DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT. BK. NO 91/41

GEOLOGY OF THE KINGOONYA 1:250 000 MAP SHEET AREA

GEOLOGICAL SURVEY

by

W.M. COWLEY and A.R. MARTIN

REGIONAL GEOLOGY

APRIL, 1991

DME 280/86

D00545

CONTENTS PAGE

INTRODUCTION 1

HISTORICAL NOTES 2

PREVIOUS INVESTIGATIONS 3

PHYSIOGRAPHY 8
- Climate 8
- Physiographic Divisions and Vegetation 8
- Drainage 13

STRATIGRAPHY 15
- GAWLER CRATON 16
  - *Archaean to Early Proterozoic* 16
    - Mulgathing Complex (AⱣ*m*) 16
      - Kenella Gneiss (AⱣ*mk*) 17
      - Christie Gneiss (AⱣ*mc*) 17
      - Glenloth Granite (AⱣ*mγ*) 18
      - Unnamed Archaean volcanics (A*v*) 18
  - *Early Proterozoic* 20
    - Wilgena Hill Jaspilite (Ᵽ*h*) 20
    - Lincoln Complex (Ᵽ*l* and Ᵽβ_1) 22
    - Tarcoola Formation (Ᵽ*t*) 24
      - Fabian Quartzite Member (Ᵽ*tf*) 25
      - Sullivan Shale Member (Ᵽ*ts*) 27
  - *Middle Proterozoic* 29
    - Labyrinth Formation (Ᵽy_1 - Ᵽy_5) 29
    - Gawler Range Volcanics (Ᵽa_1 - Ᵽa_3) 33
      - Konkaby Basalt (Ᵽa_1) 34
      - Ealbara Rhyolite (Ᵽa_2 - Ᵽa_3) 35
    - Early to Middle Proterozoic Stratigraphic Relationships 37
    - Unnamed mafic to felsic dykes (Ᵽa_4) 38
    - Unnamed possible ultramafic rock (Ᵽβ_2) 39
    - Hiltaba Suite (Ᵽγh) 40
    - CARIEWERLOO BASIN - Pandurra Formation (Ᵽ*p*) 42
    - Gairdner Dyke Swarm Ᵽβ_3) 44
- STUART SHELF 46
  - *Late Proterozoic (Adelaidean)* 46
    - Wilpena Group (Ᵽw) 46
      - Nuccaleena Formation (Ᵽwn) and Seacliff Sandstone (Ᵽwe) 46
      - Tent Hill Formation 48
        - Tregolana Shale Member (Ᵽwt) 48
        - Corraberra Sandstone Member (Ᵽwc) 49
        - Simmens Quartzite Member (Ᵽws) 50
      - Yarloo Shale (Ᵽwx) 51

- *Early Cambrian* 51
  - Hawker Group - Andamooka Limestone (Ɛa) 51
    - Curdlawidny Siltstone Member (Ɛac) 53

ARCKARINGA BASIN 54
- *Late Carboniferous to Early Permian* 55
  - Boorthanna Formation (CPb) 55
  - Stuart Range Formation (CPs) 58

EROMANGA BASIN 59
- *Late Jurassic* 60
  - Algebuckina Sandstone (Ja) 60
- *Early Cretaceous* 63
  - Cadna-owie Formation (Kc) 63
  - Bulldog Shale (Kmb) 66
- *Late Cretaceous to Early Tertiary* 70
  - Late Cretaceous to Paleocene bleaching (KTb) 70
  - ?Palaeogene ferruginisation (Tfe$_1$) 71

Equivalent of LAKE EYRE BASIN 72
- *?Paleocene to Eocene* 72
  - Munjena Formation equivalent (Tp-e) 72
- *?Oligocene* 74
  - Silicification (Tsi$_1$) 74

KINGOONYA PALAEOCHANNEL 75
- Undifferentiated ?Eocene to ?Pliocene sediments (Te-p) 75

BILLA KALINA BASIN 76
- *Miocene to ?Pliocene* 76
  - Mirikata Formation 76
    - Millers Creek Dolomite Member (Tmi) and Billa Kalina Clay Member (Tml) 77
    - Danae Conglomerate Member (Tms) 80
    - Watchie Sandstone Member (Tmw) 81
    - Unnamed sandstone member (Tm) 86
- *?Pliocene* 89
  - Ferruginisation (Tfe$_2$) and silification (Tsi$_2$) 89

TERTIARY PALAEOGEOGRAPHIC INTERPRETATION 90
- *Paleocene to Late Eocene* 90
- *Oligocene to Early Miocene* 92
- *Middle Miocene to Pliocene* 93
  - Kingoonya Palaeochannel 93
  - Unnamed member of Mirikata Formation 94
  - Mirikata Formation of Billa Kalina Basin 94

QUATERNARY 96

STRUCTURAL HISTORY AND GEOPHYSICS 102

ECONOMIC GEOLOGY 110
Groundwater 111
Iron Ore 112
Copper, Nickel, Chromium, Platinoids and Diamonds 113
Tin and Gold 113
Copper, Lead and Zinc 113
Olympic Dam-style Copper-Gold-Silver-Uranium Deposits 114
Topaz and related minerals 114
Coal and Oil shale 114
Opal 115
Celestite 116
Palygorskite 116
Road sealing aggregate 116
Roadmaking materials 116
Clay 116
"Aquarium Rock" 117

TABLES

1. Selected climatic data, KINGOONYA region. 14
2. Mineral and fossil fuel exploration summary. 118
3. Drillhole stratigraphic summary. 122

BIBLIOGRAPHY 135

PLATE CAPTIONS 161

PLATES (Slides 39369-39404).

FIGURES PLAN NO.

1. Regional location and tectonic setting. S22359
2. Drillhole locations. S22360
3. Physiographic Divisions and pastoral properties. S22361
4. Geology of Mt Eba. S22362
5. Isopachs of Adelaidean sediments. S22363
6. Structure contours (basal) and isopachs of Andamooka Limestone. S22364
7. Structure contours, base of Arckaringa Basin sequence. S22365
8. Isopachs of Arckaringa Basin sediments. S22366
9. Structure contours, base of Eromanga Basin sequence. S22367

10. Isopachs of Algebuckina Sandstone and/or Cadna-owie Formation. S22368

11. Mesozoic palaeogeographic interpretation. S22369

12. Structure contours, base of Bulldog Shale. S22370

13. Structure contours, top of Munjena Formation equivalent. S22371

14. Interpretive palaeogeographic sections, Lake Billa Kalina. S22372

15. Tertiary palaeogeographic interpretation. S22373

16. Bouguer gravity contours (above) and aeromagnetic contours (below), KINGOONYA area. S22374

17. Exploration Tenements, granted 1959-1979 (above) and 1980-1989 (below). S22375

18. Aeromagnetic and Gravity Surveys. S22376

INTRODUCTION

The KINGOONYA 1:250 000 map sheet area (hereinafter referred to as KINGOONYA) is located between longitudes 135° and 136° 30′ east and latitudes 30° and 31° south, and encompasses some 16 000 square kilometres northwest of Woomera (Fig. 1).

The only townships are Kingoonya, in the southwestern corner, and Glendambo, on the new Stuart Highway near the southern margin of the sheet. Kingoonya was once an important "railway town" and supply centre for travellers on the old Stuart Highway and for nearby sheep stations. It now has a much reduced population due to the relocation of several businesses to Glendambo in 1982 and the transfer of many of the railway workers to Tarcoola with the establishment of the new Tarcoola - Alice Springs railway.

Most of KINGOONYA is devoted to sheep grazing, and station homesteads located on the sheet are "North Well" and "Whymlet" (both part of "Wilgena" pastoral lease), "Bon Bon", "Mount Eba", "Mount Vivian", "Millers Creek", and "Parakylia". In addition, the sheet includes portions of "Wilgena", "Bulgunnia", "The Twins", "Roxby Downs", "Wirraminna" and "Coondambo" stations south of the Dog Proof Fence, and part of "Billa Kalina", which carries beef cattle, north of the fence.

Access to the area is principally by the sealed Stuart Highway, the unsealed Glendambo-Kingoonya-Tarcoola road and the old Stuart Highway north of Kingoonya. Other major roads are the station access tracks from "Roxby Downs" through "Parakylia" to "Billa Kalina", from "Mount Eba" to "Millers Creek" and "Billa Kalina" and from Kingoonya to "Bulgunnia" via "North Well". The "Range Road", constructed within the Woomera Prohibited Area, provides easy access to the southeastern corner of KINGOONYA via Woomera and Koolymilka; it is sealed to near Lake Parakylia, and a branch road runs north to "Parakylia". Elsewhere, the density of station tracks results in few areas being more than five kilometres from a track.

KINGOONYA is almost entirely within the Woomera Prohibited Area. Although restrictions on access are not as severe as in the past, permission is still required to enter the Prohibited Area apart from travel on the Stuart Highway.

Geological mapping was carried out from 1985 to 1987 and occupied 44 man-weeks in the field. Observations were recorded on the backs of 1:89 000 scale colour aerial photographs of 1972 surveys 1354 B, 1357-1360 and 1382, and in notebooks; these may be viewed in the South Australian Department of Mines and Energy. Samples from the area are stored at the SADME Core Library; reports on their petrology and geochemistry are also available from the Department using the RS (rock sample) and GEOCHEM databases. Reinterpretation of company drilling and water bore logs was carried out, and a nine-hole rotary-drilling project was undertaken by the Department north of Kingoonya in late 1987 (Cowley and Martin, 1988).

Dyeline prints of the six 1:100 000 preliminary geological compilation sheets and of the tectonic and palaeogeographic sketches (at 1:250 000 scale) are available.

HISTORICAL NOTES

The original inhabitants of KINGOONYA were aborigines of the Kokata tribe. Their territory bounded that of the Kujani tribe near the northeastern corner of the sheet, and adjoined that of the Wirangu tribe near the southwestern corner (Tindale, 1940). "Kingoonya" is an aboriginal word referring to the simpler nomadic mode of life of the more savage tribes north of Kingoonya, who did not construct wurlies, instead sleeping on the ground, and did not wear clothes (Cockburn, 1984).

European exploration commenced in 1858, when B. Herschel Babbage visited and named Lakes Hanson and Younghusband, Arcoona (Caves), Curdlawidny Lagoon and Bamboo Swamp on his way north towards Lake Eyre (Babbage et al., 1858). At the same time, John MacDouall Stuart explored the country northwest of Babbage's route, returning in July and August of that year, passing Mt Paisley, Reedy Lagoon and Lake Parakylia, before travelling northwest to near Mt Sabine, and southwest towards Fowler's Bay (Stuart, 1858; Threadgill, 1922).

Ernest Giles twice traversed the southwestern corner of KINGOONYA in 1875, passing Mt Eba during a journey from Fowler's

Bay to Beltana in March, and following a route slightly to the south in June on his westerly journey to Perth (Giles, 1899).

Pastoral occupation of the sheet area commenced in the early 1870's; by the 1880's the western two-thirds was stocked with sheep and was known as "Mt Eba", while the remainder of the sheet area was run as "Parakylia" (Richardson, 1925). Trigonometrical surveying of the northwest pastoral areas, including KINGOONYA, began in 1874. By the 1890's, however, all of KINGOONYA was abandoned and unoccupied, with the exception of "Coondambo" which has been continuously occupied from the early 1870's. Reoccupation apparently took place slowly through the early 1900's and the present leases are basically the same as those taken up at that time (Fig. 3).

PREVIOUS INVESTIGATIONS

The first geological observations on KINGOONYA were recorded by H.Y.L. Brown (1885), who was mainly concerned with the water supplies from wells on the southern part of the sheet area. He noted "Cretaceous sandstone, grit and kaolin" in the wells, now referred to as Jurassic Algebuckina Sandstone, and the widespread occurrences of "desert quartzite", now recognised as silcreted Tertiary sandstone, on tablelands and stony downs.

Brown again traversed the area in late 1893, this time journeying southwestwards from "Millers Creek" to "Wilgena". He drew attention (Brown, 1894) to a "level tableland .... showing .... a dense limestone, resembling lithographic stone" (Millers Creek Dolomite Member) northeast of Millers Creek, and "ferruginous sandstone, grit, conglomerate and brown iron ore" (Cadna-owie Formation) southwest of there. He visited Mount Paisley and commented on the abundance of "waterworn boulders....of Primary rocks" on the stony downs here and in other parts of South Australia, and ascribed their origin to a Tertiary glaciation. After leaving "Mt Eba" he visited outcrops of "Primary rocks" at Gosse's Range (now Gosse Range, see below), Rocky Hill, Wallabyng Range and Mt Eba.

The low range now known as Gosse Range is composed of Cretaceous shale and no basement rocks are known in the vicinity.

Brown's report (1894) does not mention the rocks he encountered on Gosse Range, but his state map of 1899 (Brown, 1899) depicts Gosse Range in its correct position, but as being composed of "Primary; Cambrian etc., (metamorphic)" rocks. It is likely, therefore, that he actually visited the unnamed low range of Tarcoola Formation quartzite some 10 kilometres west of Gosse Range and mistook it for Gosse Range.

"Quartzite and flint conglomerate" (Tarcoola and Labyrinth Formations) were recorded by Brown (1894) on Rocky Hill and "white quartz, quartzite and quartz conglomerate" (Tarcoola Formation) with local copper staining was noted on Wallabyng Range. Brown described southeast-dipping "white quartz rock, clay slates and sandstone" (Tarcoola Formation) with "siliceous ferruginous veins and reefs" on Mt Eba, considering it a likely place for gold, and noted poorly exposed "granitic rocks, both eruptive and metamorphic, quartz rock, quartzite, and slate" along the southern side of Lake Labyrinth, before continuing to "Wilgena".

In May 1904, Brown again visited KINGOONYA, this time travelling through "Millers Creek" and "Mt Eba", and then northwestwards via "McDouall Peak" (on COOBER PEDY) to the far northwest of the state, eventually reaching Charlotte Waters in the Northern Territory (Brown, 1905). He crossed white shale and porcellanised shale rises (Bulldog Shale) interspersed with red sand and gravelly plains both east and west of "Mt Eba".

No further geological work was undertaken until 1930 when R. Lockhart Jack (1930) produced a report outlining what was then known of factors influencing groundwater supplies from the Great Artesian Basin (now Eromanga Basin) in northern South Australia. He noted that Jurassic sands (Algebuckina Sandstone) filled depressions within the Precambrian basement near Kingoonya and Tarcoola, and are overlain by weathered shale (Bulldog Shale) on "Bon Bon" and "Mt Eba".

Segnit (1939) was the first to map the approximate distribution of Cambrian (Andamooka Limestone) and "Upper Precambrian" (Tent Hill Formation) rocks on the eastern part of KINGOONYA, after visiting "Roxby Downs" and "Parakylia" in 1932 and 1935. He recorded 60 feet (18.3m) of Cambrian shale

(Curdlawidny Siltstone Member) overlying 57 feet (17.4m) of limestone (Andamooka Limestone) in Red Lake Well southeast of "Parakylia". He considered the Tent Hill Formation to extend subsurface at least as far as "Mt Vivian", noting outcrops of current-bedded and ripple-marked coarse quartzitic conglomerate and grit near Lakes Younghusband, Parakylia and Hanson. Up to 207 feet (63.1m) of thinly laminated purple shales of the "Purple Series" (Tregolana Shale) were identified by him in the lower part of Butcher's Well on "Parakylia" and in a trial borehole to the northwest. Although Segnit assigned an upper Precambrian age to the rocks now known as Tent Hill Formation, maps and reports continued to show them as Cambrian for some time (Sprigg, 1953; Johns, 1955).

Investigations carried out on KINGOONYA in the 1940's and 1950's were dominantly concerned with groundwater supplies and prospects, the study of Ward (1946) concentrating on the Great Artesian Basin in this area, and that of Anderson (1949) on "Bulgunnia". O'Driscoll (1952a,b) commented on groundwater prospects on "Mt Eba", "The Twins", "Millers Creek", "Mt Vivian" and "Bon Bon", and Bleys (1958) did the same for "Parakylia".

Jessup (1951) reported extensively on the soils and vegetation of the northwest pastoral region, including KINGOONYA, relating the development of soils to the underlying geology as it was then known.

Ward (1954) reported an analysis, including fluorine, of the water from a well at "North Well".

Johns (1955) carried out a geological reconnaissance along the range centre line of the Woomera Long Range Weapons Establishment, from Lake Reynolds to near Lake Wingilpin, briefly describing surficial units, subsurface kaolinitic sandstone and grit (now Algebuckina Sandstone or Cadna-owie Formation) and the outcropping quartzite and sandstone around Lakes Parakylia and Reynolds, to which he assigned a Cambrian age (now Tent Hill Formation, Late Proterozoic).

Whitten (1958, 1959, 1960, 1962, 1966a) carried out investigations on TARCOOLA and western KINGOONYA, evaluating the ore potential of outcrops of iron formation.

Webb and Crawford (1961) sampled Tomato Rocks on the western shore of Lake Harris as part of a reconnaissance investigation of the Gawler Range Volcanics.

A report on the hydrology of the Great Artesian Basin, which covers most of KINGOONYA, included groundwater prospects of each pastoral property on the sheet (Ker, 1963).

The first studies of plant fossils within silicified Tertiary sandstone on KINGOONYA were by Offler (1964, 1969), who described fossil shoots, leaves, fruits, seeds and bark from Haggard Hill, Jacks Hill and The Lookout.

A seismic refraction investigation of Cainozoic sediments in Lake Younghusband by Kendall (1966) concluded that they were 40 feet (12m) thick, and overlay 90 feet (27m) of "sandy shales, dense mudstones and clays", with the basal contact to "basement quartzite, shale and siltstone" dipping two degrees to the west.

Whitten (1966b) produced the first report detailing the geology of the entire KINGOONYA sheet area; this was based on several years' work investigating iron ore occurrences and on a photo-interpretation by Bennett (1968).

The first regional aeromagnetic and radiometric survey carried out over KINGOONYA was reported and interpreted by Young and Gerdes (1966). Whitten (1960) documented a 1957-58 survey over the southwestern corner of the sheet area.

Forbes (1968) made brief observations along the old Stuart Highway from Kingoonya to "The Twins".

A regional helicopter gravity survey over KINGOONYA, GAIRDNER and YARDEA was carried out in 1969 (Gerdes, 1972).

The Cainozoic stratigraphy of the Lake Eyre Basin and an area to the southwest, including KINGOONYA, was described by Jessup and Norris (1971).

Following a two-week reconnaissance by B.G. Forbes and S.J. Daly in 1972, a preliminary geological map was prepared (plan 72-160 Bb). The accompanying report (Forbes, 1977), was originally prepared to support a rocket-borne remote-sensing project flown from Woomera (Thomson et al., 1972).

Following a decision to construct a new, sealed Stuart Highway, investigations into potential supplies of construction water (Bowering, 1975) and sealing aggregate (Pain and Johnson,

1979) were carried out. A substantial water well drilling project (Read, 1982, 1984; Sibenaler, 1982) was carried out along the chosen corridor in conjunction with a search for a potable water supply for the new township of Glendambo (Read, 1981, 1987) and a diamond drilling project to prove a resource of rhyolite suitable for quarrying west of Glendambo (Pain, 1980).

Palynological investigations were reported by Whitford (1978) on samples from Moodlampnie Hill and by Cooper (1984) on a trench sample from near Millers Creek Woolshed. Ludbrook (1980) described molluscs from the Millers Creek Dolomite Member.

Anderson (1978a, b, 1980) conducted a geophysical interpretation of the KINGOONYA area and adjacent portions of the Stuart Shelf in response to an increasing interest in the area by mineral exploration companies.

A water well survey was carried out over KINGOONYA by Clarke and Fennell (1979), who included details of nearly 600 wells and bores.

Ambrose and Flint (1981a) described the Miocene geology and palaeogeography of the Millers Creek region and areas to the northeast.

Fanning et al. (1983) sampled Pandurra Formation from Kennecott/Samedan Peeweena 1 for geochronological work. In addition, geochronological sampling of dolerites of the Gairdner Dyke Swarm was undertaken from Shell Reedy Lagoon 1 (RL-1) and Aquitaine SSR-1001 (Fanning, 1984).

Hibburt (1984), summarised the geology and exploration history of the Permian-Carboniferous Arckaringa Basin, which extends onto northern KINGOONYA.

The Cainozoic geology, fossils and landforms of the Lake Eyre and Billa Kalina Basins were described by Wells and Callen (1986), and climatic implications were made. The Billa Kalina Basin includes the Miocene sediments present on eastern and southern KINGOONYA.

Published mapsheets adjacent to KINGOONYA are BILLA KALINA (Ambrose and Flint, 1981b), ANDAMOOKA (Dalgarno, 1982), TORRENS (Johns et al., 1981), GAIRDNER (Blissett, 1985), CHILDARA (Blissett, 1980), TARCOOLA (Daly, 1985) and COOBER PEDY (Benbow, 1983). CURDIMURKA is in preparation (Krieg et al., in prep.); a preliminary map is available (plan 71-694).

