and quartzose sandstone at the top of Sequence I are correlated with similar lithologies in Sequence I of Mercury No. 1 (McClure, 1982b).

Palaeontology was unsuccessful in determining the age of oxidised red beds and salt. Two cuttings samples examined from Mercury No. 1 contained only downhole contamination of foraminifera and microflora (Lindsay & Cooper, 1982). However, the sediments have broad lithological similarities to those in the eastern Officer Basin - in particular a halite-bearing red-bed sequence in Wilkinson No. 1 (Gatehouse, 1979a) and red beds in Murnaroo No. 1 (Gatehouse, 1979b), which are believed to be Cambrian. By analogy, the sequence of red beds and salt in Mercury No. 1 and Columbia No. 1 have an interpreted ?Cambrian age. Similar sediments occur in deeper onshore sections of the Polda Basin where they are associated with mafic volcanics.

Late Palaeozoic

Extensive exploratory drilling for Jurassic coal by SADME and ETSA during 1976-1978 in the Lock area resulted in the discovery of pre-Mesozoic sediments. Palynological examination of two drillholes in this programme, Polda Nos. 8 and 37, indicated a Carboniferous-Permian age (Harris, 1979; Gatehouse, 1980), which was supported by subsequent investigations on Lock No. 1 (Cooper *et al.*, 1982). Microfloras include *Cycadopites cymbatus* and *Parasaccites gondwanensis*.

These Carboniferous-Permian sediments (Coolardie Formation) consist dominantly of diamictite and mudstone. Diamictite is brown, grey or green in colour and has a muddy-sandy matrix containing dispersed clasts (Kwitko, 1982). Coolardie Formation was deposited in a glacial environment, though one foraminifer present in contaminated cuttings in Mercury No. 1 and probably derived from this unit suggests some marine influence in the western portion of the Polda Basin (Lindsay & Cooper, 1982).

Distribution and thickness of the Coolardie Formation are not well known as only a few drillholes are deep enough to fully penetrate the unit. However the Coolardie Formation is likely to be extensive in the Polda Basin with 87 m known from Mercury No. 1 and at least 181 m in Lock No. 1.

MESOZOIC RECORD

Interest in coal on Eyre Peninsula started when a sheep herder in 1923 recognised spoil of coal fragments from a water well at "Win Gully" 15 km W of Lock. The Central Eyre Peninsula Coal and Oil Company then deepened the well but no significant quantity of coal was found. Subsequent hydrogeological drilling revealed grey lignitic silts and clays which yielded a Jurassic microflora (Harris, 1964). Polda No. 1 stratigraphic bore, drilled in 1965, was the first drillhole to penetrate the entire Jurassic Polda Formation (Harris & Foster, 1974; Gatehouse & Cooper, 1982).

The Polda Formation was deposited in fluvial -swampy environments and consists of grey to dark-grey, fine to coarse-grained clayey sand, dark grey claystone and lignite (Table 5). The sub-bituminous Lock coal deposit of 260 million tonnes (measured-indicated & in situ) has been delineated near "Win Gully". It is elongate east-west, 2-4 km long and has 50-130 m of overburden. Individual seams of high-ash coal are up to 6 m thick with a maximum cumulate coal thickness of 17 m.

Distribution of the Polda Formation is reasonably well known and it has been intersected in numerous holes throughout the Polda Basin. Thickness varies from a maximum of 170 m onshore in Lock No. 1 to an interpreted 511 m in offshore Mercury No. 1.

Palynology of the unit was reviewed by Harris and Foster (1974) who used the presence of <u>Dictyotosporites complex</u> and various other abundances and absences to determine a Late Jurassic age, correlating with unit J6 of Evans (1966). The Late Jurassic age coincides with initial rifting prior to breakup of Australia and Antarctica. Rejuvenation of tectonism within the Polda Basin occurred along pre-existing faults within this intracratonic trough, resulting in deposition of the Polda Formation.

No Cretaceous sediments, either marine or nonmarine are known from the Polda Basin.

TERTIARY RECORD

Tertiary sediments represent a variety of lithologies, ages and depositional environments. They include Middle-Late Eocene fluvatile and marginal-marine sediments, Miocene-Pliocene lacustrine clay and dolomite with marine limestone and Pliocene-Pleistocene alluvials (Table 5). They are widely distributed over Eyre Peninsula occurring in both basins and shallow channels on an irregularly eroded palaeosurface over Precambrian rocks.

Middle-Late Eocene sediments are present in the Uley-Wanilla-Cummins Basins (Wanilla Formation), Polda and Robinson Basins (Poelpena Formation), palaeochannels in western Corrobinnie Depression (Pidinga Formation), and the Cowell Basin. Lithologies in the various basins and channels are similar, consisting mostly of brown-grey, fine to coarse-grained sand, silt and clay. Sediments may be uraniferous and are often carbonaceous with minor lignitic horizons. A rich and varied assemblage of spores and pollen, including Proteacidites asperopolus and P. pachypolus, were used by Harris (1966), Harris & Foster (1974) and Lindsay & Harris (1975) to define a Middle-Late Eocene age for these fluvial to swamp-like sediments.

Marginal-marine carbonaceous sand, silt, and sapropelic silty clay are found within the Wanilla and Poelpena Formations (Ludbrook, 1963; Lindsay, 1974). Glauconite may be present sparsely, and also rare bryozoal fragments, foraminifera, sponge spicules, ostracode valves, echinoid and ?mollusc fragments. Generally sparse planktonic foraminifera in the Cummins and Wanilla Basins have been dated as Late Eocene.

Thin, yellow-buff fossiliferous marine limestone crops out along the Randell Fault Scarp, at Deep Creek, and near Murninnie Mine southwest of Whyalla (Miles, 1952; Ludbrook in Miles, 1955). The presence of the foraminifer Austrotrillina howchini is diagnostic of a Miocene age (Lindsay, 1970), and the unit correlates with the Melton Limestone on Yorke Peninsula.

At Fishery Bay, similar Miocene limestone is overlain by a thin conglomeratic sandy limestone (Johns, 1957, 1961), which contains moulds and casts of molluscs including Anodontia sphericula. A Pliocene age was inferred by Ludbrook (1959) for the molluscan assemblage in this upper unit, although A. sphericula is now known to range from Middle Miocene to Early Pleistocene (Ludbrook 1973a).

Restricted to the eastern end of the Polda Basin is an unnamed sequence of sand, carbonaceous grey to green clay and minor dolomite. Little is known about its thickness and distribution, however the sediments were probably deposited in a lacustrine-fluviatile environment. The clays contain a sparse microflora including Nothofagidites mataurensis and Haloragacidites harrisii which suggest a Miocene-Pliocene age (Harris in Morgan, 1974).

Uley Formation (of the Cummins and Uley Basins) and equivalent Pantoulbie Formation (Robinson Basin) are fluviatile-regolithic sediments consisting of orange-brown quartz sand, sandy clay, clay and rare gravel with abundant laterite nodules (Barnett, 1978). Ferruginised gravelly sand grading through to clay, cropping out over granite along the west coast are likely to be of similar age as are the Gibbon Beds south of Whyalla (Parker, 1983). In all cases, fossil evidence is absent, however stratigraphic relationships suggest a ?Pliocene-Pleistocene age.

Many inland Archaean-Proterozoic outcrops have been kaolinised and/or ferruginised and may have a capping of silicified conglomerate (silcrete), silicified sandstone or laterite. These weathering events are generally regarded as being Tertiary in age, however their precise relationships to the palynologically dated sequences are not known.

QUATERNARY RECORD

Thin veneers of Quaternary sediments mask many of the earlier Phanerozoic sediments and Precambrian rocks on central and western Eyre Peninsula. Most prominent are Pleistocene calcrete and carbonate-cemented aeolianite (Bridgewater Formation, Figs 15-17) which form cliffs along the southern and western coasts, and Pleistocene-Holocene inland longitudinal dunes and sand spreads (Wiabuna Formation and Moornaba Sand).

Aeolianite of the Bridgewater Formation contains large dune-size crossbeds and consists dominantly of comminuted shell fragments in a micrite cement. Also present are numerous calcrete horizons (Ripon and Bakara Calcretes of Firman, 1967; 1975) which are of various forms; intraclast breccia, nodular, massive and laminated. Calcretization is by progressive dissolution and replacement of comminuted shell fragments and gradual development of nodular to laminar fabrics (Warren, 1983a).

Common within aeolianite are carbonate-cemented root casts, elliptical calcareous cases of the weevil *Leptopius duponti* (Lea, 1925) and fossils of the land snail *Bothriembryon barretti* (Ludbrook, 1973b).

Laterally equivalent to Bridgewater Formation are carbonate-cemented marine shell beds exposed at or just above present-day sea level (Glanville Formation; Firman, 1967) which are characterised by the mollusc *Anadara trapezia* and foraminifer *Marginopora vertebralis*. Neither fossil is present in the modern fauna of South Australia. Belperio *et al*. (1984), from amino acid racemization and thermoluminescence dating,, suggested a Late Pleistocene age of *c*. 110 000 years for Glanville Formation.

A variety of younger Late Pleistocene-Holocene sediments exists, however these will be only briefly outlined. They include Pleistocene orange-fawn clayey sand which forms the cores to inland longitudinal sand dunes (Wiabuna Formation) and capping white sands and sand dunes and spreads of the Corrobinnie Depression (Holocene Moornaba Sand) (Firman, 1974; Twidale *et al*., 1976). Equivalent Holocene coastal white sands are known as the Semaphore Sand whereas beach sand, mangrove, samphire and supratidal sediments formed within the last 6 500 years are St Kilda Formation (Belperio *et al*., 1983). Near-coastal salt lakes and inland salinas contain saline mud, gypsum silt, crystalline gypsarenite and selenite (Yamba Formation). Lake MacDonnell, west of Ceduna has the largest and purest gypsum deposit yet mined in Australia (Warren, 1983b).

John Parker

REFERENCES

Barnett, S.J. (1978). Late Tertiary sediments on Eyre Peninsula. Q. geol. Notes, Geol. Surv. S. Aust. 67,1-4.

Belperio, A.P., Hails, J.R. & Gostin, V.A. (1983). A review of Holocene levels in South Australia. In Hopley, D. (Ed.), Australian sea levels in the last 15 000 years: A review. Monograph series, Occasional paper No. 3. James Cook University of North Queensland, 37-47.

Belperio, A.P., Smith, B.W., Polach, H.A., Nittrouer, C.A., DeMaster, D.J., Hails, J.R. & Gostin, V.A. (1984). Chronological studies of the Quaternary marine sediments of northern Spencer Gulf, South Australia. Marine Geol. 61, in press.

Brown, H.Y.L. (1908). Record of the mines of South Australia. Adelaide.

Carter, B.R. & Scott, A.F. (1976). Gemini No. 1 well completion report. S. Aust. Dept. Mines & Energy open file Env. 2621 (unpubl.).

Coin, C.D.A. (1976). A study of the Precambrian rocks in the vicinity of Tumby Bay, South Australia. Unpubl. Ph.D. thesis, Univ. of Adelaide.

Compston, W., Crawford, A.R. & Bofinger, V.M. (1966). A radiometric estimate of the duration of sedimentation in the Adelaide Geosyncline. J. geol. Soc. Aust. 13, 229-276.

Cooper, B.J., Harris, W.K. & Meyer, G.M. (1982). The Late Palaeozoic Coolardie Formation, Polda Basin. Q. geol. Notes, Geol. Surv. S. Aust., 81, 9-13.

Cooper, J.A., Fanning, C.M., Flook, M.M. & Oliver, R.L. (1976). Archaean and Proterozoic rocks on southern Eyre Peninsula, South Australia. J. geol. Soc. Aust. 23, 287-292.

Daly, S.J., Webb, A.W. & Whitehead, S.G. (1978). Archaean to early Proterozoic banded iron formations in the Tarcoola region, South Australia. Trans. R. Soc. S. Aust. 102, 141-149.

Evans, P.R. (1966). Mesozoic stratigraphic palynology in Australia. Australas. Oil Gas J. 12, 58-63.

Fanning, C.M. (in press). Comments on Rb-Sr total rock measurements for Wardang Volcanics, Yorke Peninsula. Q. geol. Notes, Geol. Surv. S. Aust.

Fanning, C.M., Flint, R.B. & Preiss, W.V. (1983). Geochronology of the Pandurra Formation. Q. geol. Notes, Geol. Surv. S. Aust. 88, 11-16.

Fanning, C.M., Flint, R.B. & Preiss, W.V. (in press). Rb-Sr geochronology on clays from the Pandurra Formation. Q. geol Notes, Geol. Surv. S. Aust.

Fanning, C.M., Oliver, R.L. & Cooper, J.A. (1981). The Carnot Gneisses, southernmost Eyre Peninsula. Q. geol. Notes, Geol. Surv. S. Aust. 80, 7-12.

Firman, J.B. (1967). Stratigraphy of Late Cainozoic deposits in South Australia. Trans. R. Soc. S. Aust. 91, 165-180.

Firman, J.B. (1974). Upper Cainozoic stratigraphic units of the Gawler Block and Eucla Basin in South Australia. Q. geol. Notes, Geol. Surv. S. Aust. 52, 2-4.

Firman, J.B. (1975). Australia - South Australia. In Fairbridge, R.W. (Ed.), The Encyclopedia of World regional geology, Part 1 - western hemisphere. Hutchinson & Ross Inc, Stroudsburg, USA 61-81.

Flook, M.M. (1975). The geology and geochronology of high grade metamorphic rocks at Kirton Point and Cape Donington, Southern Eyre Peninsula. Unpubl. B.Sc. Hons thesis, Univ. of Adelaide.

Gatehouse, C.G. (1979a). Well completion report for Murnaroo No. 1. S. Aust. Dept. Mines & Energy report 78/152 (unpubl.).

Gatehouse, C.G. (1979b). Well completion report, Wilkinson No. 1. S. Aust. Dept. Mines & Energy report 79/58 (unpubl.).

Gatehouse, C.G. (1980). A report on the relinquished areas of EL 280 outside the area of EL 434. S. Aust. Dept. Mines & Energy report 80/56 (unpubl.).

Gatehouse, C.G. & Cooper, B.J. (1982). The Late Jurassic Polda Formation, Eyre Peninsula. Q. geol. Notes, Geol. Surv. S. Aust. 81, 13-16.

Giles, C.W., Goode, A.D.T. & Lemon, N.M. (1980). Middle Proterozoic volcanism and sedimentation in the Moonabie area. J. geol. Soc. Aust. 27, 53.

Giles, C.W. & Teale, G.S. (1979). A comparison of the geochemistry of the Roopena Volcanics and the Beda Volcanics. Q. geol. Notes, Geol. Surv. S. Aust. 71, 7-13.

Glen, R.A., Laing, W.P., Parker, A.J. & Rutland, R.W.R. (1977). Tectonic relationships between the Proterozoic Gawler and Willyama Orogenic Domains, Australia. J. geol. Soc. Aust. 24, 125-150.

Harris, W.K. (1964). New and redefined names in South Australian Lower Tertiary stratigraphy. Q. geol. Notes, geol. Surv. S. Aust. 20, 1-3.

Harris, W.K. (1979). Palynology of the Lock coalfield: synoptic report. S. Aust. Dept. Mines & Energy report 813 (unpubl.).

Harris, W.K. & Foster, C.B. (1974). Stratigraphy and palynology of the Polda Basin, Eyre Peninsula. Min. Resour. Rev. S. Aust. 136, 56-78.

Jack, R.L. (1914). The geology of the County Jervois and portions of the Counties Buxton and York, with special reference to underground water supplies. Bull. Geol. Surv. S. Aust. 3.

Jack, R.L. (1922). The iron ore resources of South Australia. Bull. Geol. Surv. S. Aust. 10.

Johns, R.K. (1957). Eyre Peninsula. In Glaessner, M.F. & Parkin, L.W. (Eds), The geology of South Australia. J. geol. Soc. Aust. 5(2), 61-70.

Johns, R.K. (1961). Geology and mineral resources of southern Eyre Peninsula. Bull. Geol. Surv. S. Aust. 37.

Johns, R.K. (1968). Geology and mineral resources of the Andamooka-Torrens area. Bull. Geol. Surv. S. Aust. 41.

Klappa, C.F. (1980). Rhizoliths in terrestrial carbonates: classification, recognition, genesis and significance. Sedimentology 27, 613-629.

Kwitko, G. (1982). Lock No. 1 well completion report. S. Aust. Dept. Mines & Energy report 81/109 (unpubl.).

Laing, W.P., Sun, S.S. & Nesbitt, R.W. (1984). Acid volcanic precursor to Potosi Gneiss at Broken Hill and its implications for ore genesis. In Geoscience in the development of natural resources. Geol. Soc. Aust. Abst. 12, 318-321.