Company mineral and fossil fuel exploration on KINGOONYA is outlined in the chapter on Economic Geology.

PHYSIOGRAPHY

Climate

The KINGOONYA area is characterised by a warm to hot, semi-arid climate, with hot, dry summers and short, cool to cold winters. Rainfall is low and unreliable, and periods of drought are common. Mean annual rainfall varies from 190 mm in the southwest to 140 mm in the northeast (Laut et al., 1977). Rainfall data for the southern part of the sheet (Table 1) show that the wettest month is February and the driest, April, with rainfall maxima in February and May-July corresponding to the maximum influences of tropical and Southern Ocean weather systems respectively. Contrastingly "Millers Creek", being further north, experiences a single rainfall maximum in February, and normally receives no benefit from cold fronts during the winter. Mean annual evaporation is approximately 3000mm, and greatly exceeds rainfall. The mean annual maximum for January, the hottest month, is 35°C, while temperatures exceeding 40° are not uncommon. The average maximum and minimum for July are 17°C and 5°C respectively, and frosts do occur (Jensen and Wilson, 1980). Winds are dominantly from the south to east in summer and from the north to west in winter (Laut et al., 1977).

Physiographic Divisions and Vegetation

The physiographic divisions on KINGOONYA largely reflect the underlying Mesozoic to Quaternary geology, and comprise eleven units (Fig. 2). Vegetation and soil details are based on Jessup (1951), Specht (1972) and Laut et al. (1977). The KINGOONYA area is in large part about 150 m above sea level (ASL), but ranges from 180 m ASL in the northwest to 100 m ASL in the east. Topographic relief is highest around the dissected tablelands of the north and on basement hills in the southwest.

Dunefields

This division consists mainly of east-west oriented linear red-brown sand dunes which are up to 6m high and may be several kilometres long. The intervening swales are underlain by Pleistocene red-brown sand which is commonly calcreted or, locally, by Cambrian limestone or Tertiary silcreted sandstone or dolomite. Vegetation is dominated by open mulga (Acacia aneura and A. brachystachya) woodland on sandy swales, mulga-myall (A. sowdenii) woodland on calcareous swales, and by sandhill mulgas (A. linophylla and A. ramulosa) on the dunes. An understory of bindyis (Bassia spp.), and grasses such as blackheads (Enneapogon spp.), mulga grass and kerosene grass (Aristida spp.) and mitchell grass (Astrebla pectinata), is present on deep sand or sandy soils, but is replaced by saltbush (Atriplex spp.) and bluebush (Maireana spp.) on calcareous soils as well as on the clayey soils developed on swales underlain by silcreted sandstones. Native pine (Callitris collumellaris) is common near "Parakylia", while black oak (Casuarina cristata) is locally encountered. After substantial rains, the dunefields are carpeted by a lush growth of annual plants and wildflowers. An isolated patch of spinifex (Triodia irritans) is present some ten kilometres north of Boggy Lake.

Sandplains

Sandplains are developed on calcreted Pleistocene red-brown sands and differ from the dunefields mainly in the lack of well-developed duneforms, these being replaced by a thin sand sheet. Vegetation is similar to that of the swales within the dunefields, except that the woodland is generally more open, and there are areas of bladder saltbush (Atriplex vesicaria) - bluebush shrubland where the calcrete is at or very near the surface.

Arcoona plateau

The western extremity of the Arcoona plateau appears in the southeastern corner of KINGOONYA, and is sharply bounded to the north by sandplains, and to the west by the lowlands bordering Lake Hanson. A deep clayey gypseous soil with crabholes (gilgai) is developed in pebbly clay on Tent Hill Formation and forms a treeless plateau strewn with quartzite gibbers. Vegetation consists of a sparse bladder saltbush -plover daisy (Ixiolaena leptolepis) shrubland with scattered grasses and bindyis.

Northeastern lowlands

The internal drainage of Devils Playground, Bamboo Swamp and Curdlawidny Lagoon dominates this area and is interspersed with sand dunes. These normally dry freshwater claypans and floodplains are colonised by canegrass (Eragrostris australasica), lignum (Muehlenbeckia cunninghamii) and cottonbush (Maireana aphylla), while the dunes support sandhill mulgas and native pines. The clay pans are shallowly underlain by relatively impervious Carboniferous-Permian sediments, which differentiates them from the saline playas on southern KINGOONYA. Millers Creek, which drains into Devils Playground and Bamboo Swamp, is fringed by coolibahs (Eucalyptus microtheca) along part of its length. The lowlands are generally below 100 metres elevation and include the lowest area on the KINGOONYA sheet, a claypan northwest of Curdlawidny Lagoon (78m above sea level).

Millers Creek plateau

This very flat plateau comprises the flat-lying Millers Creek Dolomite Member of the Mirikata Formation with a very thin clayey soil cover; its eastern and southern margins are marked by low cliffs where it borders Devils Playground. The sparse vegetation consists almost entirely of bluebush and bladder saltbush.

Kingoonya Palaeochannel and other saline playas

The Kingoonya Palaeochannel extends from Lake Parakylia across the southern part of KINGOONYA to Lake Labyrinth. It is characterised by numerous saline playas with gypsiferous leeside dunes on their eastern sides, marking the line of a Tertiary drainage system choked by Quaternary aeolian and lacustrine sediments. The palaeochannel is underlain largely by Tertiary fluvial and lacustrine sediments. Lakes Harris and Hanson are also included in this physiographic division. The salt lakes are unvegetated except for a fringe of samphire (Arthrocnemum spp.) or tea tree (Melaleuca spp.). Bordering dunes or sandplains normally carry mulga-myall woodland as previously described, but there are local occurrences of red mallee (Eucalyptus oleosa) to the east of Lakes Parakylia and Reynolds, alongside a salt lake 10 kilometres northeast of Kingoonya, and on the southern shores of Lake Labyrinth near Mt Eba.

Silcrete tablelands

This physiographic division is characterised by mesas and breakaways, resulting from prolonged erosion of a resistant plateau of silcreted early Tertiary sandstone. The mesas of Wingilpin Bluff and Mt Vivian, which define the level of the plateau at approximately 220m above sea level, are bordered by gibber-strewn talus slopes eroded into the underlying Cretaceous Bulldog shale, whereas the outliers to the southwest (Gosse Range and Hickson Hill) are similar but have had aeolian sands draped around and over the mesas. This division can be considered the southernmost extension of the Stuart Range.

Transitional uplands

The transitional uplands division represents a mosaic of the silcrete tableland, sandplain and undulating gibber upland divisions, and is underlain by Bulldog Shale, Tertiary silcreted sandstones and Pleistocene red-brown sands. They form a transition zone between the undulating gibber plateau of the northwest of KINGOONYA and the sandplains and dunefields which dominate the southern and eastern portions of the sheet. Vegetation is highly variable, and reflects the soil and underlying geology as detailed in the relevant sections.

Gibber slopes and plains

To the east of the silcrete tablelands, the early Tertiary silcrete plateau has been so deeply eroded that only isolated remnants, such as Mt Paisley, remain. Mt Paisley, at 243m above sea level, is the highest point on KINGOONYA. The Bulldog Shale which underlies the slopes and plains is mantled by clayey sand with a dense carpet of gibbers on the surface. Gilgai microtopography is commonly developed. The shallow stony soils of this country support a low shrubland of bladder saltbush, bluebush and bindyis, with scattered mulga in creeks and on isolated sand dunes. Jessup (1951) reports an area of silver saltbush (Atriplex rhagodioides) northeast of Mt Paisley.

Undulating gibber uplands

The largest area of this physiographic division occupies the northwestern portion of the KINGOONYA sheet, where the sediment resulting from erosion of the Early Tertiary silcrete plateau has been deposited in the intervening lowlands instead of being removed, as has happened on the eastern slopes of the silcrete tablelands. Remnants of this plateau such as North Knoll (210m above sea level), Haggard Hill (216m above sea level), Mt Sabine (228m above sea level) and Mintabyng trig (193m above sea level) define an undulating surface concordant with that deduced from Wingilpin Bluff and Mt Vivian (see Fig. 12). The underlying geology is represented by Bulldog Shale generally mantled to a lesser or greater degree by silcrete gibber-strewn colluvium and alluvium, and aeolian sediments. Bulldog Shale with only a thin soil cover is vegetated by a sparse mulga woodland with bluebush understory, but where it is covered by gibber-strewn colluvium, only bluebush shrubland is present. In the broad valleys of the undulating uplands, thick sequences of alluvium have collected and are generally mantled by "buckshot" ironstone gravels. On this alluvium, a sparse woodland of mulga and dead finish (Acacia tetragonophylla) is developed, with an understory of bindyi and grasses, and areas of bluebush-bindyi shrubland. The trees are often collected into rows paralleling the topographic contours, and form an obvious pattern on aerial photographs.

Similar undulating uplands are developed on Jurassic Algebuckina Sandstone capped by silcreted sandstone from Glendambo to south of Mt Eba. Early Tertiary remnants such as Kingoonya Hill (176m above sea level) and Jim Hill (172 m above sea level) define a similar, but lower surface to that further north. Vegetation here is dominated by bladder saltbush, bluebush and bindyis, with some mulga in areas with aeolian sands.

Basement Hills

These isolated hills are confined to the southwestern corner of the KINGOONYA sheet and are formed from Proterozoic and Archaean basement rocks, prominent examples being Mt Eba (228m above sea level), Wallabyng Range (215m above sea level) and Rocky Hill. Vegetation is sparse because of the shallow stony soils developed, and comprises mainly mulga (usually stunted), bluebush and bladder saltbush, with local spinifex, particularly on quartzite on Mt Eba and Wallabyng Range.

Drainage

No permanent streams or waterholes are present on KINGOONYA; and ephemeral streams are poorly defined, often disappearing into the sand, broad floodouts or salt lakes. Drainage is entirely internal, either to the northeastern lowlands via Millers Creek, No.10 Creek and Mulga Creek, or into the salt lakes which presently occupy the Kingoonya Palaeochannel.

TABLE 1
SELECTED CLIMATIC DATA FOR THE KINGOONYA SHEET AND SURROUNDING AREAS.

Rainfall Creek"	Kingoonya	"Mt Eba"	"Parakylia"	"Millers Creek"
Mean annual rainfall (mm)	188	146	151	145
Wettest month (Ave. rainfall mm)	Feb (21)	Feb (18)	Feb (26)	Feb (23)
Driest month	Apr (9)	Apr (8)	Apr (7)	Dec (6)
Rainfall maxima	Jan, May	Feb, May-Jun	Feb, Jun-Aug	Feb

Temperature	Coober Pedy	Tarcoola	Woomera
Average maximum January (°C)	36.6	34.9	34.0
Average minimum January (°C)	20.2	18.1	19.3
Average maximum July (°C)	18.8	18.0	16.5
Average minimum July (°C)	6.0	4.7	5.8

Data from Johns (1968), Clarke and Fennell (1979) and Jensen and Wilson (1980)

STRATIGRAPHY

KINGOONYA is underlain by rocks of six major geological provinces, providing a record of a substantial part of South Australia's geological history, from Archaean to Quaternary, on a single 1:250 000 sheet (Fig. 1).

The oldest province is the **Gawler Craton** (Wilgena Subdomain of Parker, 1987), comprising Archaean to Middle Proterozoic metamorphic, granitic, acid volcanic and sedimentary rocks, representing a long and complex history. Metamorphosed and deformed Archaean to Middle Proterozoic basement outcrops are scattered widely on Kingoonya (1:100 000 sheet), southwestern Vivian and northwestern Bon Bon, and basement is present at shallow depth over most of Kingoonya. This basement is almost completely concealed by thick, unmetamorphosed Middle Proterozoic sediments of the Cariewerloo Basin over the remainder of KINGOONYA, although these sediments themselves do not crop out.

Late Proterozoic (Adelaidean) and Early Cambrian sediments of the **Stuart Shelf** form a blanket over the eastern half of KINGOONYA, and are exposed on Younghusband and southern Parakylia.

Scattered outcrops of Carboniferous-Permian **Arckaringa Basin** sediments are present on Parakylia, but these rocks have been intersected in drillholes over the entire northern half of KINGOONYA.

Most of the western two-thirds of KINGOONYA is underlain by **Eromanga Basin** sediments of Jurassic to Cretaceous age, and a few outliers are present even on this eastern third.

Palaeogene sediments equivalent in age to the **Lake Eyre Basin** are preserved on elevated parts of northwestern and southwestern KINGOONYA, and Neogene clastic and lacustrine rocks of the **Billa Kalina Basin** are widespread.

The majority of KINGOONYA is blanketed by Quaternary alluvial, aeolian and lacustrine sediments, often completely concealing older rocks despite meagre thicknesses.

GAWLER CRATON

Archaean to Early Proterozoic

Mulgathing Complex (AⱣ*m*)

The Mulgathing Complex encompasses all Archaean to Early Proterozoic rocks older than 2300 Ma in the northwestern Gawler Craton and comprises the Kenella Gneiss, Christie Gneiss, Glenloth Granite and metabasic rocks (Daly, 1986a), all of which outcrop extensively on adjoining TARCOOLA (Daly, 1985). Outcropping and near-surface Mulgathing Complex is known from the southwestern corner of KINGOONYA. Weakly deformed, low-grade volcanics on northern Eba are also, by definition, part of the Mulgathing Complex as they have been dated at 2558 Ma. Mulgathing Complex metabasic rocks are not known on KINGOONYA, although amphibolite, dolerite and biotite gneiss reported from drillholes (Samedan of Australia, 1982) on southeastern COOBER PEDY may be equivalent.

Radiometric dating of Kenella and Christie Gneisses on TARCOOLA and TALLARINGA (Webb et al., 1986) yielded Rb-Sr metamorphic ages of 2500-2400 Ma, representing the late Archaean-earliest Proterozoic Sleafordian Orogeny. A preliminary U-Pb age of 2430 ± 5 Ma has been determined for the Kenella Gneiss (C.M. Fanning, ANU, pers. comm., 1991). The Glenloth Granite, which intrudes Kenella Gneiss on TARCOOLA and GAIRDNER, has been dated at 2435 ± 17 Ma (U-Pb; C.M. Fanning, ANU, pers. comm., 1991) and, being largely undeformed, postdates the major part of the orogeny. Christie Gneiss has a Rb-Sr age of 2417 ± 59 Ma (Webb et al., 1986) but the precursors to these metasediments are probably much older, having T^{Nd} model ages of 2690-2600 Ma (McCulloch, 1987).

Daly (1986a) states that the Kenella Gneiss and Christie Gneiss are interlayed on TARCOOLA, but the two units have not been found in contact on KINGOONYA. The Christie Gneiss is of probable metasedimentary origin, but the Kenella Gneiss may have had a sedimentary, volcanic or granitic precursor (Daly, 1986a).

Kenella Gneiss (AŁ*mk*)

The Kenella Gneiss (Daly, 1986a) is poorly exposed on southwestern Kingoonya as a series of low, rocky rises (Plate 1).

The dominant rock type is a red to orange, fine to coarse-grained quartz + microcline + plagioclase ± muscovite granitic gneiss which contains rare garnet or biotite. Zircon is an occasional accessory, and sericitisation of plagioclase is common. The gneiss has a moderate to well developed foliation defined by the alignment of elongate, recrystallised quartz grains, and occasionally by elongate feldspars. Where intense, this foliation results in a prominent streaky appearance in hand specimen. Compositional banding has not been observed.

The outcrop on the border with TARCOOLA varies to a gneissic adamellite where plagioclase dominates over orthoclase. The Kenella Rock area, located on TARCOOLA on a continuation of this outcrop, was considered by Whitehead (1977) to have been subjected to granulite-facies prograde metamorphism followed by a retrograde fabric-forming event. A similar sequence on KINGOONYA may be interpreted from biotite replacement of garnet in granitic gneiss.

An outcrop of dark red, fine-grained quartz + microcline + plagioclase + garnet microgranite near the extreme southwestern corner of Kingoonya is included within the Kenella Gneiss.

Float of bluish green to purplish quartz + muscovite schist recovered from rabbit burrows surrounded by subcropping Kenella Gneiss 6.5 km west of Mount Eba may represent portions of Kenella Gneiss retrogressed (in a shear zone?) during the Kimban Orogeny. It is possible that the blue-green colour of the schist results from a high Cr content of the muscovite (fuchsite).

Numerous quartz veins and blows intrude the Kenella Gneiss, mostly trending northwesterly, but occasionally northeasterly. Occasional pegmatitic segregations are seen within the gneiss.

Christie Gneiss (AŁ*mc*)

The Christie Gneiss is known only from Amoco drillholes KRP 4 and 5 on southwestern Kingoonya (Fig. 2). Petrological reports for Amoco (Miller, 1982) described these cuttings as quartzo-feldspathic gneiss with variable amounts of magnetite, garnet, sillimanite and pyrite, with sericitic and chloritic alteration, and some mylonite development. Their content of garnet, magnetite and sillimanite implies that they are part of the metasedimentary Christie Gneiss (Daly, 1986a).

Other lithologies noted within the Christie Gneiss on adjacent TARCOOLA include banded iron formation, cordierite-bearing paragneiss, migmatitic quartzo-feldspathic gneiss, marble, dolomite, calc-silicate and graphitic quartzite (Daly, 1986a); these are likely to be present in the subsurface on KINGOONYA.

Glenloth Granite (AȽ*mγ*)

A poorly outcropping, pale reddish pink, quartz + microcline + sericitised plagioclase granite on the extreme southwestern corner of Kingoonya is tentatively assigned to the Glenloth Granite. The granite is mostly fine to medium grained, but is locally coarser, with graphic intergrowths of quartz and feldspar.

Unnamed Archaean volcanics (A*v*)

Over 450 m of basic and acidic volcanics were intersected in Esso DP-1 near the northern margin of Eba, below 166 m of Mesozoic and Palaeozoic sediments (Esso Australia Ltd - Minerals Department, 1982). This locality is 30 km south of the nearest basement occurrence (Newmont SR-1 on BILLAKALINA; Ambrose and Flint, 1981b) and 67 km east of the iron formation outcrops on northwestern Bon Bon, both of which are assigned to the Early Proterozoic ?Hutchison Group.

Esso described these volcanics from petrographic observations as interlayered pink or grey dacite tuff and lava and grey to green andesitic to basaltic lava and breccia, overlying brecciated and massive vesicular trachyte. Many of the samples were impossible to classify confidently due to alteration and foliation development (Esso Exploration and Production Australia Inc., 1985, pp. 418-422, 427-432, 463-489). Limited geochemical analyses by SADME suggest that the dacite is rhyodacite and that the trachyte and basalt both have the composition of andesite. Trace element values and ratios suggest a bimodal suite of calc-alkaline rhyodacite and andesite.

Strong sericite and chlorite alteration has transformed many of the volcanics into quartz + sericite + chlorite ± carbonate schist with a moderately dipping foliation. This deformation is not homogeneous; portions of the core which have escaped most of the stress (Plate 2) retain amygdales, feldspar phenocrysts, spherulites and fragmental textures, evidence of the volcanic origin of these rocks.

Biotite, actinolite, chlorite, epidote and quartz identified in the lower part of the hole indicate metamorphic conditions of 350-400°C, within lower to middle greenschist facies.

Original bedding in the tuff is only rarely observed. From orientated core, Esso inferred two separate dips of 20° southeast and 60° east. Drillhole DP-2, 4 km south of DP-1, recovered 656 m of Middle Proterozoic Pandurra Formation, suggesting that DP-1 was drilled in an upfaulted block from which the Pandurra Formation has been eroded.

Immobile trace element analyses carried out for Esso led Giles (1981) to compare the basic volcanics in DP-1 with basalts of the Gawler Range Volcanics and the acid volcanics with some of the less common rhyolites in the lower part of the Gawler Range Volcanics. The mineralogy and deformation of the volcanics in DP-1, indicative of lower to middle greenschist metamorphism, points instead to an age older than that of the unmetamorphosed Middle Proterozoic Gawler Range Volcanics.

U-Pb and Rb-Sr geochronology was carried out on the volcanics in DP-1 because of the uncertainty in their stratigraphic position (Cowley and Fanning, in prep.). The age determined from U-Pb zircon dating was 2558±6 Ma, much older than the Early to Middle Proterozoic age expected, and was confirmed as Archaean with a Rb-Sr metamorphic age of 1912±11 Ma, with a high initial ratio of 0.7118±0.0005.

These volcanics, therefore, have been largely unaffected by both the 2500-2400 Ma Sleafordian Orogeny, and the ca 1740 Ma Kimban Orogeny (Mount Woods Inlier, Fanning et al., 1988). The relationship of these volcanics to the remainder of the Mulgathing Complex is uncertain; it may be that they are younger and unconformably overlie older Mulgathing Complex at depth (Cowley and Fanning, in prep.).