Lea, A.M. (1925). Notes on some calcareous insect puparia. Rec. S. Aust. Mus. 3, 35-36.

Lindsay, J.M. (1970). Melton Limestone: multiple mid-Tertiary transgressions, southeastern Gawler Platform. Q. geol. Notes, Geol. Surv. S. Aust. 33, 2-10.

Lindsay, J.M. (1974). Marine foraminifera from Eocene carbonaceous sediments, Polda, Cummins and Wanilla Basins, Eyre Peninsula. Min. Resour. Rev. S. Aust. 136, 46-51.

Lindsay, J.M. & Cooper, B.J. (1982). A.O.P. Mercury-1 well, palaeontological examination of cuttings samples. S. Aust. Dept. Mines & Energy report 820 (unpubl.).

Lindsay, J.M. & Harris, W.K. (1975). Fossiliferous marine and non-marine Cainozoic rocks from the eastern Eucla Basin. Min. Resour. Rev. S. Aust. 138, 29-42.

Ludbrook, N.H. (1958). A widespread Pliocene molluscan fauna with Anodontia in South Australia. Trans. R. Soc. S. Aust. 82, 219-234.

Ludbrook, N.H. (1963). Correlations of the Tertiary rocks of South Australia. Trans. R. Soc. S. Aust. 87, 5-15.

Ludbrook, N.H. (1973a). Distribution and stratigraphic utility of Cenozoic molluscan faunas in southern Australia. Spec. Vol. Sci. Rep. Tohoku Univ., Ser. 2 (Geol.), (Hatai Memorial Vol.), 6:241-261

Ludbrook, N.H. (1973b). Stratigraphic range of the Bulimulid land snail Bothriembryon in the Fowlers Bay area. S. Aust. Dept. Mines & Energy report 73/51 (unpubl.).

Mason, M.G., Thomson, B.P. & Tonkin, D.G. (1978). Regional stratigraphy of the Beda Volcanics, Backy Point Beds and Pandurra Formation on the southern Stuart Shelf, South Australia. Q. geol. Notes, Geol. Surv. S. Aust. 66, 2-9.

McClure, I. (1982a). Mercury No. 1, Offshore Polda Basin EPP-SA15, well completion report. S. Aust. Dept. Mines & Energy open file Env. 5161 (unpubl.).

McClure, I. (1982b). Columbia No. 1, Offshore Polda Basin EPP-SA15, well completion report. S. Aust. Dept. Mines & Energy open file Env. 5160 (unpubl.).

Miles, K.R. (1952). Middleback map sheet, Geological Atlas of South Australia, 1:63 360 series. Geol. Surv. S. Aust.

Miles, K.R. (1955). The geology and iron ore resources of the Middleback Range area. Bull. Geol. Surv. S. Aust. 33.

Morgan, P.J. (1974). Final report, exploration of EL 37, Lock area - South Australia. S. Aust. Dept. Mines & Energy open file Env. 2256 (unpubl.).

Mortimer, G.E., Cooper, J.A. & Oliver, R.L. (1980). Petrological and petrochemical evolution of the 1.82 b.y. Donington Granitoid Suite of the southeast Eyre Peninsula. J. geol. Soc. Aust. 27, 50.

Parker, A.J. (1978). Structural, stratigraphic and metamorphic geology of Lower Proterozoic rocks in the Cowell/Cleve district, eastern Eyre Peninsula. Unpubl. Ph.D. thesis, Univ. of Adelaide.

Parker, A.J. (1980a). The Kalinjala Mylonite Zone, eastern Eyre Peninsula. Q. geol. Notes, Geol. Surv. S. Aust. 76, 6-11.

Parker, A.J. (1980b). The six 1:100 000 compilation sheets of WHYALLA - A progress report. S. Aust. Dept. Mines & Energy report 80/93 (unpubl.).

Parker, A.J. (1981). Structural and metamorphic controls on the origin of nephrite jade near Cowell, South Australia. S. Aust. Dept. Mines & Energy report 81/114 (unpubl.).

Parker, A.J. (1983). WHYALLA map sheet, Geological Atlas of South Australia, 1:250 000 series. Geol. Surv. S. Aust.

Parker, A.J., Fanning, C.M. & Flint, R.B. (1981). Archaean to Middle Proterozoic geology of the southern Gawler Craton, South Australia. EPIC excursion guide. S. Aust. Dept. Mines & Energy report 81/91 (unpubl.).

Parker, A.J. & Lemon, N.M. (1982). Reconstruction of the Early Proterozoic stratigraphy of the Gawler Craton, South Australia. J. geol. Soc. Aust. 29, 221-238.

Tate, R. (1882). Notes on geology about Franklin Harbour, west side of Spencer's Gulf. Trans. R. Soc. S. Aust. 4, 143-144.

Tilley, C.E. (1920a). Metamorphism of Precambrian dolomites of southern Eyre Peninsula. Geol. Mag. 57, 449-462.

Tilley, C.E. (1920b). The metamorphism of the Precambrian dolomites of southern Eyre Peninsula, South Australia. Geol. Mag. 57, 492-500.

Tilley, C.E. (1921a). The granite gneisses of southern Eyre Peninsula and their associated amphibolites. Q. J. Geol. Soc. Lond. 77, 75-134.

Tilley, C.E. (1921b). Precambrian paragneisses of southern Eyre Peninsula, South Australia. Geol. Mag. 58, 251-259.

Trendall, A.F. (1976). Geology of the Hamersley Basin. 25th Int. geol. Congr. Excursion guide 43A (unpubl.).

Twidale, C.R., Bourne, J.A. & Smith, D.M. (1976). Age and origin of palaeosurfaces on Eyre Peninsula and in the southern Gawler Ranges. Z. Geomorph. 20, 28-55.

Warren, J.K. (1983a). Pedogenic calcrete as it occurs in Quaternary calcareous dunes in coastal South Australia. J. Sed. Petrol. 53, 787-796.

Warren, J.K. (1983b). A review of gypsum reserves at Lake Macdonnell, Eyre Peninsula. Min. Resour. Rev. S. Aust. 152, 12-18.

Webb, A.W. (1978). Geochronology of the younger granites of the Gawler Craton and its northwestern margin. S. Aust. Dept. Mines & Energy open file Env. 1582 (unpubl.).

Webb, A.W., Coats, R.P., Fanning, C.M. & Flint, R.B. (1983). Gechronological framework of the Adelaide Geosyncline. In Adelaide Geosyncline: sedimentary environments and tectonic settings. Geol. Soc. Aust. Abst. 10, 7-9.

Webb, A.W. & Thomson, B.P. (1977). Archaean basement rocks in the Gawler Craton, South Australia. Search 8, 34-36.

Webb, A.W., Thomson, B.P., Blissett, A.H., Daly, S.J., Flint, R.B. & Parker, A.J. (in press). Geochronology of the Gawler Craton, South Australia. J. Geol. Soc. Aust.