Early Proterozoic

Wilgena Hill Jaspilite (Ᵽ*h*)

Widely scattered outcrops of iron formation on KINGOONYA are correlated with the Wilgena Hill Jaspilite (Whitten, 1968; Daly, 1981), and have been assigned tentatively to the Early Proterozoic Hutchison Group. The Hutchison Group on eastern Eyre Peninsula (Parker and Lemon, 1982) was deposited between 1960 and 1850 Ma (Fanning et al., 1988).

Iron formation crops out on Kingoonya at several localities southwest and west of Mount Eba and east of Wallabyng Range, and in the northwestern corner of Bon Bon. Contacts with the Mulgathing Complex basement are inferred to be faulted.

At the Hicks Hill prospect 19 km southwest of Mount Eba (Whitten, 1960), outcrop consists entirely of a dark grey to black, well-banded, fine-grained jaspilite composed of finely granular limonite, replacing original magnetite and/or haematite, and fine-grained granoblastic quartz mosaic. Banding is defined by varying proportions of quartz and limonite and by grain-size variations, and varies in thickness from 0.2 to 10 mm. Small scale, tight to isoclinal folds and boudinaging of the quartz-rich layers are common, but no penetrative fabric is developed, even in fold hinges. Recrystallisation of the quartz appears to postdate the deformation. The deformation evident in this outcrop is more intense than that displayed by other outcrops assigned to the ?Hutchison Group.

The Big Tank prospect (Whitten, 1960), 3 km southwest of Mount Eba, comprise abundant float and scattered sub-outcrop of well bedded, brownish to dull red jaspilite and grey to pink, banded and brecciated chert. No fold hinges were observed; the bedding dips steeply southeast and is cut by veins of medium to coarse-grained quartz and red-brown limonite. The jaspilite is composed of quartz and limonite (replacing haematite or magnetite) but the grainsize, at about 0.03mm, is finer than that in jaspilite of the Hicks Hill prospect.

Bright red and black, well bedded jaspilite, identical in appearance to that of Wilgena Hill on TARCOOLA, crops out east of Wallabyng Range (Plate 3). It strikes north-northwesterly and dips 40° west and is unconformably overlain by Middle Proterozoic Tarcoola Formation quartzite which dips shallowly east. The top of the jaspilite is marked by an interpreted regolith, represented by a west-to-east succession (up-sequence) of jaspilite; red-brown, brecciated, silicified jaspilite; a breccia composed of clasts of jaspilite in a white, cherty siliceous matrix; white Tarcoola Formation quartzite containing pebbles of quartz and rare jaspilite.

On northwestern Bon Bon, banded iron formation outcrops consist of two lithologies. The predominant lithology is a grey-black to dull red jaspilite composed of 0.2 - 8mm bands of very fine-grained quartz (<0.01mm), massive limonite, and less common coarser quartz (0.1 - 0.2mm). Prismatic to acicular limonite on the margins of the iron-rich bands, and dispersed elsewhere, is considered by Farrand (1986b) to possibly represent growth of acicular haematite from original magnetite. The second lithology is a greenish brown quartz + limonite + magnetite ± talc ± tremolite ± anthophyllite iron formation, with a total iron content greater than that of the jaspilite. This ferromagnesian mineral assemblage and the presence of euhedral magnetite indicate low amphibolite facies metamorphism. Farrand (1986b) considered that this iron formation originally contained volcanic detritus or carbonate sediment. Folding in the jaspilite varies from open chevron style or kinking, to tight or nearly isoclinal, with bedding mostly trending north-south.

Brownish, finely banded iron formation 5 km west of Mount Eba and float of banded pyritic chert 800 m to the south have also been assigned tentatively to the Wilgena Hill Jaspilite. The iron formation is composed of quartz, limonite (replacing magnetite and haematite) and amphibole (grunerite-cummingtonite), indicating prograde amphibolite grade metamorphism of a magnesium-bearing silicate-facies iron formation.

Diopside ± tremolite marble with possible graphite has been intersected by drilling on eastern TARCOOLA (PNC Exploration (Aust.) Pty Ltd, 1985, 1986). This is tentatively considered a facies equivalent of the Wilgena Hill Jaspilite and may be present in the subsurface on KINGOONYA near iron formation outcrops.

The greenschist to amphibolite grade metamorphism and deformation seen in the Wilgena Hill Jaspilite on KINGOONYA are believed to be a product of the Early Proterozoic Kimban Orogeny, which is of a lower grade than the upper amphibolite-granulite grade metamorphism on Eyre Peninsula (Parker et al., 1988) and the granulite facies metamorphism at Mount Woods on BILLA KALINA (Ambrose and Flint, 1981b). The preservation of microscopic siliceous spherical bodies within the chert bands of the jaspilite of Wilgena Hill (Daly, 1979) on TARCOOLA indicates that the degree of deformation and metamorphism here is even lower.

Prominent aeromagnetic anomalies on southern Vivian, northeastern Parakylia and northwestern Bon Bon (see Tectonic Sketch) have been attributed tentatively to Hutchison Group iron formation, in each case overlain by Pandurra Formation. It is also possible that they represent Archaean iron formation, magnetic Gawler Range Volcanics (e.g. Bulgunnia area on TARCOOLA) or iron-rich hydrothermal systems similar to that at the Olympic Dam Cu-U-Au mine (Reeve et al., 1990).

Lincoln Complex (Ᵽ*l* and Ᵽβ_1)

Foliated granitoids cropping out in three localities on Kingoonya are interpreted to be representatives of the Lincoln Complex, intruded during, and subsequently deformed by, the Early Proterozoic Kimban Orogeny. Whole rock Rb-Sr geochronology on TARCOOLA indicates a minimum span of time of 1700-1580 Ma (Rb-Sr) for this orogeny, whose effect on the Mulgathing Complex is variable (Daly, 1981, 1986a). A metamorphic age of ca.1740 Ma has been obtained for the Mount Woods Inlier (Fanning et al., 1988).

A cream to pink, medium to coarse-grained, quartz + microcline + plagioclase ± biotite porphyroblastic gneiss crops out north of Lake Labyrinth (Plate 4). A weak foliation and lineation is defined by the alignment of dispersed biotite grains and by elongate patches of recrystallised quartz. The gneiss is interpreted to be intruded by a red-orange to red-pink, quartz + microcline + plagioclase ± muscovite granite of medium grainsize, which makes up most of the outcrop. Although it is generally massive and sometimes occurs as rounded outcrops similar to the Hiltaba Suite granites, petrography reveals some evidence of stress within the quartz grains of the granite; close to the gneiss, there is a weak gneissic fabric developed and there is some macroscopic gradation into the gneiss. Both rock types are mineralogically and geochemically similar, and are believed to be derived from the same magmatic source. Pegmatite dykes are occasionally observed; aplite dykes and quartz veins are rare.

Another outcrop, 5.5 km west of Mount Eba, consists of a red-orange, coarse-grained to porphyroblastic quartz + orthoclase + plagioclase gneiss with a weak, irregular foliation defined by elongate mica grains and thin subparallel bands of granulation between the coarser quartz and feldspar grains. Most of the feldspar is heavily sericitised, but one sample shows some altered grains surrounded by clear unaltered feldspar rims. Limonite staining gives the rock its red colour. Accessory minerals include sphene and zircon. This rocktype is identical to the outcrop of syn-Kimban (Ᵽγk) granite at the western extremity of Lake Labyrinth on TARCOOLA (Daly, 1985).

On the western boundary of <u>Kingoonya</u>, a small outcrop of Hiltaba Suite syenite in Lake Labyrinth intrudes a reddish orange, very coarse-grained, weakly foliated diorite, which consists of coarse plagioclase and minor amounts of orthoclase, quartz, muscovite and chloritised biotite, and is likely to be Lincoln Complex.

A small pod or dyke of strongly foliated amphibolite within Kenella Gneiss 6 km west of Mount Eba is probably a syn-Kimban Orogeny basic dyke similar to those exposed northwest of South Lake on TARCOOLA.

Undeformed ultramafic rocks (Ƚβ_1) intersected in CRA DD88ME-2 northwest of Lake Labyrinth (Kingoonya; Palmer, 1988) are also tentatively assigned to the Lincoln Complex. Dark blue-grey and green-grey, medium-grained peridotite and pyroxenite show cumulate crystals of pyroxene, amphibole-altered pyroxene and serpentinised olivine set in post-cumulus clinopyroxene or primary hornblende, with minor phlogopite and magnetite. Carbonate and chlorite alteration is common, particularly near pegmatite dykes (Hiltaba Suite); the ultramafic is also intruded by basic dykes attributed to a late phase (Ƚa_4) of the Gawler Range Volcanics.

Tarcoola Formation (Ƚ*t*)

The Tarcoola Formation (Daly 1981, 1985) crops out on Kingoonya on Mount Eba (Fig. 4), on Wallabyng Range and hills to the southeast, around Rocky Hill and on a low range 20 km north of Wallabyng Range. The Fabian Quartzite Member and Sullivan Shale Member as described on TARCOOLA (Daly, 1985 and 1986b) are recognised on KINGOONYA, but the basal Peela Conglomerate Member is not known to occur.

The age of the Tarcoola Formation was inferred to be the same as the "older" Gawler Range Volcanics (Ealbara Rhyolite) by Daly (1981), who interpreted these units to be interbedded on TARCOOLA. An outcrop of Ealbara Rhyolite west of "Gibraltar", and close to an outcrop of Peela Conglomerate Member interbedded with tuffaceous rhyolite assumed to be also Ealbara Rhyolite, was dated (together with other samples of Ealbara Rhyolite) at 1511±91 Ma (Rb-Sr; Webb, 1978), and subsequently at 1589±16 Ma (U-Pb; Fanning, 1987a).

However, U-Pb dating on a tuff within Tarcoola Formation in Wilgena 1 on TARCOOLA (Daly, 1984) indicates an older age of 1656 ± 7 Ma (Fanning, 1990). Preliminary geochronology for the unconformably overlying Labyrinth Formation also supports the interpretation that the Tarcoola Formation is significantly older than the Gawler Range Volcanics.

A maximum age is provided by the ?Hutchison Group (1960-1840 Ma; Fanning et al., 1988), on which the Tarcoola Formation rests near Wallabyng Range. No contact relationship is known between Tarcoola Formation and Lincoln Complex intrusives (1700-1580 Ma) on KINGOONYA or TARCOOLA. Granite assigned to the Hiltaba Suite (1600-1585 Ma U-Pb; Fanning et al., 1988; Creaser, 1989) clearly intrudes the Tarcoola Formation northeast of Lake Labyrinth and at various localities on TARCOOLA.

Correlation of the Tarcoola Formation with the Corunna Conglomerate on PORT AUGUSTA was proposed by Whitten (1966a) and Thomson (1969) on lithological similarities, and later on the interpretation of interbedded volcanics in both units as Gawler Range Volcanics equivalents (Lemon, 1972; Daly et al., 1986). The Corunna Conglomerate rests on McGregor Volcanics (and Moonabie Formation) and is intruded by Charleston Granite, and therefore was deposited between 1740 and 1576 Ma, the respective U-Pb ages determined for these magmatic events (Fanning et al., 1988); it may still be equivalent to the ca 1660 Ma Tarcoola Formation.

Fabian Quartzite Member (Ƚtf)

The oldest unit of the Fabian Quartzite Member on KINGOONYA is exposed on the southern half of Wallabyng Range, and consists of 530 m of white, medium to coarse-grained conglomeratic quartzite (Plate 5), containing subangular to rounded granules and pebbles to 5 cm of white quartz together with prominent red jasper and grey-red banded iron formation pebbles derived from the Hutchison Group. The base is not exposed. The conglomeratic quartzite grades upsequence into 500 m of white, silicified medium-grained to granular quartzite, containing local thin pebble conglomerate interbeds, and which makes up the remainder of Wallabyng Range. Dips on Wallabyng Range are generally 25-45° north or northwest. Bed thickness decreases upsequence in the conglomeratic quartzite from 1-2 m to a few tens of centimetres, but milky silicification of the overlying quartzite often obliterates bedding. Trough-cross-bedding is locally observed, in sets a few tens of centimetres thick.

Presumed lateral equivalents of the upper quartzite of Wallabyng Range crop out in hills extending 10 km to the southeast. The quartzite is milky, siliceous, medium-grained and locally pebbly, and dips to the south, southeast or west at about 40°. On the northernmost of these hills, Tarcoola Formation quartzite rests unconformably on Hutchison Group jaspilite instead of grading down into conglomeratic quartzite as seen in Wallabyng Range. This implies that substantial topographic relief was developed on Hutchison Group (and older?) rocks prior to deposition of the Tarcoola Formation, with debris eroded from the more elevated basement areas deposited in bordering low areas, followed by deposition of a blanket of quartzite over both areas.

East and southeast of Rocky Hill are several scattered outcrops of quartzite, mostly white to pale grey, and very siliceous and milky, but occasionally ferruginised to a red-brown colour. Outcrops close to Rocky Hill dip about 20° west, and show cross-bedding, whereas outcrops 6 km southeast of Rocky Hill dip 30° northwest. Bedding is in most cases masked by strong silicification.

A low range of hills extends northwards for about 13 km from near the eastern extremity of Lake Labyrinth. They are composed of quartzite and granule to pebble conglomerate, which dip 50-70° to the northeast in the southern part, and 20° to the east at the northern end. The most common lithology is a pink, white, brown or rarely pale green, medium-grained to granular quartzite; this grades in places to a granular or pebble conglomerate containing clasts of quartz and minor chert, jasper and iron formation. The quartzite locally includes 50cm-thick beds containing well-rounded white quartzite cobbles and pebbles. It is usually massive to vaguely bedded but, in erosional gullies on the southern end of the range, better outcrop reveals low-angle cross-bedding and planar bedding in certain beds. Here, the more massive quartzite beds are approximately 1m thick, but the interbedded planar-bedded quartzite, which grades into fine-grained, silty sandstone, is thinly-bedded and flaggy and locally displays ripple-marked surfaces. Correlation of the quartzite of this range with the jasper-pebble-bearing conglomeratic quartzites of Wallabyng Range and the greenish quartzite of Mount Eba (described below) is based on lithological similarities. An isolated hill to the southwest consists of milky white to pale green, massive, coarse-grained to pebbly quartzite, identical to that on Mount Eba. Trough cross-bedding is locally observed, and the quartzite dips 37° southwest.

The Fabian Quartzite Member on Mount Eba (Fig. 4) is a 480 m thick unit of white to very pale or dull green, medium-grained to granular quartzite (Plate 6), the base of which is not exposed. Occasional beds containing fine pebbles are present, with clasts exclusively of white quartz. Traces of green muscovite or fuchsite are present. The quartzite is strongly silicified by milky quartz but, rarely, trough cross-bedding on a scale of several tens of centimetres, or planar bedding, is preserved. Clay-pellet impressions are locally observed in the upper part of the unit. Bed thickness is best observed on the dip slope, where it typically ranges up to 1 m; dip averages 54° southeast. The top 2 m is red, pink, or grey-black due to a variable haematite content, but is otherwise identical to the underlying white quartzite.

All outcrops of quartzite and conglomeratic quartzite described above are correlated here with the Fabian Quartzite Member of the Tarcoola Formation (Daly, 1986b). The underlying heterolithic, polymict Peela Conglomerate Member on TARCOOLA (Daly, 1981, 1985) has not been recognised on KINGOONYA. The conglomeratic quartzite in Wallabyng Range, although the oldest Tarcoola Formation seen on KINGOONYA, is thus lithologically correlated with the Fabian Quartzite Member.

Sullivan Shale Member (Ꝑts)

Conformably overlying Fabian Quartzite Member on Mount Eba (Fig. 4) is a unit of interbedded, reddish brown to buff, micaceous siltstone, sericitic shale and fine to medium-grained sandstone, with common cross-bedding (Plate 7). The unit is variably haematitic and, in places, is intensely ferruginised; pink reduction spots and blotches, and a greenish (chlorite?) colouration or spotting are locally observed. Its top is faulted, but approximately 220 m of the unit is preserved. A distinct cleavage strikes east- northeasterly and dips vertically to 85°SSE; this cleavage is not developed in the underlying quartzite because of its greater competency and simpler mineralogy. In one locality, there appears to be a second cleavage developed at approximately right angles to the first resulting in the development of thin, elongated cleavage fragments ("pencil slates").

It is likely that this siltstone-shale-sandstone sequence on Mt Eba is a correlative of the Sullivan Shale Member, although the abrupt contact with the underlying Fabian Quartzite Member at Mount Eba contrasts with the gradational and intertonguing contact at the type section near Tarcoola Mine (Daly, 1986b). Unit 9 and the upper part of Unit 10 of the Sullivan Shale Member type section are very similar in outcrop to the sequence on Mount Eba, but are pyritic and carbonaceous at depth, and it is possible that their likely equivalents on Mount Eba are the same.

Both the Fabian Quartzite Member and Sullivan Shale Member on Mount Eba are repeated to the southeast by a low angle reverse fault, which truncates the Sullivan Shale Member of the main sequence (Fig. 4). In the repeated sequence, up to 80m of the siltstone-shale-sandstone and normally 50 m of the quartzite are present; the quartzite thickens appreciably to the southwest, following a curve in the fault trace.

In the creek bed immediately southeast of the repeated sequence are isolated low outcrops of weathered and ferruginised amygdaloidal basalt, and green, chloritic, possibly tuffaceous, fine-grained greywacke (Fig. 4). These are tentatively interpreted to be interbedded with the Sullivan Shale Member and may correlate with the greenish chloritic siltstone of the equivalent part of the main sequence mentioned above. If this interpretation is correct, these rocks represent the only known occurrence of volcanism contemporaneous with deposition of the Tarcoola Formation on KINGOONYA.

Possible equivalents of the Sullivan Shale Member crop out poorly 11 km west of Gosse Range on northern Kingoonya. Angular float chips of pale grey to pale brown, finely laminated chert or cherty siltstone are found in interdunal corridors, interspersed with whitish quartzite subcrops. Both lithologies are greisenised in proximity to a Hiltaba Suite microgranite outcrop to the south; the chert loses its lamination and becomes a compact, grey, massive rock with white speckling and the quartzite gains pyrite and quartz, resulting in a hydrogen sulphide odour when the rock is broken.

Pyritic, carbonaceous, sericitic, silty claystone recovered from BHP drillhole PK-22 11 km to the south (BHP Minerals Ltd, 1983) may also be Sullivan Shale Member.

Middle Proterozoic

Labyrinth Formation (Ᵽy_1-Ᵽy_5)

Polymict conglomerate and sandstone cropping out on the southern flank of Mount Eba (Fig. 4) were initially tentatively correlated with Peela Conglomerate Member of the Tarcoola Formation, in inferred faulted contact with the Fabian Quartzite Member and a chert bed. Later detailed examination revealed an erosional unconformity at the base of the chert, which is apparently conformable with the overlying conglomerate and sandstone unit. Recognition of this unconformity divided the outcrop on Mount Eba into two sequences separated by a time period sufficient to deform, uplift and erode the Tarcoola Formation prior to deposition of the younger sequence, which is named the Labyrinth Formation (Cowley and Martin, 1990).

Equivalents of the Labyrinth Formation are also present on a low hill 6 kilometres southeast of Mt Eba and on Rocky Hill; possible correlatives have been intersected in drillholes southwest of "Gosses" O.S. and on northwestern Bon Bon.

The basal unit of the Labyrinth Formation at Mount Eba is a finely banded, red, pink, white and dark grey chert (Ᵽy_1) clearly derived in part by silicification of an algal-laminated and stromatolitic carbonate rock. The chert may also be mottled in the same colours, or may be brecciated or strongly ferruginised. The base of the chert is uncon- formable on the Tarcoola Formation, but there is no basal conglomerate. The stromatolites are mainly low, flattened domes and are laterally linked (Preiss, 1987a). The chert strikes northeasterly, sub-parallel to the Tarcoola Formation, but tends to dip more steeply, from 60° to 80° southeast. Its maximum thickness is 30 m.

Conformably overlying the chert on the southern end of Mount Eba is a unit of buff, pink and purple-red, sericitic sandstone with a distinct, irregular foliation (Ƚy_3). It contains scattered quartz, chert and quartzite pebbles and in places displays prominent, moderate scale, high-angle cross-bedding, outlined by faint grainsize variations and rare heavy-mineral banding (now largely haematite streaks) (Plate 9). Occasional fine, red haematite spotting is present, and there are rare, thin interbeds of green, fine-grained sandstone. With an increase in the proportion of coarse detritus, the sericitic sandstone grades into a foliated, sericitic pebbly sandstone or conglomerate, with well rounded pebble to boulder-sized clasts of a wide variety of lithologies (in approximate order of abundance):

- white, red or dull greenish quartzite
- white quartz
- reddish and white brecciated, silicified chert or quartzite
- grey, red and brown crystalline limestone or dolomite, sometimes stromatolitic, and often with a silicified crust
- red and black iron formation or jasper
- mottled chert
- reddish acid volcanics
- shale and grey phyllite
- granite

Many of the white and greenish quartzite and quartzite breccia clasts in the conglomerate are identical to lithologies found in the Tarcoola Formation of Mt Eba and it is likely that this is their source. The mottled chert clasts are identical to the basal unit of the Labyrinth Formation (Ƚy_1) and indicate reworking of this unit into the overlying conglomerate.

Interbedded within the foliated sericitic sandstone is a pink rhyolite lens only 5 m thick (Ƚy_2), with a distinct foliation paralleling that in the enclosing rocks, and associated with a mottled pinkish chert similar to the basal chert. U-Pb dating of this rhyolite has yielded an approximate age of 1640-1600 Ma (Fanning, 1987b). Volcanic detritus identified in a sample of sericitic sandstone 500 m to the east (Farrand, 1986b) may reflect either contemporaneous volcanism or erosion of nearby volcanic terrain. Although bedding is commonly observed, a combination of high-angle cross-bedding, lack of continuous outcrop and inferred folding in a generally uniform rock type prevents resolution of the structure. Although a regional dip to the southeast is evident, no reliable thickness can be determined. The cleavage dips on average 85° southeast, and an arcuate line of quartzite outcrops to the southwest of Mount Eba suggests a synclinal axis in the concealed area to the southeast.

Abundant float of quartzite pebbles and cobbles covers a hill 6 km south of Mount Eba; the underlying pebbly sandstone and conglomerate from which they have been weathered (Ᵽy_3) are well-exposed only on the northeastern and eastern slopes. The lithology is the same as on Mount Eba, but includes interbeds of cream, pale green or grey sericitic phyllite and purple to cream siltstone. Rare pinkish rhyolitic ignimbrite and lapilli tuff on the western end of the hill are further evidence of contemporaneous volcanism. Rare dolerite clasts are also evident in addition to the clast suite seen on Mount Eba, and boulders of dolomite up to 1 metre in diameter were noted from a small outcrop 1.5 km north of this hill. Deformation appears to be stronger than at Mount Eba, with two cleavages, or a steeply-pitching crenulation of the first cleavage, being occasionally recognised. The first cleavage closely parallels that on Mount Eba while the second trends more northerly. Bedding, where observed, dips very steeply to the west-northwest on the eastern part of the hill, and steeply northwest further west. Unusual features are the presence of stressed quartzite clasts and deformed, vuggy quartz veins within the sericitic sandstone. The stressed quartzite pebbles are characterised by healed parallel fractures up to several centimetres apart showing minor displacement. Reddish to pink lithic sandstone intersected in SADME drillhole ERD-2 between this hill and Mount Eba and in ERD-8 just east of the hill, and green micaceous lithic sandstone recovered from ERD-5, 2.1 km further east (Cowley and Martin, 1988; Farrand, 1988) are also assigned to the Labyrinth Formation.

Rocky Hill and the western part of the hill to its east are formed from red, white and yellowish, mottled, finely banded, brecciated and locally stromatolitic chert (Plate 8) correlated with the basal chert (Ꝑy_1) on Mount Eba. The chert dips approximately 40° west and is inferred to unconformably overlie Tarcoola Formation quartzite (dipping 20° west), although the actual contact is not exposed. The stromatolites are larger and more rounded than on Mount Eba, and range up to 40cm across.

Lithic sandstone intersected in three drillholes near "Gosses" O.S. on northeastern Kingoonya (Ꝑy_4) and in several drillholes on northwestern Bon Bon (Ꝑy_5) are tentatively correlated with the Labyrinth Formation.

Carpentaria percussion drillholes BB-2, BB-3 and BB-4 northwest and southwest of "Gosses" intersected dark red, orange and grey-green, indurated, fine to medium-grained volcanogenic lithic sandstone, and laminated and massive cherty and carbonaceous siltstone to very fine-grained sandstone (Ꝑy_4; Darlington, 1980; Radke, 1980, 1986). A single outcrop of the lithic sandstone 12 km west of "Gosses" is interbedded with rare, cross-bedded, heavy-mineral-banded medium-grained sandstone. The colour and lithology of this lithic sandstone is indicative of erosion of nearby acid volcanics, possibly the Ealbara Rhyolite, inferring that unit Ꝑy_4 is younger than at least some of the Ealbara Rhyolite. Twelve metres of green-black basalt resting on 14 m of pink-orange rhyolite in BB-2 are contained within the lithic sandstone sequence; these volcanics, if correlatable with the Ealbara Rhyolite and Konkaby Basalt, imply contemporaneity (at least in part) with the Labyrinth Formation. This would suggest an age for the Labyrinth Formation approximating 1589±16 Ma (U-Pb; Fanning, 1987a), the accepted age for the Ealbara Rhyolite ("older" Gawler Range Volcanics), but this differs from the approximate 1640-1600 Ma age determined for a rhyolite lens within the Labyrinth Formation. Very similar volcaniclastic sandstone and grit towards the base of SADME Bulgunnia 2 on eastern TARCOOLA is instead assigned by Daly (1988) to the Peela Conglomerate Member of the Tarcoola Formation. Here, it contains large clasts of tuffaceous Ealbara Rhyolite.

Grey and green, sericitic, carbonaceous and chloritic metasiltstone, phyllite and lithic pebbly sandstone (Ꝑy_5) were recovered from Esso percussion holes HN-7 and HN-9 (plus HN-5 and HN-10 on BILLA KALINA) and from Newmont/Dampier percussion hole SR-7 and diamond drillholes SR-9 and SR-15, on northwestern Bon Bon (Greig, 1980; Wright, 1978). A volcanic source area was inferred for lithic sandstone in SR-9 and SR-15 (Radke, 1986). Drillcore shows that bedding dips at 50°-90°, and a variably developed foliation dips at 50°. Although correlated tentatively here with the Labyrinth Formation, the strong sericitic and chloritic alteration, volcaniclastic input and weak foliation of these metasediments invite comparison with the Archaean volcanics (Av) intersected in Esso DP-1, 65 km to the east. If this correlation holds, it is then possible that the nearby iron formation is also Archaean instead of belonging to the Early Proterozoic Hutchison Group.

Gawler Range Volcanics (Ꝑa_1 - Ꝑa_3)

The Gawler Range Volcanics are divided informally into an "older" sequence, represented by the Ealbara Rhyolite and Konkaby Basalt on TARCOOLA (Daly, 1985), and by the Lake Gairdner Rhyolite on GAIRDNER (Blissett, 1985), and a "younger" sequence, comprising the Carnding Rhyodacite on TARCOOLA and the Chandabooka Dacite on GAIRDNER. Basic and acid volcanics on southwestern KINGOONYA have been assigned respectively to the Konkaby Basalt and Ealbara Rhyolite of the "older" sequence; no representatives of the "younger" sequence are known in this area. The U-Pb ages determined for the "younger" and "older" volcanics are indistinguishable at 1592±2 Ma (Fanning et al., 1988), indicating extrusion of the entire volcanic province over a very short time interval.

Giles (1988) attributed the origin of the Gawler Range Volcanics to high temperature, dry, partial melting of mafic-intermediate granulitic lower crust, induced by crustal rifting and underplating.

Konkaby Basalt (Ᵽa$_1$)

Basic volcanics encountered in widely scattered outcrops and drillholes on Kingoonya are assigned to the Konkaby Basalt (Daly, 1985).

The largest outcrop, a low hill 500 m across located 5 km west of Mount Eba, consists of dark green to blue-grey amygdaloidal metabasalt lava and fine to coarse metabasaltic lapilli tuff and agglomerate (Plate 10). These rocks are extensively altered to tremolite or hornblende, chlorite, dolomite, quartz and epidote, but often retain primary features such as lapilli or aligned plagioclase laths. Some albitisation of the plagioclase and leucoxene alteration of primary ilmenite have occurred (Farrand, 1986a,c). A very weak foliation is evident in places in outcrop, trending east-southeasterly and dipping vertically or steeply to the south, paralleling foliation trends in Mulgathing Complex to the west. One outcrop of bedded lapilli tuff dips 75° southwest, but bedding was not observed elsewhere. A faulted, arcuate outcrop of ?Wilgena Hill Jaspilite crosses the northwestern slopes of the metabasalt hill, and partly surrounds Kenella Gneiss further to the northwest. No clearly unconformable or faulted relationships could be demonstrated between these three rock types, although they are tentatively assigned to units widely separated in age. The inferred ages of rock types on this hill therefore are not certain, and metabasalt assigned here to the Konkaby Basalt may be substantially older.

Four kilometres west of this hill is an outcrop of dark green, fine-grained trachyandesite lava which preserves fresh augite and plagioclase and altered olivine phenocrysts in a biotite-bearing groundmass (Farrand, 1988). Poorly outcropping, dark red to dark greenish mottled andesite and greenish yellow, very fine-grained basalt and amygdaloidal basalt are present 2 km northwest of Renton Hill.

Altered basic volcanics have been recovered from 11 company drillholes distributed over northern Kingoonya, being described petrographically as basalt, dolerite or trachybasalt, some with abundant magnetite and a few with olivine (Darlington, 1980; Miller, 1982; Radke, 1980, 1986; Farrand, 1987). The alteration noted in these cuttings is similar to that of the metabasalt hill west of Mount Eba.

Ealbara Rhyolite (Ᵽa$_2$, Ᵽa$_3$)

Acid volcanics crop out on Kingoonya on the western shore of Lake Harris, south and west of Mount Eba, west of "Big Tank" O.S., and 12 km west of "Gosses" O.S., as well as on southwestern Vivian. Comprising dacite, rhyodacite and rhyolite, they have been mapped as Ealbara Rhyolite (Daly, 1985) and are separated here into two lithological units: Ᵽa$_2$, consisting largely of pale-coloured, weakly welded pyroclastics and lava, and Ᵽa$_3$, characterised by red or brown ignimbrite. Units Ᵽa$_2$ and Ᵽa$_3$ are believed to be equivalent in age.

South of Mount Eba are several low hills prominent on aerial photographs because of their whitish appearance, and which have been mapped as Ᵽa$_2$. Most of these hills comprise float and scattered outcrop of off-white to greenish or pink, massive or finely bedded, fine to coarse rhyolitic lapilli tuff and laminated chert. Occasionally, graded bedding is observed, implying an ash-fall origin for at least some of the tuff.

The chert is characterised in several localities by concentrically banded ovoid or hemispherical concretions ranging in diameter from 3 mm to 10 cm. Commonly, many small hemispherical concretions form a shell, completely surrounding a larger concretion. Locally, voids in the centres of concretions contain drusy quartz and rare gypsum and fluorite. Some of the larger concretions are hemispherical, having grown upwards from a point and, because of their concentric banding, closely resemble miniature stromatolites. Because the original sedimentary banding can, in some cases, be seen to pass through the concretions (Plate 11), Preiss (1987a) considered that they had formed by diffusive replacement by silica of an original carbonate rock, rather than by the action of algae or by inorganic precipitation of silica from hot springs.

At the northeastern and western ends of the largest Ᵽa$_2$ outcrop are two, 1 km wide bodies of off-white to purple, flow-banded rhyolite lava, which are either aphanitic or contain small phenocrysts of orange microcline, whitish plagioclase and rounded quartz. These are closely associated with rhyolitic agglomerates, and probably are infilling eruptive vents.

The remainder of the volcanic outcrops on <u>Kingoonya</u> and southwestern <u>Vivian</u> largely comprise red-brown, grey and purple porphyritic rhyolitic and rhyodacitic ignimbrite, and minor purple porphyritic dacitic ignimbrite; these have been mapped as $Ꝑa_3$. Phenocrysts of quartz and red-orange (haematitic) K-feldspar are prominent in rhyolite and rhyodacite, and white, pink or greenish plagioclase phenocrysts are commonly seen in rhyodacite and dacite. Chloritic clots, presumably replacing ferromagnesian phenocrysts, occur sparingly in all lithologies.

Devitrification of the matrix of rhyolite and rhyodacite is usually complete, although glass shards, flow-layering and perlitic fractures can sometimes be recognised. This devitrification has commonly proceeded irregularly, resulting in patches or spots in hand specimen. Finely divided haematite within the matrix gives the red colour typical of these rocks. Dacite matrix usually comprises felted or aligned plagioclase laths within haematite-stained cryptocrystalline felsic material. Quartz phenocrysts may be rounded or euhedral-bipyramidal and commonly display embayed margins. K-feldspar and plagioclase phenocrysts are mostly subhedral and are strongly altered to sericite and clays. Zircon, opaques, leucoxene and rare apatite are trace accessories.

These predominantly massive ignimbrites occasionally display compaction layering and flattened lapilli. Dips of layering can vary markedly over short distances, and have been measured up to 74°. With an increase in the content of undeformed lithic clasts the ignimbrites grade locally into lapilli tuffs of probable ash-fall origin.

Excellent exposures of rhyolitic ignimbrite are found in a road-metal quarry 20 km west of Glendambo (Plate 12). Here, the volcanics dip about 10-15° south or southeast, and contain large flattened pumice lapilli, mafic xenoliths and rare xenoliths of coarse pink-orange granite resembling the Kenella Gneiss of eastern TARCOOLA. Close jointing (spacing 5-30 cm) is prominent in places, striking northwesterly, and dipping 60° southwest.

Lithologically similar volcanics cropping out at Tomato Rocks on the western shore of Lake Harris (Lake Gairdner Rhyolite equivalent of Blissett, 1985) have also been assigned to Ƀa$_3$. Most of the outcrop area consists of a purple-red rhyolite to rhyodacite with quartz and pinkish white feldspar phenocrysts, mostly massive, but occasionally flow banded. The central part of the outcrop is a brick-red to orange-red rhyolite to rhyodacite lava with quartz and brick-red feldspar phenocrysts and prominent flow-banding which is wavy or contorted on a scale of several metres. This lava, 1 km across, probably fills an eruptive vent.

Fourteen exploration company drillholes (Darlington, 1980; Miller, 1982; Radke, 1980, 1986; Farrand, 1987) and two SADME drillholes (Cowley and Martin, 1988; Farrand, 1988) have recovered rhyolite to dacite assigned here to Ƀa$_3$. In addition, trachyte described from BHP PK-3 (BHP Minerals Ltd, 1983) is porphyritic in biotite, titanomagnetite and possible pyroxene, while trachyte (or microsyenite) in Amoco KRP-2 (Miller, 1982) has rare possible plagioclase and pyroxene phenocrysts in a groundmass of fine-grained K-feldspar prisms.

Early to Middle Proterozoic Stratigraphic Relationships

The Tarcoola Formation, Labyrinth Formation, Corunna Conglomerate and the Gawler Range Volcanics together define a major Early to Middle Proterozoic volcano-sedimentary province.

Correlation between the volcanic and sedimentary successions has relied largely on the interpretation of thin volcanic interbeds within the Tarcoola Formation and Corunna Conglomerate as Gawler Range Volcanics equivalents and thereby inferring an age for the enclosing sediments of about 1592 Ma (Fanning et al., 1988). However, tuff within the Tarcoola Formation has been dated at ca 1656 Ma and the overlying Labyrinth Formation has been dated at ca 1640-1600 Ma, and these correlations are now called into question.

Thus, there may be at least two volcano-sedimentary sequences in the KINGOONYA-TARCOOLA area: the ca 1656 Ma Tarcoola Formation and interbedded volcanics and the ca 1600-1640 Ma

Labyrinth Formation and interbedded volcanics. The latter volcanics may correlate with the 1592 Ma "older" Gawler Range Volcanics. Alternatively, they may be an independent sequence intermediate in age between the Gawler Range Volcanics and the Tarcoola Formation, possibly correlating with the Nuyts Volcanics (1627 ± 2 Ma, U-Pb; Rankin *et al*., 1990) which crop out on islands in the Great Australian Bight. The "younger" Gawler Range Volcanics are inferred to postdate the Labyrinth Formation, and are not known to be associated with any sediments equivalent in age.

The problem therefore arises of correctly assigning isolated outcrops of volcanics. On KINGOONYA and TARCOOLA, these have been mapped as Gawler Range Volcanics but, alternatively, they could be volcanics extruded during deposition of either the Labyrinth Formation or Tarcoola Formation. Lack of outcrop, ambiguous field relationships and paucity of geochronological data preclude confident resolution of the ?Early to Middle Proterozoic stratigraphy at present.

Unnamed mafic to felsic dykes ($\underline{P}a_4$)

Scattered rhyolite to basalt dykes on *Kingoonya* intrude Mulgathing Complex, Lincoln Complex , Konkaby Basalt and Labyrinth Formation.

South of the Trans-Australian railway adjacent to TARCOOLA, an outcrop of Kenella Gneiss is traversed by a northwest-trending dyke of grey rhyodacite, porphyritic in plagioclase, biotite and quartz.

Northwesterly trending red-orange to pink porphyritic rhyolite dykes cut Kenella Gneiss 8.5 km west of Mount Eba and intrude Konkaby Basalt 5 km west of Mount Eba.

Black dolerite with phenocrysts of altered pyroxene and possible olivine (Farrand, 1988) intrudes Labyrinth Formation 1.5 km southeast of Mt Eba. The largest of the two dykes, which trend northerly, is 2 m thick; the Labyrinth Formation shows no visible contact effects.

Lincoln Complex gneiss north of Lake Labyrinth is cut by a 30 cm thick dyke of vesicular grey basalt, trending just north of east. A loose block of gneiss with a 2 cm thick basalt vein was also discovered.

A variety of basic dykes intrude probable Lincoln Complex ultramafics (Ᵽβ_1) in CRA DD88ME-2 north of Lake Labyrinth (Palmer, 1988). The older suite consists of grey-green to dark pinkish grey porphyritic andesite and basalt, locally containing xenoliths of peridotite, greyish gneiss, K-feldspar-rich gneiss and pegmatite. Plagioclase phenocrysts, biotite laths and quartz + calcite ± feldspar amygdales occur in places. The andesite-basalt dykes and host ultramafic are both intruded by a suite of lamprophyre-related dykes. They are dark green, with a distinctive speckled to felted appearance caused by hornblende needles and biotite flakes.
Chilled margins are typical. Petrological samples were described as primary hornblendite, with minor chloritised biotite/phlogopite, and carbonate-altered lamprophyric basalt, composed of prisms of hornblende and biotite flakes in a matrix of cryptocrystalline K-feldspar and albite, with accessory pyrite, apatite and epidote. One xenolith of andesite-basalt was seen.

All dykes mapped as Ᵽa_4 probably correlate with the Wiltabbie Volcanics of TARCOOLA (Daly, 1985), which intrude Hiltaba Suite and are considered to be a late phase of the Gawler Range Volcanics. Rhyolite dykes intruding the "younger" Gawler Range Volcanics near "Kokatha" on GAIRDNER have been dated at 1457±22 Ma (Rb-Sr; Webb, 1978) and are possible correlatives.

Unnamed possible ultramafic rock (Ᵽβ_2)

SADME drillhole ERD-3 (Cowley and Martin, 1988), 2.8 km southeast of Mount Eba, intersected a dark green, soft, massive, non-magnetic talc + chlorite ± serpentine rock (Farrand, 1988). It can be interpreted as either a serpentinised ultramafic rock or an interbed of altered magnesian carbonate rock within Labyrinth Formation, which was intersected in ERD-2 1.5 km to the northwest and crops out 2.5 km to the southeast. High contents of MgO (12-16%), Cr (800-900 ppm) and Pt (10 ppb) in ERD-3 favour an ultramafic precursor, despite the high SiO_2 (48 and 56%) and low Ni (210 ppm) contents which may result from the hydrothermal alteration which was noted in one specimen.

No stratigraphic relationships with other units have been observed, but the presence of a weak foliation suggests that this possible ultramafic has undergone the same deformation episode as the Labyrinth Formation. It cannot therefore be much younger, and may be significantly older. Similar strongly altered ultramafics have been intersected by Kennecott drilling on TARCOOLA, and have been assigned by Daly (1981, 1985) to the Archaean-Early Proterozoic Mulgathing Complex.

Hiltaba Suite (Ɇγh)

A variety of unfoliated granitoids exposed in scattered localities around Lake Labyrinth on Kingoonya have been assigned to the Hiltaba Suite, considered by Blissett and Radke (1979) to be comagmatic with, and intrusive into, the Gawler Range Volcanics. Although no geochronology has been performed on the Hiltaba Suite granites on KINGOONYA, samples collected from other localities on the Gawler Craton have yielded U-Pb zircon ages spanning 1600-1585 Ma (Fanning et al., 1988; Creaser, 1989). The only intrusive relationship observed on KINGOONYA is into Tarcoola Formation northeast of Lake Labyrinth; all other occurrences are isolated outcrops.