STRATIGRAPHIC UNIT				LITHOLOGY	STRUCTURAL/STRATIGRAPHIC RELATIONSHIPS	MINERALOGY/PETROGRAPHY
		Unnamed unit		Fine-grained, thin bedded, feldspathic quartzite.	Weakly foliated, thin dark layers of iron oxides, zirc. and tour.; conformable with silvery schists; stratigraphic facing uncertain.	Equigranular granoblastic subpolygonal; qtz (55-65%) + kspar (20-35%) + musc. (10-20%) ± plag. (≤ 20%) + biot. + opaques + acc.
		BROADVIEW SCHIST		Fine to very fine-grained, silvery grey schist or phyllite.	Strong slaty schistosity, sometimes crenulated; conformable with Myola Volcanics; rare, primary compositional banding.	Equigranular granoblastic to lepidoblastic with local micro-augen of qtz; musc. (60-70%) + biot./chl. (5-15%) + qtz/plag. (10-30%) +acc. (rare andalusite).
				Massive fine grained amphibolite.	Foliated and often lineated; conformably interbedded with schists (and also Myola Volcanics); recrystallized former mafic volcanic or dolerite	Relatively equigranular-granoblastic; plag. (40-55%) + hbl. (30-50%) + minor opaques ± kspar ± qtz ± sph ± biot. + acc.
		MYOLA VOLCANICS		Grey to pinkish grey, porphyritic rhyolite and rhyodacite.	Foliated and often strongly lineated	Phenocrysts of kspar, plag., lesser qtz and rare mafic in a fine to very fine grained, recrystallized ground mass of felds. + qtz.
				Fine-grained, pink felsic gneiss.	Foliated and lineated; interlayered with rhyolites; local flattened augen of recrystallized qtz + felds.	Equigranular granoblastic metamorphic textures; kspar (25-45%) + qtz (50-25%) + plag. (15-25%) + minor mafics + acc.
		? Unconformity		Fine-grained, greyish-pink, quartz feldspar amphibole gneiss.	Foliated with local elongate augen of recrystallized qtz + amphib. + felds; developed along strike from rhyolites.	Relatively equigranular granoblastic; kspar (35-45%) + plag. (20-40%) + amphib. (10-20% hbl) + qtz (25-40%) + acc.
HUTCHISON GROUP		YADNARIE SCHIST		Fine-grained, locally quartz-veined quartzose schist with interlayered psammitic bands several cm thick.	Strongly foliated and often crenulated; layering of mixed primary and tectonic origin; top of unit not exposed.	Equigranular granoblastic subpolygonal (to lepidoblastic); musc. (30-50%) + qtz (30-40%) + biot. (10-25%) + felds. + acc.
HUTCHISON GROUP	MIDDLEBACK SUBGROUP	UPPER MIDDLEBACK JASPILITE		Mixed silicate and carbonate facies banded iron formation with local oxide facies banded iron formation in the Middleback Range and graphitic quartzite in western regions.	Regularly banded; gradational into units above and below.	As for Lower Middleback Jaspilite
HUTCHISON GROUP	MIDDLEBACK SUBGROUP	COOK GAP SCHIST		Layered, medium to fine-grained, quartz veined garnetiferous gneiss and schist.	Strongly foliated, layering of mixed primary and tectonic origin; multiply deformed.	Equigranular granoblastic sub-polygonal; qtz (av. 45%) + plag (20%) + musc. (20%) + biot. (15%) + kspar + gnt ± sill + acc.
				Layered garnetiferous migmatite gneiss with coarse grained quartzo feldspathic segregations	Strongly foliated parallel to quartzo feldspathic segregations; migmatized, high metamorphic grade equivalent to layered gneiss and schist.	Inequigranular granoblastic interlobate; qtz (av. 40%) + kspar (40%) + plag. (15%) + biot. (15%) + sill. + gnt ± musc. (trace) + acc.
				Massive amphibolites (equigranular medium-grained schistose amphibolite and minor porphyroblastic amphibolite	Strongly foliated, concordant bodies, 2-50+m thick within layered gneisses; either intrusive sills or quartz tholeiite volcanic flows.	Granoblastic polygonal to porphyroblastic with xenoblastic porphyroblasts (up to 5mm) of hbl in a schistose matrix; hbl (45-65%) + plag (An_{15}-An_{100}) ± qtz ± biot ± cpx + opaques + acc.
HUTCHISON GROUP	MIDDLEBACK SUBGROUP	LOWER MIDDLEBACK JASPILITE	Long Gully Member*	Mixed silicate facies iron formation and schist.	Gradational with units above and below.	
			Knight Member*	Mixed silicate and carbonate facies banded iron formation.	Gradational with lower members.	As per Duke Member.
			Duchess Member*	Oxide facies banded iron formation (magnetite quartzite).	Regularly banded and locally laminated; base is gradational into silicate facies iron formation.	Fine to medium grained and essentially equigranular; granoblastic interlobate textures; qtz + mag. (± hem.) ± minor amph. ± trace carbonate.
			Duke Member*	Silicate facies banded iron formation (amphibole magnetite quartzite).	Regularly banded and strongly foliated; interbanded with carbonate facies iron formation and ferroan dolomite; base is gradational but contains abundant iron sulphides.	Fine to medium grained, granoblastic interlobate to decussate textured; qtz + mag. (± hem.) + amph. (grunerite or cummingtonite) ± cpx (hedenbergite) ± py ± pyrrh + acc.
				Carbonate facies banded iron formation (talc magnetite schist, carbonate "ore" and talcose carbonate magnetite jaspilite).		Medium grained but inequigranular with iron oxides finer grained; mag. (± hem.) + carbonate (calc., dol., sid. and ferrodol.) ± talc, ± trem. ± py. ± pyrrh. ± acc.
			Poornamookinnie Member*	Graphitic quartzite	Thin and regularly banded with thin (<1mm) bands of amphibole; foliated; probably originally a graphitic chert.	Granoblastic subpolygonal; fine grained; qtz (80-90%) + graph. (5-10%) + amphib (5% tremolite-grunerite) ± felds + acc.
HUTCHISON GROUP	MIDDLEBACK SUBGROUP	KATUNGA DOLOMITE		Massive to poorly banded dolomitic marble and minor, banded calc-silicate gneiss.	Conformably overlies pelitic schist at top of Warrow Quartzite; very weakly foliated; banding (original) now defined by serpentine nodules + calc-silicates	Medium-grained holocrystalline; dol. + calc. (combined 60-98%) + serp. ± phlog. ± diop. ± trem ± plag. ± sph + opaques + acc., serp. occurs after forsterite.
HUTCHISON GROUP		WARROW QUARTZITE		Pale brown to grey, silvery, mica schist.	Interlayered with flaggy quartzite in units a few mm to several metres thick.	Medium to fine grained, crenulated, lepidoblastic; musc. (40-70%), + biot. + qtz + felds + gnt + tour. + sill. (≤ 20%) + acc.
				Flaggy, medium-grained, feldspathic micaceous quartzite.	Strongly foliated and banded; locally lineated (qtz. rodding); dominant lithology in upper Warrow Quartzite.	Granoblastic equigranular interlobate; qtz. (70-90%) + micro. + musc. (1-5%) + biot. + plag. + sill. + acc.
				Massive, medium to coarse-grained feldspathic quartzite.	Foliated but generally only very weakly banded (as defined by thin aggregates or trains of feldspar); dominant lithology in lower Warrow Quartzite.	Granoblastic interlobate qtz (85-95%) + micro + biot. + musc. ± sill. ± acc.; local bands up to 15mm thick of diop. + trem. (near base of unit).
				Quartz-pebble conglomerate.	Beds from a few cm to several metres thick at or near base in western outcrops.	Pebbles up to 6cm in size to very coarse grained quartz in a massive feldspathic quartzite; originally clast supported.
				Podded sillimanite gneiss.	Associated with calc-silicates in Cowell-Cleve region.	Pods (5-15mm) of fibrolite in medium grained, inequigranular groundmass of micro. (40-50%) + plag. + qtz. + biot. + sill.
		Unconformity		Banded calc-silicate gneiss and massive dolomite marble.	Developed on unconformity in Cowell-Cleve region.	Interbanded dol. ± calc. and calc. + plag. (anorthitic) + cpx. + hbl. + trem. + kspar ± phlog. ± ol. ± serp. ± sph. ± acc.

* Informal names.

TABLE 3: STRATIGRAPHY AND LITHOLOGICAL CHARACTERISTICS OF THE EARLY PROTEROZOIC HUTCHISON GROUP AND ASSOCIATED ROCKS

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA
J. Parker
28.3.85
J.W.
Nov '84
84-507
3666

NATURAL HISTORY OF EYRE PENINSULA: GEOLOGY

EARLY PROTEROZOIC STRATIGRAPHY

Stratigraphic Unit			Lithology	Structural/Stratigraphic Relationships	Metamorphic Features	Age*
Sleaford Complex	Dutton Suite	Whidbey Granite	Massive, even-grained granite (locally gneissic).	Weakly foliated, relationship with Kiana Granite uncertain.	Coarse-grained granoblastic to locally porphyritic; microcline + plag. + qtz + biot. (or chl. + sph.).	2337 ± 71 Ma (Four Hummocks)
Sleaford Complex	Dutton Suite	Kiana Granite	Coarse-grained, porphyritic, tabular feldspar, gneissic granite.	Foliation variable from weak alignment of tabular feldspars to augen texture; intrudes Coulta Granodiorite.	Perthite + microcline phenocrysts (up to 5cm) in coarse-grained matrix of Kspar + plag + qtz + musc. + biot.	2334 ± 109 Ma (Marble Range)
Sleaford Complex	Dutton Suite	Coulta Granodiorite	Medium to coarse-grained granodiorite with abundant mafic xenoliths.	Foliated.	Zoned plag. phenocrysts + qtz + orthoclase + biot; Xenoliths typically hbl + plag ± qtz, biot.	
Sleaford Complex		Miltalie Gneiss	Grey to pink, medium-grained, migmatitic, granodiorite gneiss (with comformable amphibolites).	Strongly foliated parallel to banding and to D2 axial planes; unconformably overlain by Warrow Quartzite.	Equigranular granoblastic; qtz + perthitic microcline + plag. + biot. ± zircon, gnt, sill.	1697 ± 65 Ma (Plug Range area) 2315 ± 175 Ma (Minbrie Springs)
Sleaford Complex		Wangary Gneisses	Massive and layered, grey quartzo-feldspathic gneiss.	Foliated and locally mylonitized; intruded by Kiana Granite but relationship with Carnot Gneisses unknown.	Inequigranular granoblastic; micro. kspar + plag + qtz + biot. ± musc. + acc.	
Sleaford Complex		Carnot Gneisses	Basic granulite.	Concordant but boudinaged; possibly originally intrusive; foliated.	Equigranular granoblastics; Opx + Cpx + labradorite + mag + ilm + qtz; retrograde hbl + biot.	
			Magnetite-bearing gneiss.	Poorly banded but concordant with garnetiferous felsic gneisses; possibly original B.I.F	Medium-grained granoblastics; plag. + kspar + qtz + mag. (5-30% + biot. + cord. + gnt. + sill.	2520 ± 163 Ma (Warramboo WD1)
			Felsic gneisses. – Layered garnetiferous quartzofeldspathic gneiss.	Dominant lithology of supracrustal gneisses; foliated and folded.	Granoblastic; perthitic Kspar + plag + qtz + gnt. (almandine - pyrope) + biot. ± zircon, mag., sill., etc;	2428 ± 94 Ma (Waddikee Rocks)
			– Augen gneiss.	Coarse Kspar augen which may or may not be oriented parallel to regional foliation.	Inequigranular granoblastic; similar composition to garnetiferous gneiss.	2586 ± 131 Ma (Cape Carnot)
			– Biotite garnet gneiss.	Isolated pods within augen and layered garnet gneiss.	Biot. (10-20%) and gnt. (up to 25%) rich ± cord, sill.	
			– Cordierite garnet gneiss.	Foliated; local pegmatite veins (with up to 20% sill.).	Dark green cordierite porphyroblasts + gnt. + sill. + qtz + Kspar + plag.	2412 ± 72 Ma (Cape Carnot)
			– Leucogneiss	Foliated; intimately interlayered	Kspar + plag + qtz ± biot, gnt.	
			– Hypersthene gneiss	Foliated (parallel compositional layering).	Kspar + plag + qtz + hyp. + gnt ± biot.	

* Rb-Sr radiometric ages after Fanning et al (1981) and Webb et al. (in press).

TABLE 2: LITHOLOGICAL CHARACTERISTICS AND AGE RELATIONSHIPS OF THE EARLY PRECAMBRIAN SLEAFORD COMPLEX

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

J.Parker WR 28·3·85

NATURAL HISTORY OF EYRE PENINSULA : GEOLOGY J.W.

SLEAFORD COMPLEX STRATIGRAPHY Nov '84

84-506

3666

AGE		WEST COAST	SOUTHERN EYRE PENINSULA	CENTRAL EYRE PENINSULA	NORTHERN EYRE PENINSULA: MIDDLEBACK RANGE	NORTHERN EYRE PENINSULA: KIMBA/WUDINNA REGION	
ADELAIDEAN	UMBER-ATANA GROUP				Tent Hill Fm Whyalla Sandstone Willochra Subgroup Tapley Hill Fm		
ADELAIDEAN	CALLANNA GROUP				Beda Volcanics Backy Point Beds ~ Unconformity ~	dolerite dykes	
MIDDLE PROTEROZOIC					Pandurra Formation ~ Unconformity ~ rhyolite dykes	rhyolite dykes	
MIDDLE PROTEROZOIC		Hiltaba Suite		Charleston Granite	Charleston Granite	Hiltaba Suite	
MIDDLE PROTEROZOIC		acid volcanics granite	CORUNNA CONGLOM.	Blue Range Beds ~ Unconformity ~	breccia (Cowleds Mbr) quartzite (Nilgenee Mbr) conglomerate	Yardea Dacite "Older" Gawler Range Volcanics	GAWLER RANGE VOLCANICS
EARLY PROTEROZOIC	LINCOLN COMPLEX			Bungalow Granodiorite	Moonabie Formation McGregor Volcanics Wandearah Metasiltstone ~ Unconformity ~		
EARLY PROTEROZOIC	LINCOLN COMPLEX	granite gneissic granite migmatite gneiss	Moody suites Spilsby suites Donington Granitoid Suites	Carpa Granite Middle Camp Granite Minbrie Gneiss	Wertigo Granite Broadview Schist Myola Volcanics ~ Unconformity ~	granite gneissic granite Volcaniclastics	
EARLY PROTEROZOIC	HUTCHISON GROUP / MIDDLEBACK SUBGROUP		Middleback Subgroup equivalents Warrow Quartzite (basal pebble beds)	Yadnarie Schist Upper Middleback Jaspilite (Mt. Shannan Iron Fm) Cook Gap Schist (Mangalo Schist & local amphibolite). Lower Middleback Jaspilite. Katunga Dolomite Warrow Quartzite (Local calcsilicate at base)	Upper Middleback Jaspilite Cook Gap Schist Lower Middleback Jaspilite Katunga Dolomite local quartzite and leucogneiss.	Middleback Subgroup Equivalents Warrow Quartzite	
ARCHAEAN	SLEAFORD COMPLEX		Dutton Suite Whidbey Granite Klana Granite Coulta Granodiorite				
ARCHAEAN	SLEAFORD COMPLEX		Wangary Gneisses Kiana Gneisses	Miltalie Gneiss		garnet gneiss	