The most common lithology on Kingoonya is a red to pink, quartz + plagioclase + microcline granite to adamellite with occasional hornblende or biotite, which is usually altered to chlorite. Grain size is highly variable and porphyritic variants are common. Sphene, opaques and zircon are ubiquitous accessories.

Low hills northwest of Lake Labyrinth consist mainly of a pink, coarse-grained biotite adamellite containing phenocrysts of perthitic orthoclase and zoned plagioclase up to 5 cm across. This adamellite, which in places weathers to large tors up to 4 m high, grades to a finer grained, reddish pink, perthitic orthoclase + plagioclase + hornblende ± biotite syenite, which also crops out 5 km to the south in Lake Labyrinth.

Three isolated outcrops of reddish pink plagioclase + microcline + quartz ± biotite granite are known south of Lake Labyrinth. The largest of these, northwest of North Hicks Tank, displays rounded outcrops typical of a massive granite; nearby, BHP drillhole PK-8 recovered hornblende + biotite granodiorite (BHP Minerals Ltd, 1983).

Northeast of Lake Labyrinth, Tarcoola Formation is intruded by a brick-red to pink, porphyritic microgranite, consisting of quartz and brick-red orthoclase phenocrysts in a fine-grained graphic intergrowth of quartz, K-feldspar and some plagioclase with accessory muscovite, biotite and zircon (Plate 13). Both the Tarcoola Formation (quartzite and laminated cherty siltstone) and the microgranite have been extensively greisenised over an area of at least 6 km^2. At moderate levels of greisenisation, both units are extensively recrystallised and sericitised, but retain relict detrital or porphyritic (Plate 14) textures. The greisen is usually whitish, varying to distinctive blue-grey, blue-green and mauve colours. They weather to pale cream or yellowish, often with a pock-marked surface. More intensely altered rocks where textures have been obliterated consist of quartz and pyrite, with some topaz and fluorite. Zircon, rutile and sphene are ubiquitous accessories. An odour of H_2S on breakage is typical of these greisenised rocks.

Shallow quarries on the southwestern corner of BILLA KALINA revealed coarse-grained, kaolinised granite interpreted by Ambrose and Flint (1981b) as Balta Granite, dated at 1550-1450 Ma (Rb-Sr; Webb, 1977) and considered equivalent to the Hiltaba Suite. Shallowly buried granite may therefore also be present on the northwestern corner of <u>Bon Bon</u>.

Quartz + K-feldspar ± plagioclase pegmatite dykes in CRA 88DDME-2 north of Lake Labyrinth are considered to be Hiltaba Suite equivalents. They intrude both the ultramafic (Ꝑβ_1) and younger mafic dykes (Ꝑa_4).

CARIEWERLOO BASIN - Pandurra Formation (Ᵽp)

Although it is not known to crop out anywhere on KINGOONYA, a substantial thickness of Pandurra Formation has been demonstrated by exploration company drilling in the subsurface over all of Younghusband and Parakylia, over nearly all of Vivian, Eba and Bon Bon, and over the eastern and southeastern portions of Kingoonya. An isolated occurrence is interpreted in Amoco KRP-2 on western Kingoonya. The maximum thicknesses intersected are 657+ m in Esso DP-2 (Esso Australia Ltd - Minerals Department, 1982) on northern Eba and 666+ m in Dampier LY-1 (The Broken Hill Proprietary Co. Ltd, 1978a) on southern Vivian; no drillhole has yet penetrated the base on KINGOONYA.

The dominant lithology of the Pandurra Formation is a monotonous, immature, fine-grained to pebbly sandstone (Plate 15, bottom) with a mottled, red-brown, purple and white, haematitic and sericitic silty matrix containing occasional traces of pyrite. The framework consists mainly of subangular to subrounded, poorly-sorted quartz, minor kaolinised feldspar and rare ironstone sand and granules, together with pebbles of quartz and minor red acid porphyry (e.g. The Broken Hill Proprietary Co. Ltd, 1978b).

Interbeds of red (rarely green), laminated, micaceous, haematitic and sericitic siltstone are usually scattered and thin but, in Kennecott/Samedan Playford 1 and Peeweena 1 on northeastern Parakylia (Warne, 1979), they are more common and range up to 30 cm in thickness. Here they form upward-fining cycles to a few metres thick with the intervening sandstones, which rest with a sharp, erosional contact on the siltstone of the underlying cycle.

The Pandurra Formation is typically thick-bedded or massive, but cross-bedding is common and both normal and reverse grading have been recorded. Dips are within a few degrees of horizontal. Intervals of apparent reworking in Shell RL-1 on southern Parakylia (Bailey and Hungerford, 1982) contain rounded fragments of typical Pandurra Formation, up to at least 8 cm, in a homogeneous matrix of quartz and haematite. Liesegang banding and heavy-mineral banding are present in this hole, and heavy-mineral banding is reported from Dampier LY-1.

Above the Pandurra Formation in several drillholes is a red or whitish conglomeratic interval up to 19 m thick. The upper contact of the conglomerate with Adelaidean Wilpena Group sediments is invariably sharp and, in some cases, clearly erosional, but its basal contact with the Pandurra Formation is also sharp. In most cases the interval is composed of rounded quartz pebbles up to 5 cm in size in a haematitic, sericitic or kaolinitic silty matrix obviously derived by erosion of the underlying Pandurra Formation. However, in Shell RL-1, the quartz pebbles are accompanied by clasts of sandstone and quartzite (Pandurra Formation), epidote-amphibolite, granitic gneiss, and, in Kennecott/Samedan Playford 1, by stressed metaquartzite clasts. The presence of these exotic clast lithologies, together with the sharp base and top of the conglomerate interval, imply that the conglomerate is a depositional sequence intermediate in age between the Pandurra Formation and the overlying Adelaidean Wilpena Group, rather than a regolith developed on the Pandurra Formation or a basal Wilpena Group conglomerate. The conglomerate may be a time equivalent of the aeolian Whyalla Sandstone, deposited during Marinoan glaciation; periglacial effects on the Pandurra Formation at Mount Gunson on TORRENS were described by Williams and Tonkin (1985). Alternatively, it may be equivalent to Appila Tillite, of the earlier Sturtian glaciation; thick Sturtian glacials were intersected in Newmont SR-17/2 on CURDIMURKA and Newmont SR-6 on BILLAKALINA (Preiss, 1987b, p. 154; Ambrose and Flint, 1981b). In either case, the conglomerate would represent the only known record of Umberatana Group sedimentation on KINGOONYA. Because of these stratigraphic uncertainties, the conglomerate has been included here with the Pandurra Formation.

An age of 1424±51 Ma (Rb-Sr) has been determined from red siltstone of the Pandurra Formation from Peeweena 1 and from CSR PY-1 on TORRENS (Fanning et al., 1983). This is considered to represent a likely age of deposition of the Pandurra Formation.

The name Cariewerloo Basin has been erected to include the intracratonic fluviatile Pandurra Formation, which was deposited during a period of transitional tectonics finalising the cratonisation of the Gawler Craton and occurring prior to deposition of sediments on the Stuart Shelf (Cowley, in prep., a). Although the southwestern margin of the Cariewerloo Basin shows an onlapping relationship onto Gawler Range Volcanics on GAIRDNER and PORT AUGUSTA, it is believed that most of the Pandurra Formation-basement contacts are faulted on KINGOONYA (Cowley, in prep., a).

Gairdner Dyke Swarm (Ƀβ_3)

Numerous northwest-trending linear magnetic anomalies visible on aeromagnetic maps covering KINGOONYA are attributed to basic dykes of the Gairdner Dyke Swarm (Flint, in prep), considered to be eroded feeders to the pre-Adelaidean Beda Volcanics of the Port Augusta-Lake Torrens region to the southeast.

These dykes have been intersected in several drillholes: Esso HN-2 on northwestern Bon Bon; water bore 6036WW133 on southern Vivian; Shell RL-1 on southern Parakylia; and Aquitaine SSR-1001 (Haskins, 1983) on southern Younghusband. In the latter two holes, the dykes are seen to intrude Pandurra Formation, but they also traverse pre-Pandurra basement on Kingoonya and northwestern Bon Bon.

The dykes comprise mainly ophitic to subophitic coarse-grained dolerite to gabbro (Plate 16), composed of 1-4 mm laths of labradorite, interstitial augite (altered to stilpnomelane/chlorite and minor amphibole) and up to 5% magnetite (Webb and Fanning, 1983; Fanning, 1984; Farrand, 1987).

Dyke margins in drillcore are discordant and chilled, and have suffered haematite + chlorite alteration or bleaching, together with introduction of quartz and calcite. The Pandurra Formation in Shell RL-1 is chloritised and fractured for approximately 30 cm from the dyke contacts, which are seen to dip at 55-70° in Aquitaine SSR-1001.

Dykes of black, porphyritic basalt intrude both the dolerite and the Pandurra Formation in SSR-1001 and are probably a younger phase of the Gairdner Dyke Swarm. They consist of phenocrysts of plagioclase set in a matrix of unoriented fine plagioclase laths, opaques, hornblende and chlorite. Haematite alteration haloes are present in the dolerite adjacent to the basalt contact (Fanning, 1984).

Rb-Sr geochronology of dolerite from SSR-1001 and RL-1 suggests an imprecise age of 1028±185 Ma (Webb and Fanning, 1983), comparable with the 1076±34 Ma determined by Webb *et al*. (1983) for the Beda Volcanics. A more precise Rb-Sr age of 1070±74 Ma obtained by Creaser (*in* Flint, in prep.) from dykes at Olympic Dam strongly supports the interpretation that the Gairdner Dyke Swarm acted as feeders to the Beda Volcanics (Cowley, in prep.c) Geochemistry is summarised by Flint (in prep.).

STUART SHELF

Late Proterozoic (Adelaidean)

Wilpena Group (Ᵽw)

Apart from the conglomerate sequences described under Pandurra Formation, the first record of Adelaidean sedimentation on KINGOONYA is the basal Wilpena Group of late Marinoan age (ca 680 Ma, Rb-Sr; Thomson, 1980) on the eastern part of the sheet. A depositional hiatus of 740 million years is thus inferred following deposition of the Pandurra Formation.

The Wilpena Group and overlying Cambrian Andamooka Limestone are the only representatives on KINGOONYA of the Stuart Shelf sequence, which is an incomplete and flat-lying extension of Adelaide Geosyncline sedimentation on the eastern portion of the Gawler Craton. The boundary between the Adelaide Geosyncline, which contains a thicker, more complete, folded sequence of Adelaidean and Cambrian sediments, and the Stuart Shelf is the Torrens Hinge Zone, which passes just to the northeast of the KINGOONYA sheet.

The maximum thickness of Wilpena Group intersected on KINGOONYA is 283.2 m in Kennecott/Samedan Playford 1 (Parakylia). The Group is present in the subsurface over the entire eastern half of KINGOONYA (Fig. 5); its western boundary is not well defined except on central and southern Eba, where the preservational limit is delineated by several drillholes. Only the Simmens Quartzite, Corraberra Sandstone and Tregolana Shale Members of the Tent Hill Formation are exposed at the surface. Disposition of the outcrops of these members indicates a very gentle regional dip to the northeast or east. Local dips of up to 12° have been measured, but elsewhere, the Wilpena Group is essentially flat-lying.

Nuccaleena Formation (Ᵽwn) and Seacliff Sandstone (Ᵽwe)

The base of the Wilpena Group on KINGOONYA is invariably sharp and commonly marked by pink dolomite and fine-grained sandstone which have been assigned to the Nuccaleena Formation and Seacliff Sandstone, respectively. Gradational and intertonguing relationships between these two units in Aquitaine SSR-1001 support the observations by Thomson (1966) and Preiss (1987b) that the Nuccaleena Formation and Seacliff Sandstone are lateral facies equivalents.

Where the Tregolana Shale Member is not underlain by recognisable Nuccaleena Formation (Kennecott/Samedan Prices Bore 1 and Peeweena 1; Warne, 1979), it still contains very thin interbeds of dolomite identical to the Nuccaleena Formation; wavy bedding in places appears to reflect differential compaction around incipient dolomite concretions within the shale.

Nuccaleena Formation and Seacliff Sandstone are only recognised in the eastern portion of the Adelaidean sequence on KINGOONYA; their non-recognition in percussion holes to the west may be a function of their lack of substantial thickness and the inferior sampling afforded by these holes.

The Nuccaleena Formation reaches a thickness of 1.7 m (in SSR-1001) and consists of a distinctive, pink or white, massive or locally bedded dolomite (Plate 15, centre right). It is usually interbedded on a scale of 1-20 cm with Tregolana Shale Member red-brown siltstone, which is occasionally reduced to grey-green immediately adjacent to the dolomite layers. Stylolites and vughy dolomite occur locally.

The Seacliff Sandstone is confined to southern Younghusband, where the maximum thickness of 25m is recorded in SSR-1001. It consists mainly of a pale red-brown, massive to faintly graded-bedded, very fine to fine-grained sandstone (Plate 17). Occasional pink or whitish bleaching and red-brown shale flakes are present. Interbeds up to 2 m thick of red-brown and grey-green micaceous shale and siltstone mark the transition into the overlying Tregolana Shale Member.

The Nuccaleena Formation and Seacliff Sandstone represent chemical and deltaic deposition, respectively, into a shallow marine environment (Preiss, 1987b).

Tent Hill Formation

Tregolana Shale Member(Ewt): The Tregolana Shale Member (equivalent to the Woomera Shale Member of ANDAMOOKA: Dalgarno, 1982), makes up the bulk of the Wilpena Group on KINGOONYA, reaching 283 m in thickness in Kennecott/Samedan Playford 1, and is the most extensive, extending nearly to the western margin of Eba.

In the subsurface, the Tregolana Shale Member consists of monotonous red-brown, finely laminated shale and siltstone with local load casts and cross-lamination, interbedded with thin, green-grey shale or siltstone (Plate 15, top). Thin, red, white and minor greenish, fine-grained, cross-bedded micaceous sandstone beds are common; they locally display sharp, scoured bases, gradational tops and rare heavy-mineral laminations. The green-grey siltstone and shale interbeds are up to several centimetres thick and comprise up to 30% of the sequence by volume. The fine-grained sandstone interbeds are normally 5-30 cm thick but become more frequent and thicker (up to 1 m) in the upper part of the unit as it passes into the Corraberra Sandstone Member. Flaser-bedded sandstone containing thin red-brown mud drapes and red-brown siltstone with fine-grained cross-bedded sandstone interbeds and starved ripples indicate a shallow-water oxidising environment of deposition; a subtidal marine shelf environment is inferred for the Tregolana Shale Member by Preiss (1987b).

The lithologies described above are essentially identical to those described from the Tregolana (and Woomera) Shale Member over the entire Stuart Shelf. In Kennecott/Samedan Playford 1, however, the Member includes three intervals (6 to 23 m thick) of intraformational conglomerate and lesser massive siltstone and sandstone, separated by normal Tregolana Shale Member siltstone (Plate 18). The intraformational conglomerate is composed of rounded to angular intraclasts (to 25 cm) of red-brown and green micaceous siltstone, shale and fine-grained sandstone in a green or red micaceous matrix of silt to sand-sized fragments of the same lithologies. It also contains rare clasts of greenish white or red and white limestone and dolomite, and includes thin interbeds of red-brown and green siltstone and shale and fine-grained sandstone identical to the rest of the Member. The upper interval of conglomerate also includes 1.9 m of grey-green massive micaceous siltstone at the base where there is an erosional contact with the underlying typical Tregolana Shale Member. The lower part of the central conglomerate interval is a massive, red quartzitic sandstone with common small red shale chips.

These conglomerate intervals indicate periods of disturbance and reworking of Tregolana Shale Member and Nuccaleena Formation not recognised elsewhere on the Stuart Shelf or in the Adelaide Geosyncline (W.V. Preiss, SADME, pers. comm., 1988).

The Tregolana Shale Member crops out only in low cliffs on the western shores of Lakes Hanson and Reynolds, where it is commonly bleached to pale green-grey or yellow colours. Only the upper part of the Member is exposed; this contains cross-laminated, pale brown-red, very fine to fine-grained sandstone lenses up to 50 cm thick, making up to 20% of the section.

Corraberra Sandstone Member (Ᵽwc): With an increase in the proportion of interbedded sandstone, the Tregolana Shale Member grades upwards into the Corraberra Sandstone Member, which in turn grades upwards into the Simmens Quartzite Member.

The Corraberra Sandstone appears to be restricted to Younghusband as it is not present in Kennecott/Samedan Prices Bore 1. In outcrop and in the subsurface, the unit consists mainly of fine to medium-grained micaceous sandstone, typically pinkish brown, but occasionally grey, red or white. Its lower part contains red-brown and grey-green shale and micaceous siltstone interbeds.

On the western shores of Lakes Parakylia and Reynolds (Plate 19), and north of Lake Hanson, the Corraberra Sandstone Member is thinly bedded to laminated and displays prominent low-angle trough-cross-bedding, resulting in typical flaggy to fissile outcrop. Bleaching is common where it is overlain by Mesozoic or Tertiary sediments. Ferruginisation and honeycomb weathering ("aquarium rock") are notable near the margins of salt lakes.

The maximum thickness recovered by drilling is 17.3 m in SSR-1001, although the outcrops north of Lake Hanson indicate a thickness of about 30 m.

The Corraberra Sandstone Member is considered by Preiss (1987b) to represent eastward progradation of deltaic sediments. Belperio (in Forbes, 1988) interpreted an intertidal environment for outcropping equivalents of the Corraberra Sandstone Member on adjacent CURDIMURKA.

Simmens Quartzite Member (Ᵽws): The Simmens Quartzite Member (equivalent to the Arcoona Quartzite Member) overlies the Corraberra Sandstone Member with gradational and intertonguing contacts. It occurs over most of Younghusband and the south-eastern part of Parakylia, having been removed by pre-Andamooka Limestone erosion on northern and western Parakylia. The unit crops out more extensively than the underlying members, forming the Arcoona plateau and the tops of plateaux bordering Lakes Parakylia and Reynolds. Its maximum known thickness is 48 m, in Australian Selection PRE-1 (Mason, 1978a), although it is 76 m thick in Seltrust PPR-6 (Mason, 1978b) on the western margin of ANDAMOOKA, 15 km southeast of "Parakylia".

White or pink, fine to coarse-grained, well sorted sandstone or quartzite is the dominant lithology of this Member (Plate 20). It is thickly bedded (20-100 cm), resulting in slabby to blocky outcrop, but grades in places to a flaggy, cross-bedded sandstone with increased muscovite. Prominent large-scale trough cross-bedding is ubiquitous; heavy-mineral layering, ripple-marked surfaces and clay-pellet casts occur less commonly. The sandstone weathers to orange and brown colours, and occasionally displays silicified rinds on weathering blocks.

The Simmens Quartzite Member is normally flat lying, but a line of small sharp hills trending northwesterly through The Knoll and Roxby Hill on Younghusband displays dips of up to 52°. The possible origin of this line of hills is discussed in the section on Structural History and Geophysics. Both this line of hills, and a less well-defined line of higher ground trending northwesterly from Shell Lagoon (ANDAMOOKA) approximately 20km to the east, were first identified by Miles (1956).

Preiss (1987b) considered the Arcoona Quartzite Member to have originated by tidal reworking of deltaic sand.

Yarloo Shale (Ᵽwx)

The Yarloo Shale (Johns, 1968) is interpreted to occur in two places on northern Younghusband. The first is 5 m of chocolate brown to red-orange, strongly micaceous (chlorite), massive mudstone, silty mudstone and siltstone in the base of Arcoona Cave Dam, below Cambrian Andamooka Limestone. The upper part is bleached to blue-grey or altered to multicoloured clays close to the contact, implying a break in sedimentation.

The second occurrence is 25 m of brown and blue-green shale between Andamooka Limestone and probable Simmens Quartzite Member in Dampier P-4 (The Broken Hill Propriety Company Limited - Exploration Department, 1976). The Yarloo Shale is probably subtidal marine (Preiss, 1987b).

Early Cambrian

Hawker Group - Andamooka Limestone (Ꞓa)

The only record of Cambrian sedimentation on the Stuart Shelf on KINGOONYA is the Andamooka Limestone, correlated by Johns (1968) and Daily (1976) with the Lower Cambrian Ajax and Wilkawillina Limestones of the Adelaide Geosyncline. The fossiliferous Ajax Limestone is interpreted by Daily (1976) to have been deposited on a shallow, stable shelf with sufficient water circulation to favour the growth of archaeocyaths, trilobites, hyolithids and brachiopods. The Andamooka Limestone on eastern KINGOONYA, by comparison, is virtually unfossiliferous and may represent deposition in a more restricted environment. The upper part of the Andamooka Limestone north of Lake Torrens on ANDAMOOKA is archaeocyath-bearing (Johns, 1968) and it is apparent that only the lower part of the formation is preserved on KINGOONYA. James and Gravestock (1990) suggested a peritidal to shallow-marine shelf environment for this lower part. The maximum thickness intersected in drilling is 122 m, in Kennecott/Samedan Playford 1 on Parakylia (Fig. 6).

The most common lithology in outcrop is a pale brown-grey, massive, unfossiliferous, recrystallised limestone or dolomitic limestone. Occasionally the rock is off-white, cream or yellow-brown. It commonly weathers to yellow, brown or greenish colours, with typical carbonate dissolution textures. Exposures are usually as sparsely vegetated flats strewn with subcrop and float of limestone or as low, hummocky rises where outcrop is better. In low breakaways (Plate 21), the limestone is seen to be flat lying and planar bedded, with local interbeds of brown or grey oolitic limestone and intraformational breccia. Calcrete (Qca) is commonly developed.

East of Beddome Dams on Younghusband, outcrops of grey-black, haematitic dolomitic limestone, which weather to brown and blue-grey colours, have shed masses of botryoidal goethite. Fetid dolomite and limestone from two wells north of Arcoona Hill, in Arcoona Cave Dam, and from several localities northeast of Roxby Hill were probably originally pyritic. Grey-black chalcedony concretions weather out of limestone in the same areas, and were seen *in situ* 1.5 km southwest of Arcoona Cave Dam. At the last-mentioned locality, an S-shaped, partly-infilled sinkhole 4 m long in the centre of a depression is probably that referred to as Arcoona Caves.

The only fossils found on the surface which are likely to be Cambrian are low, domed stromatolites about 1-2 cm across, preserved in a loose block of banded greyish-white chalcedony excavated from Tolls Dam on northern Younghusband. A sample of fetid dolomite from the Andamooka Limestone was investigated for microfossils, without success (B.J. Cooper, pers. comm., 1988).

In the subsurface, the Andamooka Limestone comprises buff, grey and pink, massive to vuggy, sugary-textured limestone to dolomite, which is locally oolitic or pyritic. Algal laminations are common within Kennecott/Samedan Prices Bore 1 and stromatolites are present near the base of the formation. A local environment of deposition more conducive to the growth of organisms is inferred for the limestone in Shell RL-1, which contains archaeocyath-bearing limestone interbedded with massive and vuggy white, stylolitic limestone and grey-orange calcarenite and dolomitic siltstone.

The base of the Andamooka Limestone was only observed in outcrop 3 km south of Arcoona Cave Dam, where the unit is flat lying and appears to lap out against a small hill of dipping Arcoona Quartzite Member. Immediately to the south, both these formations are flat lying, but are separated by several metres of no outcrop. Occurrences of chalcedony float west of Lake Parakylia and southwest of Marshalls Swamp indicate that the Andamooka Limestone once covered these areas. The basal contact is disconformable, the Andamooka Limestone resting on Simmens Quartzite Member on Younghusband and on Tregolana Shale Member in the subsurface on Parakylia.

Curdlawidny Siltstone Member (Єac)

A mixed clastic-carbonate facies of the Andamooka Limestone crops out around "Parakylia" and to the northwest, and is termed the Curdlawidny Siltstone Member (Cowley, in prep., b). In undissected country, the most common lithology is a fine-grained, red, yellow or brown, massive, silty limestone or dolomitic limestone, which weathers to distinctive yellow or brown colours with finely etched dissolution grooves. However, where a breakaway or dam excavation provides better exposure, such as at Red Lake, Catch Hole Dam and E.A.G. Senior Dam No.1, it is evident that the limestone is interbedded, apparently as lenses, within the lower parts of a siltstone and sandstone sequence. The clastics comprise red-brown, and lesser blue-grey and green-grey (bleached), partly calcareous or micaceous mudstone, siltstone and fine-grained sandstone. Planar bedding, cross-lamination and cross-bedding, and local ripple marks, shale clasts and mud cracks, indicate periodic desiccation of a shallow-water environment (Plate 22). Rare planar lamination, climbing ripples and load casts suggest rapid sedimentation and strong currents. A ferruginous band seen near the top of the cliffs on the western margin of Red Lake, where exposed by erosion to the south and west at approximately 100 m elevation, results in lag gravels of small ironstone pebbles on the surface.

Dips are generally within a few degrees of horizontal, but at Red Lake, the Member shows rapid variations in dip (up to 30°)

over short distances, with an overall attitude of 10-20° to the north or west.

Reinterpretation of Dampier drillholes P-8 and P-9 (the Broken Hill Proprietary Company Limited - Exploration Department, 1976) indicates that the Curdlawidny Siltstone Member extends 30 km southwest of Red Lake within the Andamooka Limestone. The Member lenses out to the north and northeast, where it is absent from Shell RL-1 and Australian Selection PRE-1, and to the south, where only Andamooka Limestone dolomite was intersected in Dampier P-4 and P-7. The base of the Curdlawidny Siltstone Member in Dampier P-2 and P-8 is at 83 m elevation and the top, from outcrop patterns near Red Lake, is at approximately 105 m; a maximum thickness of approximately 25 m is therefore inferred.

The lithology of the unfossiliferous Curdlawidny Siltstone Member is identical to that of the Yarrawurta Shale on ANDAMOOKA (Johns, 1968). Therefore, by analogy, it probably also represents deposition of terrigenous clastics in an intertidal environment, but in a localised area near the western shore of the Cambrian depositional basin, prior to the more extensive Yarrawurta Shale. A sample of red dolomite collected from near Catch Hole Dam yielded no microfossils (B.J. Cooper, SADME, pers. comm., 1988).

Cowley (in prep., b) correlated the reddening of the Curdlawidny Siltstone Member, indicative of an oxidising and periodically subaerial environment, with the widespread episode of subaerial exposure seen between the lower and upper Wilkawillina Limestone of the Adelaide Geosyncline (Clarke, 1986) but apparently not within the equivalent Ajax Limestone (Jenkins and Gravestock, 1988). Alternatively, the Member may correlate with a later break within the upper Wilkawillina Limestone (Jenkins and Gravestock, 1988).

ARCKARINGA BASIN

A blanket of sediments of the Carboniferous to Permian Arckaringa Basin (the Mount Sabine Lobe of Finlayson, 1981) extends across the northern half of KINGOONYA (Figs 7 & 8), but is mostly concealed beneath Mesozoic and Cainozoic cover.

Exposure is restricted to scattered low breakaways and dam excavations on Parakylia; a small concealed outlier is present on northern Younghusband.

The maximum thicknesses intersected are 182 m in CEC Eba 3 on Bon Bon (Darlington, 1978) and approximately 185 m in Esso DP-2 on Eba. There is no evidence for the extension of the thick (up to 1 000 m) sedimentary sequences of the Phillipson or Boorthanna Troughs (BILLA KALINA; Ambrose and Flint, 1981b) onto KINGOONYA, unless they are confined to narrow faulted troughs, not yet intersected by drilling, analogous to the Mulgathing Trough on TARCOOLA (Daly, 1981).

Of the three formations defined by Townsend and Ludbrook (1975) in the Arckaringa Basin - in ascending order, Boorthanna Formation, Stuart Range Formation and Mount Toondina Formation - only the two older formations have been recognised on KINGOONYA. The Mount Toondina Formation has not been intersected on KINGOONYA, although it is present in Samedan BDH-1 and BDH-2 on TARCOOLA close to the KINGOONYA boundary (Daly, 1985).

Late Carboniferous to Early Permian

Boorthanna Formation (CPb)

The Boorthanna Formation comprises three major lithologies in outcrop. The first is a red-brown, grey-green and pinkish claystone and silty claystone, often containing dispersed fine sand or well rounded quartz grains and small granules. It is either massive, or finely laminated (varved?) and fissile. Weathering has resulted in bleaching to pale green or white and in the crystallisation of gypsum, which disrupts and eventually obliterates bedding. Massive gypcrete commonly caps these exposures.

The second major lithology is a friable, white to grey or yellowish, fine to medium-grained, moderately well sorted sandstone which generally shows no obvious bedding. The sandstone is locally lustre-mottled with a calcite cement (coarse crystals up to 6 mm), or may be ferruginised to yellow-brown colours, with some ironstone concretions.

These two major lithologies often occur in close proximity, and it appears that the two are interbedded. Exotic float pebbles, cobbles and rare boulders (up to 2 m) of quartzite, quartz and minor but prominent banded iron formation, limestone, chalcedony, acid porphyry, granite and gneissic granite lie at the foot of many breakaways eroded into these units. These are exotic clasts which have weathered from both lithologies, which are thus diamictites. Striations, indicative of a glacial environment, have only rarely been observed on these clasts. Baglin and David (1977, table 1) described in detail the lithologies of clasts weathered from the Boorthanna Formation and strewn over the surface of Devils Playground (Parakylia).

Possibly an example of the pebbly sandstone described above with the exotic clasts in place is represented by the third major lithology of the Boorthanna Formation, found in breakaways 1 km and 8 km west of 13 Mile Dam on Parakylia (Plate 23). The main rock type is a bright green, unconsolidated to poorly consolidated (?weathered), poorly sorted, fine-grained to granule sandstone with a clayey or silty matrix. It is interbedded with greenish silty mudstone and siltstone which display indistinct bedding on a scale of several centimetres. Near 13 Mile Dam, these finer lithologies occur towards the base of a sequence which dips 30° to the southwest. The sequence contains dispersed, well rounded pebbles and small cobbles of white and red quartzite and rare folded banded iron formation within certain ill-defined coarser-grained layers. These granular sandstone layers also contain moderately well-rounded pebbles, and angular to well-rounded grit and granules of friable, green to white sandstone and siltstone identical to the matrix, indicating intraformational reworking. The 30° dip, together with the north-south lineament which is evident passing through the chain of lakes to the east, together suggest local syndepositional faulting and subsequent reworking of a diamictitic sandstone and siltstone sequence into the poorly sorted strata described above.

Float and subcrop of a very fine-grained silty dolomite and very fine-grained dolomitic sandstone with dispersed quartz grains and fine laminations (varves?) on a sandy rise within Curdlawidny Lagoon is assigned here to the Boorthanna Formation.

Devils Playground, Bamboo Swamp, Curdlawidny Lagoon, Reedy Lagoon and Peephabie Swamp are all underlain by Boorthanna Formation at shallow depth. The numerous small claypans east of Devils Playground and Curdlawidny Lagoon also have a creamy-white colour on aerial photographs and are probably also underlain by Boorthanna Formation.

The Boorthanna Formation in the subsurface consists of similar lithologies to those seen in outcrop: fine to coarse-grained, well sorted and well rounded quartz sandstone, mostly weakly indurated, but with local calcareous or ferruginous cements, together with silty mudstone to mudstone. Pebbles of quartzite, granite, acid volcanics and chert are present at various levels within both lithologies. The unweathered sediments are light to dark grey or off-white, and locally contain pyrite cement. Garnet forms a prominent component of the heavy mineral suite in samples from a bore near Devils Playground (Baglin and David, 1977). The Boorthanna Formation in percussion drillholes west of "Mt Eba" is composed principally of the sandstone facies, while in drillholes east of "Millers Creek" and in outcrop on <u>Parakylia</u>, it is composed mainly of mudstone, with sandy and silty intervals. In the intervening area, around Millers Creek Woolshed, the sandstone facies overlies the mudstone facies, although some interlayering is indicated. This two-fold subdivision of the Boorthanna Formation closely parallels that of Wopfner (1970) and Townsend (1976), who describe an upper unit of coarse-grained lithic sandstone with pebbly and cobbly intervals, overlying a diamictite which ranges from a sandy clay to a pebbly-cobbly claystone, in the northern parts of the Arckaringa Basin.

The only drillcore recovered is from Newmont/Dampier SR-15 on northwestern <u>Bon Bon</u>; here the diamictite is an unstratified, sandy, silty, pebbly mudstone with the clast suite dominated by metasiltstone derived locally from the underlying ?Labyrinth Formation. The thickest intersection of Boorthanna Formation is 135 m, in AGIP/Stockdale DH-10, east of Devils Playground (<u>Parakylia</u>).

By analogy with Wopfner (1970), the diamictitic mudstone facies may have been deposited by mudflows redistributing near-shore glacial debris into deeper parts of the basin in response to a continuation of the tectonic movements which gave rise to the Arckaringa Basin depocentre. Interlayered claystone, such as the possibly varved claystone on KINGOONYA, were probably laid down during periods of tectonic quiescence. Wopfner (1970) envisaged the upper sandy-conglomeratic interval of the northern Arckaringa Basin to have resulted from repetitive turbidity currents redistributing glacial and post-glacial sediments on unstable slopes adjacent to active faults. However, because the Arckaringa Basin on KINGOONYA appears to shelve passively onto the Gawler Craton, with only local structural control, the upper, sandy unit of the Boorthanna Formation here may be fluvial or deltaic in origin, deposited close to the basin margin. The finely-laminated (?varved) dolomite and sandstone which crops out in Curdlawidny Lagoon may have been deposited in a local shallow-marine or lacustrine environment.

Palynomorphs recovered from drillholes in the Arckaringa Basin northwest of KINGOONYA (Townsend, 1976) and from a bore near Devils Playground (Parakylia; Baglin and David, 1977) indicate that the Boorthanna Formation belongs to Evans' (1969) Early Permian Stage 2. Because Balme (1980) and Cooper (1981) argue that Evans' Stage 2 may, be Late Carboniferous, the Boorthanna Formation is assigned herein a Late Carboniferous to Early Permian age. Samples collected from a pit dug in Paisley Creek near Millers Creek Woolshed by Stockdale Prospecting Ltd revealed a sparse microflora only identifiable as Late Palaeozoic (Cooper, 1984).

Stuart Range Formation (CPs)

The Stuart Range Formation (Townsend and Ludbrook, 1975) is known only from drillhole intersections on KINGOONYA. It is less extensive than the conformably underlying (Hibburt, 1984) Boorthanna Formation, having been removed by erosion east of 136°E. The thickest intersection is 102.8+ m (base not penetrated) in AGIP SH-10. The formation comprises grey to black (carbonaceous) mudstone, with occasional siltstone and rare sandstone interbeds. It is commonly altered to green or yellow colours near the contact with the overlying Mesozoic sediments, and is locally pyritic near the base.

Palynological examination of samples from CEC Eba 3 (Darlington, 1979) and Dampier MC-1 (Dampier Mining Co Ltd, 1974) yielded assemblages indicative of an Early Permian age (Evans' Stage 3). Palynology of the Stuart Range Formation from SADME Bulgunnia 1 and 2 on TARCOOLA (Alley, 1986b), indicated that the formation here is at least partly younger (Stage 3b of Price, 1983) and may be a time equivalent of the Early Permian Mount Toondina Formation of the northern part of the Arckaringa Basin. "Marine fossils" were reported from AGIP holes SH-3 and SH-6 near Mintabyng Hut (Bon Bon) and MS-4 near Mount Sabine (Eba) (AGIP Australia Pty Ltd, 1981), but were not described.

Although a quiet, deep-water sedimentary environment is interpreted for the Stuart Range Formation in the northern parts of the Arckaringa Basin (Wopfner, 1970), spores recovered from the formation in the Mulgathing Trough on TARCOOLA (Dewhurst, in Daly, 1981) point to a likely non-marine depositional environment near the southern margin, which includes the KINGOONYA area.

EROMANGA BASIN

Sediments of the Jurassic to Cretaceous Eromanga Basin are widespread over the western three-quarters of KINGOONYA, but are generally poorly exposed, being largely covered by Cainozoic sediments and weathering mantles. The thickest preserved sequence is at Mount Paisley on Eba, where 115 m of sediments are indicated. However, a thickness of 40-60 m of Mesozoic sediments is more usual over the northern part of the sheet (Figs 9 & 10).

From oldest to youngest, the formations present are Algebuckina Sandstone and Cadna-owie Formation (including the Mount Anna Sandstone Member) as defined by Wopfner et al. (1970), and Bulldog Shale (Freytag, 1966). The Cadna-owie Formation and Bulldog Shale are representatives of the Neales River Group (Wopfner et al., 1970), while the Bulldog Shale is the oldest formation within the Marree Subgroup (Thomson, 1980).

Late Jurassic

Algebuckina Sandstone (Ja)

The Algebuckina Sandstone (Wopfner et al., 1970) crops out in numerous widely scattered localities on Kingoonya, southern and western Vivian, and west of Lake Hanson on Younghusband. Exposures are confined mostly to low breakaways, which are often capped by silcreted Tertiary sandstone. The unit is interpreted to be present over most of the western two-thirds of KINGOONYA, but is largely concealed beneath Quaternary and Tertiary sediments on Vivian, and beneath Cretaceous Bulldog Shale on Bon Bon and Eba. It has been largely eroded from basement areas on southwestern and central Kingoonya.

Algebuckina Sandstone is commonly 25-40 m thick beneath Bulldog Shale on the northwestern part of the sheet and appears to thicken gradually southwards (Figs 9 & 10). Its extent to the north is unclear, as it appears to be replaced by Cadna-owie Formation on BILLA KALINA (Ambrose and Flint, 1981b; Forbes, 1986). Thus, a unit of sandstone of fairly constant thickness (Fig. 10) continues from KINGOONYA onto BILLA KALINA beneath the Bulldog Shale, but its differentiation into Algebuckina Sandstone and/or Cadna-owie Formation is difficult as no drillcore or useful down-hole logs are available. The Algebuckina Sandstone and Cadna-owie Formation are absent or very thin over three buried palaeotopographic highs of Carboniferous-Permian sediments or Pandurra Formation on Eba (Figs 9 & 10). On southern KINGOONYA, the thickness of the Algebuckina Sandstone varies greatly due to a combination of deposition in and around a pre-existing topography developed on the Gawler Craton basement and subsequent erosion, particularly during the Tertiary. The unit's maximum thickness is recorded from several drillholes in this region, including CEC BB-3 (49 m; Darlington, 1980) and Amoco KRP-2 (48 m; Miller, 1982) and an original depositional thickness approaching 100 m may be inferred where it has infilled palaeotopographic lows.

Although highly variable in grainsize on KINGOONYA, the lithology most typical of Algebuckina Sandstone is a poorly sorted, medium-grained to granular, gritty or pebbly sandstone, with a distinctive, white, kaolinitic matrix. The sand is usually subangular milky or clear quartz, but iron-stained (orange), bluish and smoky quartz grains are occasionally prominent. Interbeds of better-sorted fine to very fine-grained sandstone, micaceous siltstone and massive mudstone are common. These are also white and kaolinitic, and often carry scattered quartz granules and small pebbles. Outcrops north of Lake Labyrinth and near "Gosses" O.S. superficially resemble Cadna-owie Formation but are assigned to the Algebuckina Sandstone because of their ubiquitous kaolinitic matrix, a feature not generally observed in the Cadna-owie Formation.

The pebbly sandstone grades locally into pebble conglomerate, notably at Renton Hill and on a hill 5 km north of Hicks Well on Kingoonya. The clasts comprise moderately well rounded quartz and quartzite, accompanied by minor chert, jasper and fresh or kaolinised acid porphyry. Clasts of kaolinitic siltstone, banded iron formation and silicified oolitic carbonate are rare.

Medium-grained to granular sandstone of the Algebuckina Sandstone commonly displays prominent, medium-scale trough cross-bedding, typically in sets 10-20 cm thick, but ranging up to 1 m thick near Boundary Hill on Vivian (Plate 24), where subordinate tabular cross-bedding in sets 10-20 cm thick is also evident.

The basal metre of the Algebuckina Sandstone in the cliffs west of Lake Hanson contains ripped-up slabs of fine-grained micaceous sandstone up to 50 cm across and kaolinised micaceous siltstone fragments, both derived from the underlying Tregolana Shale Member, in addition to quartz pebbles.

Northwest of Lake Labyrinth, the Algebuckina Sandstone is extensively ferruginised (Tfe_1), developing a profile which grades downwards from massive, dark brown gritty ironstone through brown, yellow and red partially ferruginised sandstone into kaolinitic white sandstone. Some of the dark brown ironstone at the top of the profile may be Tertiary sandstone, ferruginised by the same event.

The age of the Algebuckina Sandstone has not been directly determined on KINGOONYA, but microflora indicating a Late

Jurassic age have been recovered from carbonaceous sediments on COOBER PEDY (Harris, 1970), on TARCOOLA (Harris, in Daly, 1981) and on CURDIMURKA (Alley, 1987). Early Cretaceous (Early Neocomian) ages are confined to equivalents of the uppermost Algebuckina Sandstone in deeper parts of the Eromanga Basin in the northeast of the State (Moore, 1986), where a conformable transition into the overlying Cadna-owie Formation is preserved, and in SADME Toodla 1 near Oodnadatta (Alley, 1985), where a break is inferred.