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

A.J. Parker
R.B. Flint

28·3·85

NATURAL HISTORY OF EYRE PENINSULA
TABLE 1
PRECAMBRIAN STRATIGRAPHY OF EYRE PENINSULA

J.W

Nov' 84

84-505

3666

Complex	Suite	Stratigraphic Unit	Lithology	Structural Relationships	Petrographic Features	Age
LINCOLN COMPLEX	HILTABA SUITE	—	Porphyritic leucogranite ; white pink.	Intrudes acid volcanics in Nuyts Archipelago.	Abundant phenocrysts of perthitic kspar and qtz (≤ 10mm) in fine-grained recrystallised qtz mosaic.	1489 ± 15 Ma 1466 ± 79 Ma
		—	Massive, pink-red granite ; coarse grained with pinkish-red feldspars.	Intrudes Gawler Range Volcanics in southern Gawler Ranges ; "type" lithology of Hiltaba Suite.	Perthitic kspar (50-70%) + zoned plagioclase (10-15%) + qtz (20-40%) and biot (<5%).	1456 ± 26 Ma 1478 ± 38 Ma
		Charleston Granite	Massive, homogeneous, coarse-grained, megacrystic granite.	Intrudes Corunna Conglomerate and older units ; non-foliated ; semi-circular pluton.	Large kspar phenocrysts (30-40%) + greenish plag. (10-15%) + biot + qtz + acc.; some phenocrysts are zoned.	1445 ± 39 to 1556 ± 30 Ma
		—	Massive, hornblende ± pyroxene granite ; medium-grained to porphyritic.	Intruded by rhyolite dykes in Nuyts Archipelago ; non-foliated.	Dominantly graphic qtz + kspar, minor plag, minor mafics are aegirine and/or hornblende.	1478 ± 15 Ma
	MOODY SUITE	—	Granodiorite ; pale grey, medium-grained, equigranular	Massive to weakly foliated dykes in Bungalow BD 2 drillhole, E of Buckleboo and in the Streaky Bay area.	Microscopically deformed and partially recrystallised ; plag. + qtz + micro. + biot. + acc.	1601 ± 14 Ma
		—	Coarse grained granite ; also foliated megacrystic granite	Weakly to strongly foliated and intruded by granodiorite dykes in the Streaky Bay region	Perthitic microcline (30-40% + plag. (30-40%) + qtz (20-25%).	
		Burkitt Granite	Massive, even-grained, hornblende granite / quartz syenite ; locally porphyroblastic	Intrudes Hutchison Group and is overlain by Corunna Conglomerate; elliptical pluton elongate parallel S_3; maybe equivalent to Chinmina Syenite.	Ortho perthite (40-60%) + plag (20-25%) + qtz (10-15%) + hbl (5-15%) ± biot. + sphene + acc	1655 ± 61 Ma
		Carpa Granite	Massive, medium-grained, weakly foliated granite.	Equivalent to granite at Moody Siding (type locality for Moody Suite).	Microscopically deformed/recrystallized qtz (30-45%) + kspar (30-60%) + plag (10-40%) + biot. + musc + gnt + acc.	1677 ± 125 Ma
		Wertigo Granite	Massive, medium-grained gneissic granite with schlieren of metasedimentary gneiss.	Intrudes Myola Volcanics and contains an S_3 foliation ; type locality is Wertigo Rockhole.	Equigranular ; qtz (20-30%) + kspar (25-40%) + plag (20-30%) + biot (5-10%) + acc ; locally granodioritic.	
	SPILSBY SUITE	Middle Camp Granite	Medium-grained gneissic granite / granodiorite with abundant pegmatite veining.	Well foliated with foliation and pegmatite veins folded by D_3 folds ; local xenoliths of Hutchison Group marble.	Qtz (20-25%) + plag (45-60% and 20-30%) + kspar (10-25% and 35-50%) + biot + sphene + acc.	1650 ± 35 Ma
		—	Medium-grained hornblende granite and tabular feldspar granite.	Massive to foliated with local D_3 shear zones intrudes Donington Granitoid Suite on Sir Joseph Banks Group islands.	Micro (35-40%) + plag (15-25%) + qtz (20-30%) + hbl (≤ 7%) + biot + acc.	1576 ± 199 Ma
	DONINGTON GRANITOID SUITE	—	Even-grained granite gneiss ; medium-grained.	Foliated and folded by D_2 and D_3 folds ; grades into megacrystic granite gneiss at Kirton Point but intrudes hypersthene granitoids at Cape Donington.	Microcline + plag (andesine) + qtz + biot + acc. ; granoblastic serriate textures.	1816 ± 10 Ma
		—	Mafelsic megacrystic granite gneiss grading into augen gneiss.	Strongly foliated and folded ; local xenoliths of mafic material.	Zoned ovoid plag + ortho/micro megacrysts (≤ 40 mm) in a coarse grained groundmass of qtz + felds + biot + hbl + opx.	
		Memory Cove Charnockite	Medium to coarse-grained hypersthene granite gneiss.	Intruded by even grained granite gneiss at Cape Donington.	Plag + hyp + ortho phenocrysts in a partly recrystallised groundmass of felds + qtz + biot ± hbl + acc.	1818 ± 13 Ma
		—	Coarse-grained quartz gabbronorite gneiss.	Xenoliths in even-grained granite gneiss ; probable earliest intrusive phase of Donington Granitoid Suite.	Zoned plag phenocrysts (oligoclase) + augite + hyp. + biot + qtz + acc. + secondary hbl.	

TABLE 4 : LITHOLOGICAL CHARACTERISTICS AND AGE RELATIONSHIPS OF SYN-KIMBAN AND POST-KIMBAN OROGENY GRANITOIDS

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA
J.Parker
28-3-85
NATURAL HISTORY OF EYRE PENINSULA : GEOLOGY J.W
EARLY & MIDDLE PROTEROZOIC GRANITOIDS Nov '84 84-508
3666

3666

TABLE 5 : STRATIGRAPHY & LITHOLOGICAL CHARACTERISTICS OF PALAEOZOIC, MESOZOIC & TERTIARY SEDIMENTS

AGE	STRATIGRAPHIC UNIT	LITHOLOGY	DEPOSITIONAL ENVIRONMENT	COMMENT
PLEISTOCENE - PLIOCENE	GIBBON BEDS	Orange-brown qtz. sands, sandy clays, mottled clayey sands and conglomerates. Laterite nodules common.	Alluvial.	Probably laterally equivalent to Uley Formation (Cummins & Uley Basins) and Pantoulbie Formation (Polda & Robinson Basins). 50 m max. thickness.
PLIOCENE - MIOCENE	Unnamed	Sands, sandy clays, brown-green -grey clays, dolomites.	Lacustrine.	Restricted to eastern Polda Basin, e.g. Tuckey No.1 and Polda No.9.
	Unnamed	Yellow-buff fossiliferous limestones, sandy limestones	Marine.	Includes both Pliocene & Miocene limestones of Fishery Bay and Miocene limestones at Deep Creek (Melton Limestone equivalent).
EOCENE (MIDDLE - LATE)	POELPENA FORMATION	Brown-grey, quartz sands, silts and clays - carbonaceous, micaceous, pyritic and uraniferous. Carbonaceous and sapropelic clays.	Fluviatile - paludal, Marginal marine.	Equivalent to Pidinga Formation (northern Eyre Peninsula) & Wanilla Formation (Uley-Wanilla -Cummins Basins). Thickness varies e.g. 110 m Tuckey No.1 and 178 m Mercury No.1. Deposition synchronous with separation of Australia & Antarctica.
JURASSIC (LATE)	POLDA FORMATION	Dark grey carbonaceous fine to coarse grained sands, silts and clays interbedded with sub-bituminous lignites.	Fluviatile - paludal	Restricted to Polda Basin; type section in Polda No.1. Max. thickness onshore is 170 m (Lock No 1) to an interpreted 511 m offshore in Mercury No.1. Deposition synchronous with initial rifting between Australia & Antarctica. Coal deposit at Lock.
PERMIAN - CARBONIFEROUS	COOLARDIE FORMATION	Brown, grey, green diamictites, mudstones, sandstones.	Glacial-marine	Restricted to Polda Basin. Max. thickness 181 m in type section Lock No. 1. Equivalent to Cape Jervis Beds of Troubridge Basin. Top of unit, below Jurassic sediments, weathered & kaolinised
?CAMBRIAN	Unnamed	Massive rock salt, red-brown shales, siltstones with anhydrite and dolomite crystals. Minor dolomite and carbonate-cemented sandstones.	Arid fluviatile - playa lake	Restricted to Polda Basin. Only intersected in Columbia No.1 and Mercury No.1, though also expected to occur in onshore portion of the trough.

PALAEOZOIC, MESOZOIC & TERTIARY SEDIMENTS

NATURAL HISTORY OF EYRE PENINSULA : GEOLOGY

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

COMPILED	DRAWN	DATE	CHECKED
J. Parker	J.W.	Nov. '84	

C.D.O. DATE 28.3.85

SCALE

PLAN NUMBER S17762

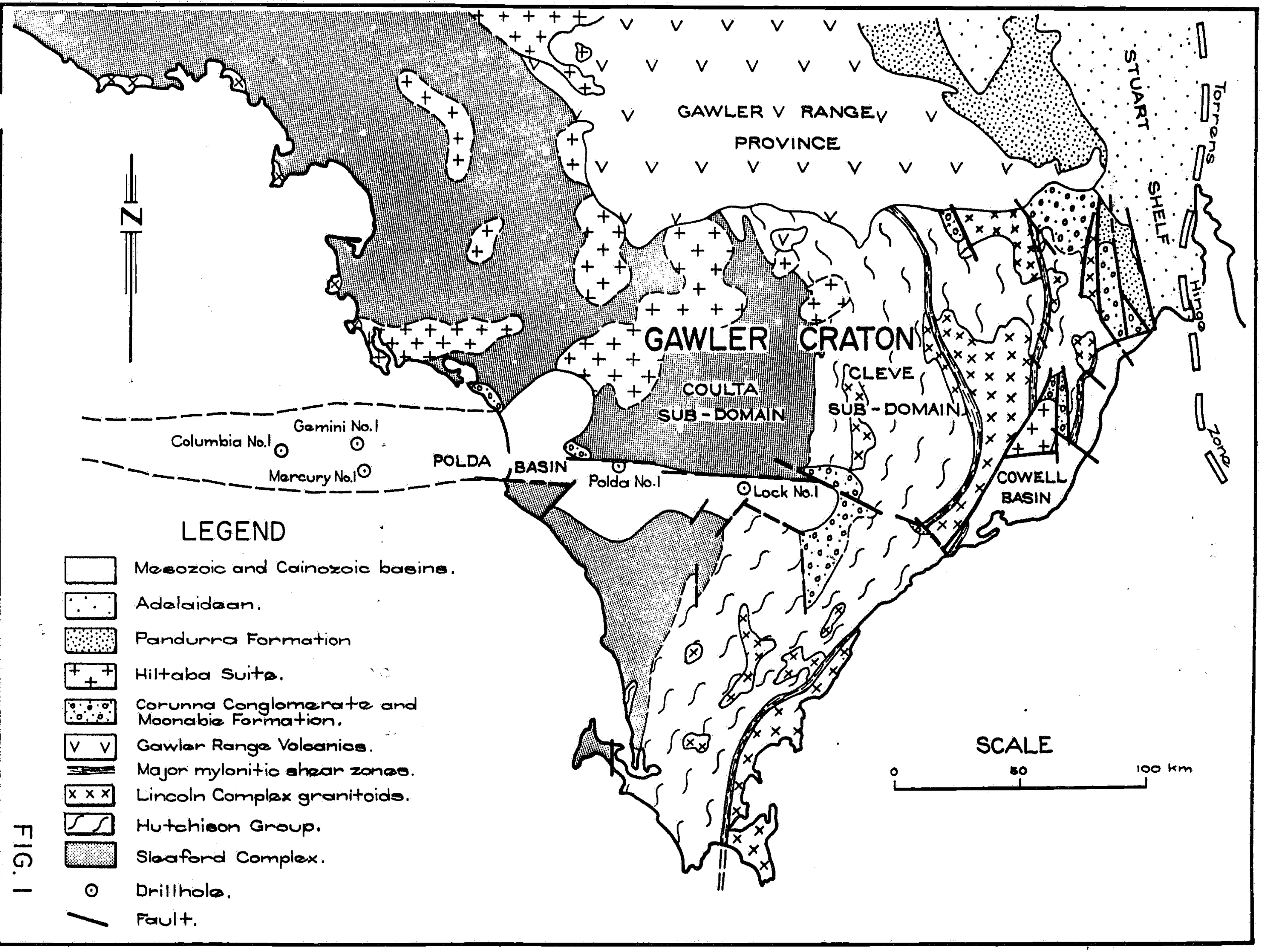
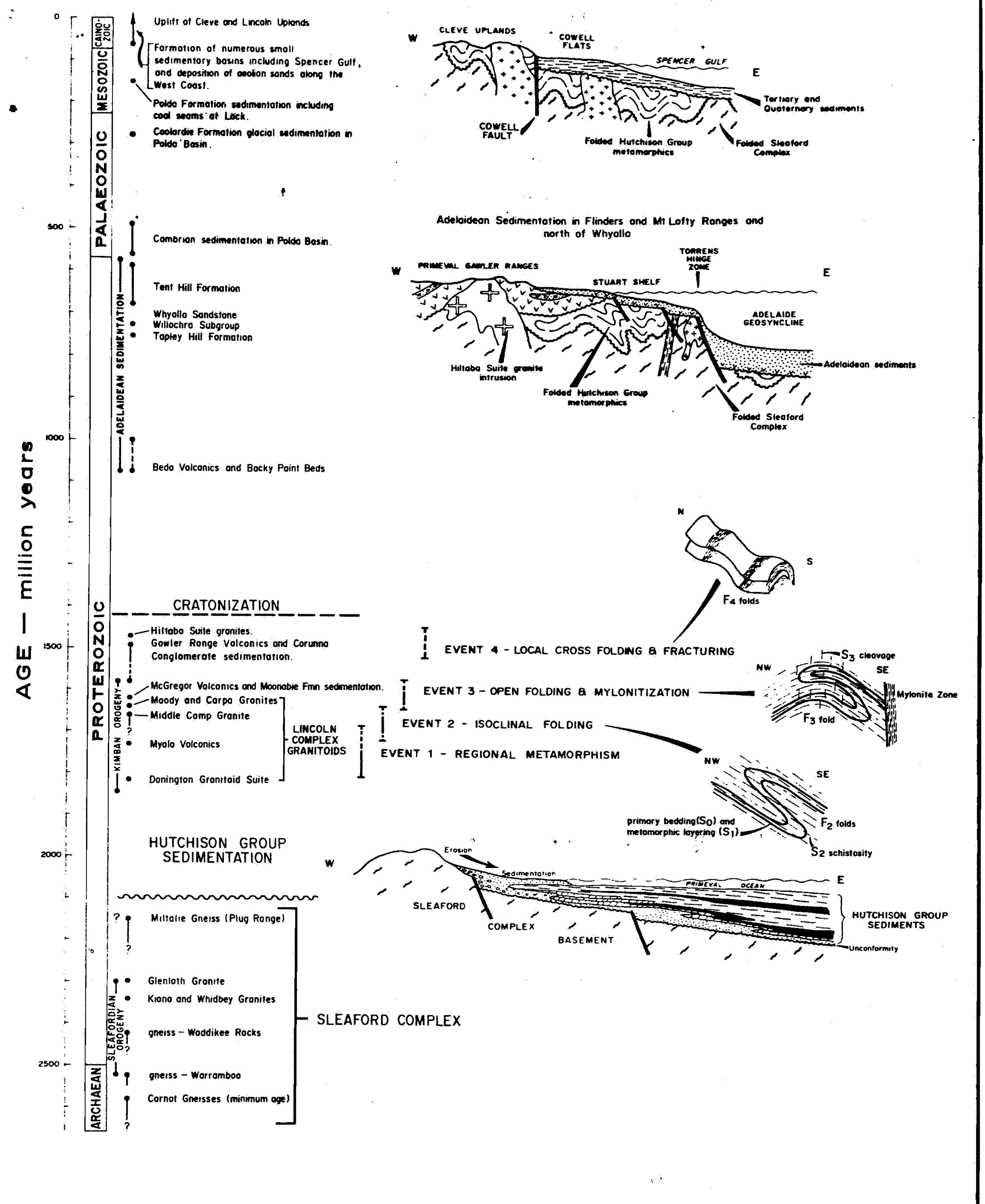


FIG. 1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

NATURAL HISTORY OF EYRE PENINSULA: GEOLOGY
TECTONIC SKETCH OF EYRE PENINSULA

COMPILED	J. Parker	
DRAWN	J.W	
DATE	Oct '84	
CHECKED		
C.D.O.		28.3.85 DATE
SCALE 1:2,000,000		
PLAN NUMBER	S17759	



GEOLOGICAL EVOLUTION OF EYRE PENINSULA

FIG. 2

Compiled by A J PARKER
DEPARTMENT OF MINES & ENERGY–
SOUTH AUSTRALIA
November 1984

S17763

FIG. 3. Layered, garnetiferous and cordierite-garnet gneisses of the Carnot Gneiss (Sleaford Complex) exposed at Cape Carnot.

FIG. 4. Migmatitic garnetiferous gneisses (Sleaford Complex) at Waddikee Rocks, which have a Rb-Sr isochron age of 2428±94 Ma.

FIG. 5. Porphyritic Kiana Granite, with its characteristic large tabular feldspars, intruding the xenolithic Coulta Granodiorite (Dutton Suite) at Mt. Hope.

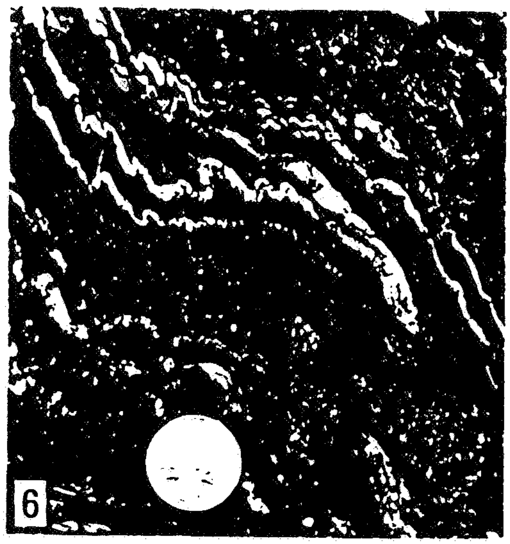


FIG. 6. Style of folding and refolding developed in the Cook Gap Schist (Hutchison Group) in Mangalo Creek. Quartz veins have been isoclinally folded by F_2 folds and subsequently refolded about a subvertical F_3 axial plane.

FIG. 7. Megacrystic granite gneiss of the Donington Granitoid Suite at Cape Donington displaying large zoned feldspar phenocrysts and narrow mylonitic shear zones.

FIG. 8. Multiple intrusions of foliated granites, and aplitic and granitic dykes (Kimban Orogeny granitoids) near Smooth Pool.

FIG. 9. Memory Cove Charnockite near Wanna containing younger, N-S trending dolerite dykes.