Kaolinitic sandstone of the Algebuckina Sandstone on KINGOONYA closely resembles the lower part (units 1-8) of the type section and the lower part (units 1-9) of the Mt Anna reference section, both located approximately 200 km to the north (Wopfner et al., 1970). The upper part of these sections is composed of clean, non-kaolinitic, well-sorted sandstone, which, although not recognised on KINGOONYA, is present on CURDIMURKA to the northeast (G.W. Krieg, pers. comm, 1988). Thus it may be inferred that only the lower (Late Jurassic) portion of the Algebuckina Sandstone (as defined by Wopfner et al., 1970) is present on KINGOONYA, the upper (Late Jurassic to Early Cretaceous) portion being absent through either non-deposition or erosion.

Late Jurassic silicification of the Algebuckina Sandstone prior to deposition of the Cadna-owie Formation has been identified near the Peake and Denison Ranges and on the northern margins of the Willouran Range and Flinders Ranges (Ambrose, 1980; Alley, 1985) but have not been positively identified on KINGOONYA, presumably because the top of the formation has been eroded. Silicified Algebuckina Sandstone is present in a low breakaway 7 km northwest of "Mulga Well" O.S. (Vivian). Here, quartz-overgrowth-silcreted sandstone grades down- section into typical kaolinitic sandstone and is capped by "greybilly"-silcreted sandstone (Tm) which penetrates fractures in its upper surface. The quartz-overgrowth silcrete thus predates the "greybilly" silcrete (assigned to Tsi_2, ?Pliocene), and could be either ?Oligocene (Tsi_1) or possibly Late Jurassic. Similar silicified Algebuckina Sandstone forms the top of a hill 5 km north of Hicks Well (Kingoonya), but there is no Tertiary silcrete cap obvious here, and the age of the silification is unknown.

The lower Algebuckina Sandstone is considered to be fluvial, deposited in low-gradient braided streams under the influence of a seasonally arid climate (Wopfner et al., 1970; Ambrose, 1980), but recent evidence from palynological studies supports cool-temperate pluvial conditions, with possible cool to cold environments on elevated parts of the topography (G.W. Krieg, SADME, pers. comm., 1988). This is in agreement with Quilty (1984) who interpreted a cool climate for southern Australia at this time, but conflicts with Douglas and Williams (1982) who favoured a humid, subtropical climate during the Jurassic-Cretaceous transition in Victoria.

Kaolinite within the Algebuckina Sandstone was probably largely derived from Jurassic erosion of a stable, low-relief landscape which had been subjected to prolonged weathering since the cessation of Permian sedimentation (Wopfner et al., 1970). Kaolinisation is inferred to have also affected the Algebuckina Sandstone prior to the Cretaceous transgression in the southwestern Eromanga Basin (Ambrose, 1980). Further kaolinisation in the Late Cretaceous-Early Tertiary (KTb) is likely in areas where the Algebuckina Sandstone was exposed at that time, such as on southern Kingoonya and southern Vivian.

Early Cretaceous

Cadna-owie Formation (Kc)

Cadna-owie Formation (Wopfner et al., 1970) has been mapped on northwestern Parakylia, eastern and southern Eba and northwestern Vivian. The unit occurs beneath Cainozoic sediments on northeastern Vivian but its exact distribution is uncertain (Fig. 10). It rests on Algebuckina Sandstone in the south, but on Carboniferous-Permian sediments to the north. There is some difficulty in distinguishing the lithologically similar Cadna-owie Formation and Algebuckina Sandstone in drillholes on northwestern KINGOONYA as no core or useful downhole logs are available. Based on the distribution of these units on KINGOONYA and COOBER PEDY (Benbow, 1983), the Cadna-owie Formation is probably present only northwest of a line extending from near "Mt. Vivian" on Eba to the northwestern corner of KINGOONYA (Fig. 10). Cadna-owie Formation has not been identified between Bulldog Shale and Algebuckina Sandstone over the western third of KINGOONYA, and the unit is believed to be absent here.

The maximum thickness intersected in drilling is 16+ m (top eroded) in Dampier MC-2 (Dampier Mining Co. Ltd, 1974). Up to 48 m of sandstone is interpreted from water bores near Mount Vivian to the south, but although it is unclear whether it represents Cadna-owie Formation or Algebuckina Sandstone or both, its location implies that most of it is Cadna-owie Formation.

In the breakaways south of Peephabie Cliff on Parakylia, and in the area north of "South Vivian" on Eba (Plate 25), the Cadna-owie Formation comprises micaceous, white to yellowish siltstone and very fine to medium-grained sandstone, typically finely-bedded or trough cross-bedded. It locally contains feldspar grains and scattered quartz granules and fine pebbles, and is occasionally interbedded on a scale of several centimetres with white, coarse-grained to granular sandstone. Rarely, there is a white, kaolinitic matrix, which may result from either incorporation of debris from the Algebuckina Sandstone, or breakdown of detrital feldspars. In places incipient ferruginisation (Tfe_1) results in distinctive yellow and purple mottling. Silicification is locally developed below Tertiary silcreted sandstone caps.

Yellow, pink and white, micaceous siltstone, silty mudstone and very fine-grained sandstone are exposed around the southeastern margin of the Millers Creek plateau on northern Parakylia. They are unstratified, thinly bedded or cross-bedded. Although correlated with the Carboniferous-Permian Boorthanna Formation by Ambrose and Flint (1981a), they are reinterpreted here as Cadna-owie Formation because they lack illite (Brown and Steveson, 1978a and b) and well-rounded quartz grains, both common within sediments of the Arckaringa Basin (Heath, 1965; Wopfner, 1970).

Baglin and David (1977) reported fossilised leaves, stems and roots from an outcrop assigned by them to the Cadna-owie

Formation south of Devils Playground (Parakylia), but it could not be relocated by the authors. Boulder beds, locally common in the southwestern Eromanga Basin (Wopfner et al., 1970; Flint et al., 1980), have not been identified within the Cadna-owie Formation on KINGOONYA.

The Mount Anna Sandstone Member (Wopfner et al., 1970) of the Cadna-owie Formation is represented north and northwest of Peephabie Cliff on Parakylia and Eba by coarse-grained sandstone and poorly sorted conglomeratic sandstone. Small-scale cross-bedding in sets up to 5 cm thick is common within the coarse-grained sandstone. The conglomerate clasts comprise subangular to well rounded pebbles and cobbles of quartz, quartzite and prominent red-pink acid porphyry up to 20 cm in size, and rare clasts of chert, foliated quartzite and schist. The porphyry clasts are partly weathered, with the phenocrysts preferentially altered, and closely resemble Gawler Range Volcanics, which mainly crop out to the south of KINGOONYA. Although the porphyry pebbles in the Mount Anna Sandstone Member are likely to be sourced from the uplifted Gawler Ranges, significant sediment contribution from the intervening Algebuckina Sandstone and Boorthanna Formation on KINGOONYA is also probable. Surface outcrop is largely ferruginised to a dark brown colour (Tfe_1), but in pits dug in Paisley and No. 10 Creeks by Stockdale Prospecting Ltd (Emslie, 1983) and in outcrops near No. 17 Bore on Eba, the Mount Anna Sandstone Member shows mottling in white, yellow and purple colours typical of the remainder of the Cadna-owie Formation. In the pits, the member incorporates fragments of white, bleached claystone derived from the underlying Boorthanna Formation.

The lack of conglomerate in descriptions of drill cuttings from northern Eba and Bon Bon indicates that the Mount Anna Sandstone Member is absent here and is largely confined to the vicinity of known outcrop.

Palynological and palaeontological work has identified non-marine (?lacustrine) deposition in the lower part of the Cadna-owie Formation both in the northeast of the State (Moore and Pitt, 1985) and near Oodnadatta in SADME Toodla 1 (Griffiths, 1980; Alley, 1985). Previously the Cadna-owie Formation was regarded as marginal marine to brackish, with some facies deposited in marginal swamp, beach, delta and shallow agitated lagoon environments (Wopfner, 1969; Wopfner et al., 1970) and this probably still applies to the upper part of the formation. The Mount Anna Sandstone Member represents fluvial-deltaic deposition in the upper part of the Cadna-owie Formation, possibly in response to major upfaulting of the Gawler Range region to the south (Wopfner et al., 1970).

The restricted distribution inferred for the Mount Anna Sandstone Member on KINGOONYA may reflect a more confined braided river system in this region, perhaps incised into the Algebuckina Sandstone, and possibly into the lower Cadna-owie Formation, and opening out northwards into a braid-plain to deltaic environment on BILLA KALINA (Ambrose and Flint, 1981b), where the unit is thicker and much more widespread (Fig. 11).

The age of the Cadna-owie Formation has been regarded as Early Cretaceous (Late Neocomian to Early Aptian; Wopfner et al., 1970). Recent work, however, indicates that on the southern and western margins of the Eromanga Basin the Cadna-owie Formation may be Early Aptian in age only (Alley, 1985, 1987) while it is almost wholly Neocomian in age in deeper parts of the basin (Moore and Pitt, 1985). Taken together, these observations support the expected marginward younging of the transgressive Cadna-owie Formation and therefore a likely Early Aptian age for the unit on KINGOONYA.

Bulldog Shale (Kmb)

The most widespread outcrop and sub-outcrop of Bulldog Shale (Freytag, 1966) is on the northwestern portion of KINGOONYA, mainly on Bon Bon and Eba, where it forms a sheet 20-40 m thick, thickening northwards. In these areas, it is largely covered by red-brown clayey sand (Qp_2), calcreted red-brown clayey sand (Qp_1) and gibber-strewn colluvial sediments (Q_1). The Bulldog Shale is often strongly calcreted (Qca), notably in the area between North Knoll and Lloyd Swamp (Bon Bon). It is often covered by alluvial and talus deposits on the flanks of mesas of overlying silcreted Tertiary sandstone such as Wingilpin Bluff

Range; better exposures are found in areas such as western Bon Bon where the gibber mantle is absent. The greatest stratigraphic thickness (approximately 100 m) is preserved beneath Mount Paisley. Figure 12 shows the structure contours of the base of the Bulldog Shale, or alternatively, the top of the Algebuckina Sandstone/ Cadna-owie Formation aquifer sands.

Isolated occurrences of Bulldog Shale are present at Kingoonya Hill (Kingoonya), near Devils Playground (Parakylia), near Rawlinson Hill (northern Younghusband), on the Arcoona Plateau (southeastern Younghusband) and near "East Well" O.S. (southwestern Younghusband) and the unit probably once formed a near-continuous blanket over KINGOONYA. It rests either conformably on Cadna-owie Formation, or unconformably on Algebuckina Sandstone or older units; its top has been eroded.

The Bulldog Shale consists dominantly of monotonous, white, kaolinised (KTb) mudstone or siltstone, with minor sandy siltstone and rare fine to coarse-grained sandstone interbeds, such as the sandy interbed represented by outcrops surrounding a small lake 1.5 km north of Duncans No. 17 Bore on Bon Bon. The shale is dominantly massive and unstratified but bioturbation occurs locally. Well rounded, pale quartzite pebbles and boulders up to 1.5 m in size are present locally near the base (Plate 26). In exposures west of Devils Playground (Parakylia) and in quarries 2.5 km southwest of The Knoll (Younghusband), these clasts are seen to be derived from thin layers (up to 10 cm thick, but mostly less than 5 cm) of pebbly, sandy siltstone enclosed within the more usual mudstone-siltstone sequence.

Weakly silicified sediments are exposed in road metal quarries 3.0 and 3.8 km east of Roxby Hill and 2.2 and 4.0 km east of The Knoll (Younghusband). They comprise white, micaceous, finely bedded and cross-bedded siltstone, pale green-grey micaceous mudstone with dispersed quartz granules and disrupted (bioturbated?) sandy lenses, and flaggy, cross-bedded, whitish fine-grained sandstone to siltstone. They are tentatively assigned to the Bulldog Shale, transitional into Cadna-owie Formation, but it is also possible that these sediments are Neogene Mirikata Formation.

A 1.5 m unit of interbedded kaolinitic fine-grained sandstone and siltstone below Bulldog Shale west of Lake Hanson on Younghusband is also considered transitional between Bulldog Shale and Cadna-owie Formation and may imply intertonguing of the two units.

The white colour seen in the Bulldog Shale on KINGOONYA is a result of bleaching of the original grey colour during a deep weathering episode in the late Cretaceous or early Tertiary (KTb). Barker (1980), in a study of the Coober Pedy opalfield, determined that the clay component of the unweathered Bulldog Shale is montmorillonite, which converts to kaolinite during bleaching. Virtually the entire thickness of the Bulldog Shale on KINGOONYA has been affected by this event. The only surface occurrence of grey mudstone is on the slopes of Mt Paisley.

Further alteration in the form of ferruginisation (Tfe_1) is common, resulting in mottling in brown, red, yellow and purple colours. In addition, this bleached or ferruginised mudstone is often silicified (Tsi_1 or Tsi_2) to white or multi-coloured porcellanite where overlain by silcreted Tertiary sandstone. Irregularly-shaped concretions of cherty pinkish porcellanite weather out of kaolinitic mudstone 3 km north of "Mount Eba". These originally had very sharply defined margins with the enclosing rock, but elsewhere a gradation is apparent between porcellanised and unsilicified mudstone.

The Bulldog Shale is generally considered to be Early Cretaceous (Early Aptian to Middle Albian; Moore and Pitt, 1985; Alley, 1985) in age. Evidence of breaks within the sequence near the Eromanga Basin margin is given by a possible hiatus spanning the Late Aptian to Early Albian in SADME Toodla 1 near Oodnadatta (Alley, 1985) and by the absence of the Early Aptian portion of the unit in SADME Finniss 2 west of Marree (Alley, 1986a). The latter occurrence indicates the presence of a local hiatus between the Cadna-owie Formation and Bulldog Shale; elsewhere in the Eromanga Basin, a sharp but conformable contact is observed (Moore and Pitt, 1985).

On BILLA KALINA, the Bulldog Shale has been dated as Aptian (Ludbrook, 1966), the overlying Albian portion of the unit having been removed by erosion. The formation on KINGOONYA is thus probably also Aptian in age with significant breaks in the sequence likely due to its proximity to the Eromanga Basin margin.

A widespread basal unit of the Bulldog Shale in the southwestern Eromanga Basin area contains numerous well-rounded pebbles, cobbles and small to large boulders of quartzite, with minor chalcedony and acid porphyry clasts (Flint et al., 1980). Erosion of this layer results in a lag pavement littered with these clasts. The lag gravels resting on the Bulldog Shale on KINGOONYA are instead composed largely of silcrete pebbles and subordinate quartzite pebbles to cobbles derived from overlying Tertiary silcreted sandstone. Hence the basal Bulldog Shale on KINGOONYA probably does not contain the abundance of coarse clasts noticeable in other parts of the southwestern Eromanga Basin.

This bouldery layer, in which well rounded clasts up to 1.5m across of resistant lithologies are enclosed within mudstone and siltstone indicative of low-energy depositional conditions, has been the subject of considerable debate (e.g. Wopfner et al., 1970; Flint et al., 1980; Frakes and Francis, 1988). The debate hinges largely on whether ice-rafting has played a part in the final placement of the clasts, and this is reflected in a diversity of opinion on the prevailing palaeoclimate in the Early Cretaceous. Though palaeomagnetic evidence places the KINGOONYA region at approximately 60°-70°S at this time (e.g. Veevers, 1984), palynological and palaeontological data infer warm, subtropical conditions extending from the equator to these latitudes, and warm to cool temperate climates from there to the south pole, which developed no ice cap (e.g. Scheibnerova, 1971; Frakes and Rich, 1982; Quilty, 1984; Rich and Rich, 1988). Ice-rafted deposits from the Cretaceous of high northern palaeolatitudes are cited as supportive evidence for at least seasonal ice at this time near the poles (Frakes and Francis, 1988).

Wopfner et al. (1970), on the other hand, proposed transport of locally-derived clasts from the shoreline into deeper water by slow sediment creep, possibly assisted by tectonic activity.

This activity would possibly be the continuation of those movements proposed to account for deposition of the Mount Anna Sandstone Member.

Flint et al. (1980) used the widespread presence of boulders bearing Devonian fossils (which are not known *in situ* in South Australia) to infer initial transport of these and other clasts to the Eromanga Basin region by Carboniferous to Permian glaciation. They then suggested Cretaceous reworking of the resulting diamictites from the shore into deeper water by debris flows, and subsequent winnowing of all but the largest clasts by currents and waves.

Late Cretaceous to Palaeogene

Late Cretaceous to Paleocene bleaching (KTb)

Following cessation of deposition within the Eromanga Basin, there occurred a widespread episode of deep weathering and bleaching, affecting both Cretaceous and older units. In northeastern South Australia its age lies between the youngest formation affected, the Mount Howie Sandstone (probably early Late Cretaceous (Turonian); Wopfner, 1963) and the oldest unaffected overlying unit, the Middle Paleocene to Late Eocene (Callen, 1983) Eyre Formation.

On KINGOONYA, the major unit affected by this weathering event is the Bulldog Shale. The event may also have contributed to some of the kaolinite content of the Cadna-owie Formation and Algebuckina Sandstone, and to the bleaching noted locally within Stuart Range Formation, Corraberra Sandstone Member and Tregolana Shale Member in areas of thin or absent Bulldog Shale cover.

Ambrose and Flint (1981b) recorded up to 30 m of bleaching profile on BILLA KALINA, and Benbow (1983) noted up to 60 m on COOBER PEDY; a similar thickness of profile is inferred for KINGOONYA.

This weathering event has been variously termed the Stuart Pedoderm (Jessup and Norris, 1971), the Arckaringa Palaeosol (Firman, 1981), or, in Queensland, the Morney Profile (Senior and Mabbutt, 1979).

?Palaeogene ferruginisation (Tfe_1)

Ferruginisation (Tfe_1) has affected Algebuckina Sandstone, Mount Anna Sandstone Member, and Bulldog Shale. Within the Bulldog Shale, ferruginous mottling is widespread, particularly near Red Hill on Bon Bon and Mount Sabine on northern Eba, but is not differentiated on the map because of its patchy nature. The stronger ferruginisation affecting the Mt Anna Sandstone Member and parts of the Algebuckina Sandstone has enabled its photo-interpretation and depiction on the map as an overprint (Tfe_1).

This ferruginisation on KINGOONYA is most likely part of the late Cretaceous to Paleocene bleaching event (KTb); the ferruginisation is within the lower part of the weathering profile (e.g. Senior and Mabbutt, 1979). Palaeomagnetic dating on ferruginisation associated with an equivalent weathering profile in Queensland (Idnurm and Senior, 1978) indicates a latest Cretaceous (Maastrichtian) to Early Eocene age. On KINGOONYA, no exposures of the ?Paleocene-Eocene Munjena Formation equivalent directly overlying ferruginised Cretaceous sediments are known, so the interpreted pre-Munjena Formation age of the ferruginisation is unproven.

Ferruginisation of the Eromanga Basin units may include a younger superimposed event (?Pliocene; Tfe_2), with the lack of ferruginisation in the Munjena Formation equivalent (see later) attributable to the negligible porosity remaining after the ?Oligocene silicification (Tsi_1) of this unit. Ferruginised Tertiary sandstone (Mirikata Formation) is closely associated with strongly ferruginised Algebuckina Sandstone east of "Whymlet" on Kingoonya; here there may be two events represented (Tfe_1 in Algebuckina Sandstone and Tfe_2 in the Tertiary sandstone) or only one (Tfe_2) of post-Mirikata Formation age.

Equivalent of LAKE EYRE BASIN

?Paleocene to Eocene

Munjena Formation equivalent (Tp-e)

Silcreted sandstone considered equivalent to the upland portion of the Munjena Formation of Benbow (1986 and pers. comm., 1989) outcrops on elevated portions of the topography over the western two-thirds of KINGOONYA, such as Mount Paisley, The Deputy, Coolarrikinna Cone, Mount Vivian, Wingilpin Bluff Range, The Lookout, Haggard Hill, North Knoll, Mount Sabine, Gosse Range, Kingoonya Hill and Jim Hill. These hills appear to be remnants of a rolling plateau surface developed on the Munjena Formation equivalent (Figure 13).

Munjena Formation equivalent, where it overlies Bulldog Shale, comprises grey to yellow-grey, poorly sorted sandstone; the original grain size distribution is largely concealed by greybilly silcrete development, but the sandstone was probably matrix-rich, with a dominance of very fine to medium-grained sand. Quartz granules and small pebbles (often polished) and pebbles and cobbles of usually well-rounded quartzite are locally common. Unsilicified sediments on the northeastern and of the mesa at Hickson Hill (Vivian) comprise 2 m of grey to pale grey-green medium-grained sandstone is exposed, with only a thin silcreted cap. The sandstone contains silcrete granules and pebbles which are not polished, and have been found elsewhere only on Eba 9km north of Hickson Hill, at Jacks Hill (Plate 27), 6km southwest of Jacks Hill and on The Deputy, and on Bon Bon at Haggard Hill. Munjena Formation equivalent is up to 2.5 m thick but usually much less. On Mount Paisley (Eba) about 2 m of coarser Munjena Formation equivalent comprises medium-grained to pebbly silcreted sandstone with angular to subangular grit and well-rounded pebbles of quartz and chert.