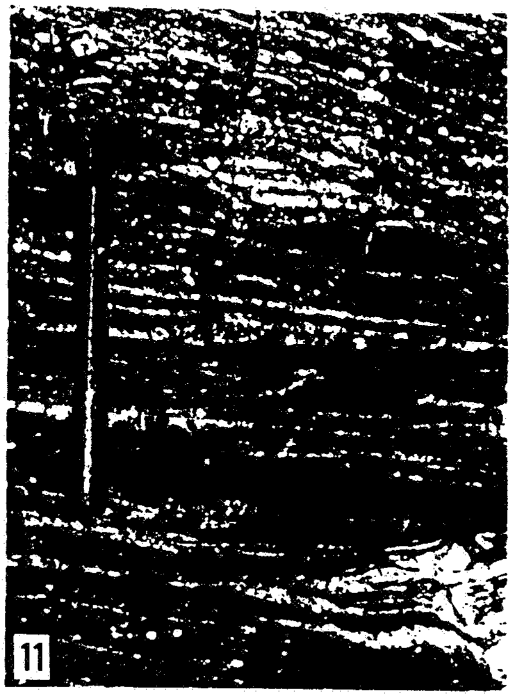


FIG. 10. Mylonitic gneisses containing melanocratic boudins of amphibolite, Kalinjala Mylonite Zone at Port Neill.

FIG. 11. Mylonite and ultramylonite at Port Neill showing relic feldspar augen, and tails and ribbons of recrystallised quartz and feldspar.

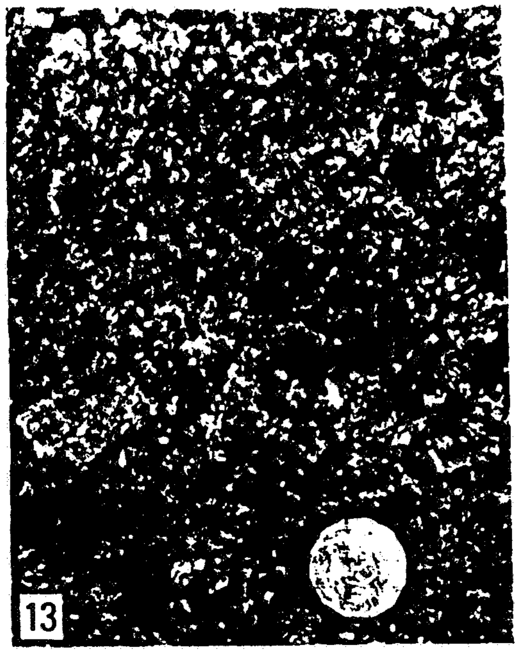


FIG. 12. Steeply dipping, fluvial conglomerates and sandstones of the Corunna Conglomerate, Moonabie Range.

FIG. 13. In Moonabie Range, the Charleston Granite (massive with large microcline phenocrysts) intrudes the Corunna Conglomerate.

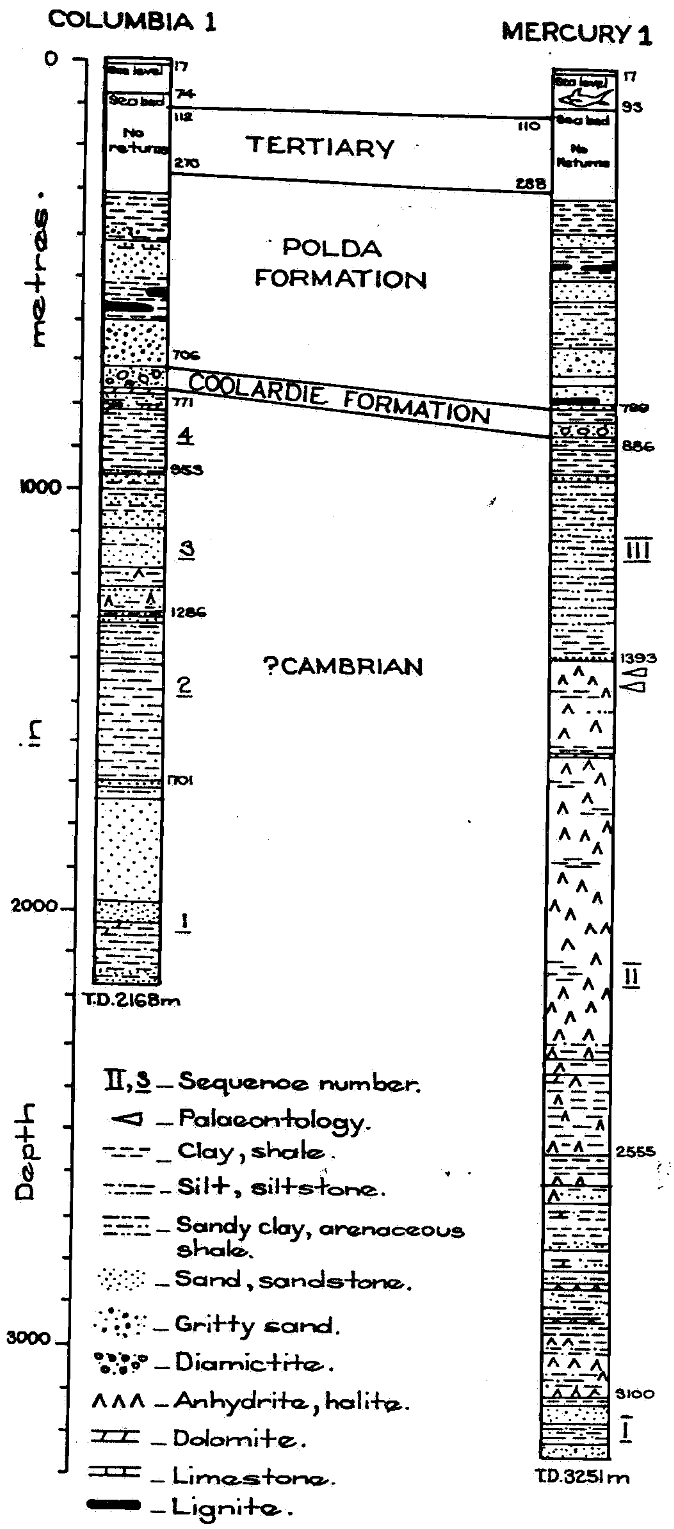


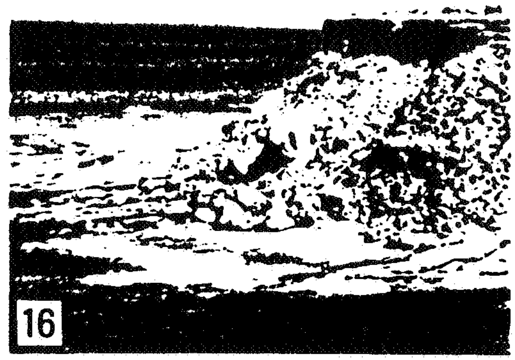
FIG. 14

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

NATURAL HISTORY OF EYRE PENINSULA: GEOLOGY
STRATIGRAPHIC SEQUENCES
OFFSHORE POLDA BASIN

COMPILED J. Parker	C.D.O.	DATE 28·3·85
DRAWN J.W	SCALE	
DATE Nov '84	PLAN NUMBER	S17761
CHECKED		

3GGG



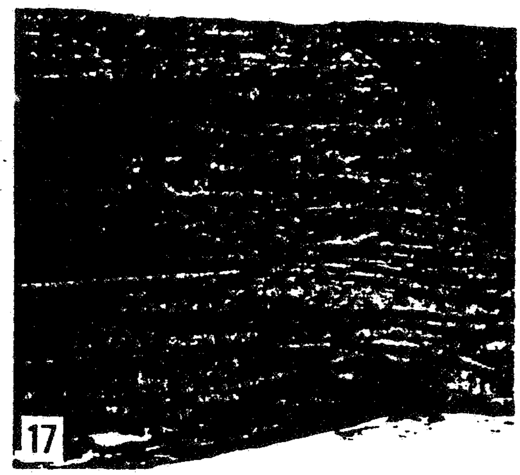


FIG. 15. Coastal cliff exposures of the Bridgewater Formation near Elliston featuring a 12 m thick sequence of nodular calcrete (oldest horizon), an overlying aeolianite with large foresets and solution pipes (note geo-hammer for scale), silty clay and basal calcrete clasts, and upper aeolianite.

FIG. 16. Aeolianites and calcretes of the Bridgewater Formation overlying wave-washed platform of Middle Proterozoic Blue Range Beds near Talia Caves.

FIG. 17. 130 m high cliffs at Cape Wiles displaying alternating cross-bedded aeolianite and calcrete horizons (Bridgewater Formation).