Where the Munjena Formation equivalent rests on Algebuckina Sandstone, as on southern Kingoonya and southern Vivian, it is correspondingly coarser, consisting of poorly sorted medium-grained to pebbly sandstone, with mostly well-rounded clasts of white quartz and minor quartzite. Silicification by "greybilly" silcrete is ubiquitous. A small outcrop of Munjena Formation equivalent resting on Hiltaba Suite greisen 5 km west of Range Well No.7 on Kingoonya contains abundant pebbles of greisen and Tarcoola Formation quartzite.

It appears that the Munjena Formation equivalent contains a large proportion of locally-derived detritus, and is likely to be a residual to colluvial deposit, with no appreciable fluvial influence in the form of well-sorted or crossbedded sediments.

The age of the Munjena Formation equivalent on KINGOONYA in uncertain. Its occurrence as isolated mesas on the highest parts of the topography indicates that it is likely to be the oldest Tertiary unit preserved in a landscape which has undergone slow uplift and erosion since the cessation of deposition in the Eromanga Basin. M.C. Benbow (SADME, pers. comm., 1989) believes that the upland part of the Munjena Formation on TALLARINGA (Benbow, 1986) may be analogous to the Late Cretaceous to Paleocene Lampe Beds of Jackson and van de Graaff (1981) in Western Australia.

The Munjena Formation equivalent on KINGOONYA occurs on the southern tip of the Stuart Range, which is interpreted to have defined the watershed between the Paleocene-Eocene portion of the Lake Eyre Basin (Birdsville Basin of Wells and Callen, 1986) to the northeast, and the Eucla Basin palaeodrainage to the southwest, active from at least the middle Eocene (Pidinga Formation; Pitt et al., 1978). Hence, a tentative Paleocene-Eocene age is attributed to the unit on KINGOONYA, although it is probable that extensive reworking and resilicification (Tsi_2) took place during the Pliocene. The unit is therefore considered a colluvial-regolithic lateral equivalent of the fluvial Eyre Formation of the Lake Eyre Basin (Wopfner et al., 1974).

Fossilised leaves, fruits, seeds, bark and shoots were reported from The Lookout, Jacks Hill (Eba) and Haggard Hill (Bon Bon) by Offler (1964, 1969), who concentrated her studies on the coniferous vegetative shoots. She considered the flora from the above localities to be more "prodigious" than from other sites known at the time (Offler, 1964). All three localities were visited briefly by the authors, but only a few specimens were recovered; presumably prior collection has been heavy. Fossils collected during mapping included leaves resembling *Brachychiton* and *Banksia*, a coniferous shoot and a spherical mould, possibly of a seed. The sandstone in which the fossils are preserved is better-sorted and coarser-grained than is normal for the Munjena Formation equivalent and may be fluvial. Insect burrows were noted at Jacks Hill and The Lookout. Although a Paleocene-Eocene age for these fossils is inferred from mapping on KINGOONYA, their relationship to the better-known ?Eocene-Oligocene floras of Stuart Creek (CURDIMURKA; Ambrose et al., 1979; Wells and Callen, 1986) is unknown.

?Oligocene

Silicification (Tsi_1)

Virtually all of the Munjena Formation equivalent on KINGOONYA has been silicified to "greybilly" silcrete, which is mostly massive or crudely columnar, but is locally nodular. It probably corresponds to the pedogenic silcretes of Callen (1983), formed at or very near a past land surface.

Silicification of the underlying Bulldog Shale to porcellanite is widespread, and postdates both the bleaching (KTb) and ferruginisation (Tfe_1) seen in this unit. This porcellanite is white or, if ferruginised, mottled in red, purple, brown and yellow. It is usually very brittle, breaking easily into small, angular chips bounded by conchoidal fractures. Where the porcellanite is directly beneath a cap of silcreted Munjena Formation or on other elevated parts of the topography from which the Munjena Formation has been recently eroded, it probably formed contemporaneously with silicification. However, abundant instances of porcellanised mudstone 20-30 m below the level of the postulated post-Munjena land surface (Fig. 13) may in part be attributable to the younger post-Mirikata Formation silicification episode (Tsi_2).

The age of the Palaeogene silicification (Tsi_1) in northern South Australia has been interpreted as Late Eocene to Oligocene (Wopfner et al., 1974; Wopfner, 1978), being bracketed between the

Paleocene to Mid-Late Eocene Eyre Formation (Wopfner et al., 1974) and the Miocene Etadunna Formation (Stirton et al., 1961), although Callen (1983) suggests that it may have continued forming until Early Miocene. Palaeomagnetic dating of ferruginisation associated with the possibly equivalent younger portion of the Canaway Profile in Queensland (Senior and Mabbutt, 1979) has yielded a Late Oligocene age. An approximate Oligocene age is thus inferred on KINGOONYA in the absence of accurately-dated stratigraphic constraints.

KINGOONYA PALAEOCHANNEL

Undifferentiated ?Eocene to ?Pliocene sediments (Te-p)

A chain of playas extending across southern Younghusband, Vivian and Kingoonya, together with a tributary chain joining this chain from the north near Rocky Hill, is the present-day surface expression of a Tertiary palaeodrainage channel, termed here the Kingoonya Palaeochannel.

Exploration company drillholes and water bores have intersected 20-30 m of Tertiary sediments (Te-p) close to the playa chain, but the greatest thickness recovered is 76 m, in SADME ERD-5 (Cowley and Martin, 1988).

Lithologies include pale green, grey and brown sandy clay often oxidised to red-brown colours, and containing scattered carbonaceous fragments; white to yellow-orange, fine to very coarse-grained quartz sand with minor quartz pebbles; and grey to black, gypsiferous or carbonaceous (lignitic) clay and sand.

Because a consistent vertical sequence of lithologies cannot be determined because of sparse and shallow drilling, the sediments are undifferentiated and mapped as Te-p. Nevertheless, they probably comprise Pidinga Formation (Harris, 1966) overlain by Garford Formation (Benbow and Pitt, 1978), by comparison of their lithologies with analogous palaeochannels on adjacent TARCOOLA (Daly, 1981; 1985) and in the Tallaringa and Garford Palaeodrainage Systems (Barnes and Pitt, 1976b). The Pidinga Formation is Middle to Late Eocene in age (Pitt et al., 1978) and the Garford Formation, Miocene to Pliocene (Benbow and Pitt, 1978; Alley, 1983; Binks and Hooper, 1984). No palynological ages are available on KINGOONYA; two samples of black, carbonaceous clay from ERD-5 (Cowley and Martin, 1988) proved to be barren of palynomorphs (N.F. Alley, SADME, pers. comm., 1988).

Green clay, partly oxidised to red-brown occurs on the shore of the eastern arm of Lake Younghusband (Younghusband), and in two localities north of Lake Labyrinth (Kingoonya) (Plate 28). White, fine-grained and cavernous limestone crops out 5 km southwest of Glendambo (Vivian) and east of Lake Reynolds (Younghusband), and occurs in the spoils of Scotts Well, west of "Gosses" O.S. (Kingoonya), and McKinnons Dam, west of Glendambo. The above lithologies are consistent with those described from the Garford Formation (Benbow and Pitt, 1978); other undiscovered occurrences are likely in the palaeochannel. Compact, cream, crystalline limestone in a creek 4 km west of Mount Eba (Kingoonya) is also tentatively correlated with the Garford Formation.

The origin and history of the Kingoonya Palaeochannel are described in the Section on Tertiary Palaeogeography.

BILLA KALINA BASIN

The name Billa Kalina Basin was introduced by Wells and Callen (1986) to refer to sediments, mostly of Miocene age, which were deposited in an enclosed basin situated between the Eucla Basin palaeodrainage network and the Lake Eyre Basin.

Miocene to ?Pliocene

Mirikata Formation

The sediments of the Billa Kalina Basin on KINGOONYA are referred to as the Mirikata Formation, comprising the Millers Creek Dolomite, Billa Kalina Clay, Danae Conglomerate and Watchie Sandstone Members (Ambrose and Flint, 1981a). Collectively, these sediments represent deposition resulting from desiccation and shrinkage of a Miocene lake (termed Lake Billa Kalina by Wells and Callen, 1986).

The name Mirikata Formation is extended in this report (as unnamed member, Tm) to include widespread silcreted fluvial sandstone on southern KINGOONYA which is considered to be equivalent in age. The formation as mapped on KINGOONYA may include ?Eocene-Oligocene Willalinchina Sandstone (Wells and Callen, 1986), which underlies the Watchie Sandstone Member (Watchie Sandstone of Wells and Callen, 1986) on CURDIMURKA.

The Mirikata Formation is considered to be equivalent to the Mirackina Conglomerate (Barnes and Pitt, 1976a) of the northern Stuart Range, to the Garford Formation of the Eucla Basin palaeodrainage, and to the Etadunna Formation (Stirton _et al_., 1961) and Namba Formation (Callen and Tedford, 1976) of the Lake Eyre Basin.

Millers Creek Dolomite Member (Tmi) and Billa Kalina Clay Member (Tml)

Jessup and Norris (1971) correlated dolomite and underlying dolomitic and palygorskitic clay around the margins of the Millers Creek plateau (informal name) on _Parakylia_, on the basis of strong lithological similarities, with the Miocene-?Pliocene Etadunna Formation. They applied the names Millers Creek Dolomite Member and Billa Kalina Clay Member to the dolomite and underlying clays respectively. Ambrose and Flint (1981a) retained the member names but changed the formation name to Mirikata Formation to emphasise that this formation and the Etadunna Formation were deposited in separate basins.

The Millers Creek Dolomite Member on KINGOONYA consists mainly of white, cream, and lesser pale grey-brown and pink, very fine-grained dolomite, dolomitic limestone and minor limestone, extensively calcreted (Qca equivalent) on exposures in flat terrain. Although it is dominantly massive, with numerous small, irregular cavities, the Member locally displays intraformational brecciation, with clasts of dolomite in a slightly coarser-grained calcite matrix. It typically weathers to a brilliant white colour, with finely-etched dissolution grooves; these features differentiate the member from the Cambrian Andamooka Limestone, which it overlies southwest of "Parakylia". The Millers Creek Dolomite Member attains its maximum thickness of approximately 10 m on the eastern margin of the Millers Creek plateau (near Section A of Ambrose and Flint (1981a) on southernmost BILLA KALINA), and steadily thins southwards to approximately 1 m or less at Moodlampnie Hill (their Section C) (Plates 29 and 30). The Member consists of two dolomite beds separated by 1 to 5 m of cream and green dolomitic and palygorskitic clay. The upper dolomite bed and the underlying clay gradually disappear south of Devils Point, leaving only the lower dolomite bed at Moodlampnie Hill.

Banded, drusy and nodular limestone, sometimes brecciated, is present in an outcrop located 1.2 km south of No. 9 and 10 Yards on northeastern Parakylia. Rare fragments of carbonised wood were also noted. These rocks resemble cave travertine, and probably correspond to the tufa noted elsewhere by Ambrose and Flint (1981a), who attributed the tufa to spring activity.

The Billa Kalina Clay Member underlies the Millers Creek Dolomite Member at the Millers Creek plateau (Plate 30) and west of Peeweena Dam, and comprises up to 5 m of green clay, which is usually highly gypsiferous in outcrop and is locally sparsely gritty. Jessup and Norris (1971) determined that the clay is dominantly palygorskite, with lesser amounts of illite and montmorillonite. The Billa Kalina Clay Member is not seen in outcrop south of these areas.

Mapping has demonstrated that the Millers Creek Dolomite Member extends approximately 50 km further south than previously known (e.g. Ambrose and Flint, 1981a). In this area, south of Peephabie Swamp (Parakylia), it generally occurs as low calcreted subcrop beneath and between sand dunes. On central Parakylia, the member rests directly on Carboniferous-Permian Boorthanna Formation, and on southern Parakylia and northern Younghusband, it overlies Cambrian Andamooka Limestone; Billa Kalina Clay Member is apparently absent except possibly in Dampier P-8 near Beamish Hill, where it is inferred to be 7 m thick (Table 3). Millers Creek Dolomite Member is 5 m thick in breakaways west of 13 Mile Dam (Parakylia), southeast of Reedy Lagoon and 6m of the unit is inferred in Dampier P-3 and P-9 (northern Younghusband; Table 3). Elsewhere, lack of vertical exposures precludes any estimate of thickness. Local variations in the lithology near

Reedy Lagoon (Parakylia) include outcrops north of Inchman trig point, where the typical white, very fine-grained dolomite rests on off-white to grey, mottled, medium-grained, porous limestone and calcareous medium-grained sandstone. Similar cavernous, pink, sparsely sandy medium-grained limestone is found as lenses within very fine-grained dolomite near No. 20 Bore, west of Reedy Lagoon. Both occurrences indicate clastic input into, and shoreline reworking of, the lacustrine dolomite. Scattered MnO_2 staining occurs in this area.

An outcrop 4 km southeast of Reedy Lagoon shows typical white, very fine-grained dolomite grading into sparsely gritty dolomite containing angular quartz granules up to 5 mm in size. This in turn grades laterally and probably downwards into calcareous fine-grained to granular sandstone and finally into silicified, cross-bedded, well sorted, friable, fine to medium-grained quartz sandstone with dispersed angular quartz granules assigned to the Watchie Sandstone Member (see later). Float boulders of this sandstone, silica-cemented (quartz-overgrowth type) at one end and calcite-cemented at the other end, indicate post-depositional replacement of one matrix by the other.

Millers Creek Dolomite Member outcrops define a concordant surface, tilted slightly from 120-130 m ASL at the Millers Creek plateau to 110-115 m ASL at their southern limit.

The age of the Millers Creek Dolomite Member (and Mirikata Formation) is indirectly determined as Miocene-?Pliocene by its correlation with the Etadunna and Namba Formations of the Lake Eyre Basin, both of which also display the distinctive dolomite-palygorskite mineralogical association. The freshwater molluscs Syrioplanorbis hardmani, Syrioplanorbis sp., Rivisessor sp. and Physastra rodingae were identified on BILLA KALINA by Ludbrook (1980), indicating a lacustrine depositional environment, but inferring a Miocene age only. On KINGOONYA, scattered external moulds molluscs up to 5 mm in length were noted at three localities between 2.5 and 5 km southwest of "Millers Creek".

Danae Conglomerate Member (Tms)

The term Danae Conglomerate Member was introduced by Ambrose and Flint (1981a) to refer to colluvial and fluvial silicified conglomeratic sandstone which intertongues with, and underlies, the lacustrine Millers Creek Dolomite and Billa Kalina Clay Members on the western side of the Millers Creek plateau. They considered that the Member could be traced upslope to the northwest to the top of the Stuart Range, which is capped by thin silcreted sandstone then also considered Miocene.

Observations on KINGOONYA support their interpretations at Millers Creek plateau, but the silcreted sandstone on the Stuart Range, because it has the same geomorphic position and altitude (190-240 m ASL) as the Paleocene-Eocene Munjena Formation on KINGOONYA, is considered to be equivalent. The original contact (since disrupted by erosion) between this older silcreted sandstone and the Danae Conglomerate Member was probably not a sharp unconformity. Instead, the contact was probably gradational, related purely to the degree of reworking, culminating eventually in transformation into colluvial-fluvial sediments, that the earlier silcrete suffered during the Miocene on the slopes bordering Lake Billa Kalina.

The Danae Conglomerate Member on KINGOONYA crops out around the margins of the Millers Creek plateau and southwest of Peephabie Cliff. It consists of up to 3 m of poorly sorted, fine to coarse-grained silcreted sandstone containing scattered to common granules of quartz and silcrete which are occasionally well-rounded and polished. The sandstone grades into a poorly sorted pebble to cobble conglomerate, with clasts of quartz, fine-grained quartzite, "greybilly" silcreted sandstone and rare chalcedony (Plate 31), which are locally well-rounded and polished, indicating significant fluvial transport. The quartzite and chalcedony cobbles are probably derived from the Cretaceous Bulldog Shale, perhaps via the Munjena Formation equivalent, which provided the silcrete clasts.

Both the sandstone and the conglomerate are silicified to grey- or red-weathering "greybilly" silcrete of a grey, buff or distinctive blue-grey colour. It often shows a bulbous or ropy surface-weathering texture. Intense dark brown ferruginisation was noted 1.3 km northwest of Moodlampnie Hill (Parakylia).

Numerous, isolated outcrops of silicified sandstone of uncertain identity on central Parakylia occur at elevations varying from 90 to 120 m, and originally underlay the Millers Creek Dolomite Member, since eroded (see Palaeogeographic Sketch). It is difficult to confidently assign these to either the Danae Conglomerate or Watchie Sandstone Members of the Mirikata Formation; some may be equivalent to the ?Eocene-Oligocene Willalinchina Sandstone of Wells and Callen (1986), originally included by Ambrose and Flint (1981a) within their Mirikata Formation. Those outcrops assigned herein to the Danae Conglomerate Member are characterised by "greybilly" silicification, although the host sandstone tends to be finer-grained and better sorted than at Millers Creek plateau and Peephabie Cliff, and there is some lithological overlap with outcrops assigned to the Watchie Sandstone Member (described later). Conglomerate is confined to outcrops around Bamboo Swamp.

Impressions of strap-like leaves up to 4cm wide with vertical ribbing similar to reeds occur in outcrops along the western edge of Curdlawidny Lagoon, southeast of Bamboo Swamp and 2.5 km north of Camels Hump, north of "Parakylia". Wells and Callen (1986) have closely linked silcrete containing reed impressions (their "reed mold silcrete") with the top of ?Eocene-Oligocene Willalinchina Sandstone on CURDIMURKA. The silcreted sandstone at Camels Hump, however, is lithologically identical to, and at the same topographic level as, the reed-impression occurrence just to the north, and is gradational into dolomite indistinguishable from Miocene Millers Creek Dolomite Member. This implies a Miocene age for the sandstone containing reed impressions on KINGOONYA.

Watchie Sandstone Member (Tmw)

Ambrose and Flint (1981a) included within their Mirikata Formation the sediments comprising a conspicuous series of concentric, arcuate ridges prominent on CURDIMURKA, ANDAMOOKA, southeastern BILLA KALINA and easternmost KINGOONYA, naming them the Watchie Sandstone Member. They interpreted this coarsening-upward unit as representing regressive shoreline deposits formed during the drying and contraction of Lake Billa Kalina. Wells and Callen (1986), however, separated the Member from the Mirikata Formation because of its physical separation from the remainder of the Mirikata Formation, and renamed it the Watchie Sandstone. Despite this, it is clear that they still considered the Watchie Sandstone (upper part) and the Millers Creek plateau sequence as lateral equivalents, and that their deposition could be related to the same events (Wells and Callen, 1986, pp. 87,89). Evidence from mapping on KINGOONYA supports the original interpretation of Ambrose and Flint (1981a), and their stratigraphic scheme is used here, with some additions.

The descriptive summary following is taken from Ambrose and Flint (1981a), Wells and Callen (1986) and Krieg _et al_. (in prep.), and results from field work carried out on the Watchie Sandstone Member, mainly on CURDIMURKA.

> The Watchie Sandstone Member is uniformly 5-10 m thick throughout its occurrence and consists of cross-laminated siltstone overlain by well-sorted medium to coarse-grained sandstone which coarsens upwards to a poorly sorted, pebbly silcreted sandstone. The siltstone rests on a basal gravel which includes granules of polished quartz and chert, rough and rarely polished silcrete and fossil wood pebbles, together with pebbles to boulders reworked from underlying Cretaceous sediments. It also includes some fine-grained sandstone. The uppermost portion of the overlying sandstone is poorly sorted, and is composed of rounded to sub-rounded quartz sand, abundant angular quartz silt and polished, well-rounded pebbles of quartz and silcrete, particularly on the tops of the parallel ridges. Ambrose and Flint (1981a) report irregular masses of silty and sandy limestone intertonguing and merging with the sandstone. A similar gradation from silica to carbonate-cemented sandstone was noted at several localities south of Peephabie Swamp.
>
> The basal siltstone is probably lacustrine, with the overlying sandstone representing regressive beach or offshore bar deposits resulting from the desiccation of

Lake Billa Kalina. Cross-bedding indicative of both longshore currents, driven by persistent westerly to southwesterly winds, and of wave activity perpendicular to the strandline, have been recorded from the sandstone. The pebbly sandstone capping the ridges is interpreted by Ambrose and Flint (1981a) as a lag deposit formed on beaches or behind dunes (subsequently eroded) and by Krieg _et al_. (in prep.) as beach ridges originating from storm activity. In uneroded areas, the ridges are 2-10 m high, 100 to 1 000 m (typically 300-400 m) wide and are separated by flats 200-300 m wide. The plateau on which they are located is consistently at approximately 120 m altitude.

The silcrete developed at the top of the Watchie Sandstone Member is most pronounced in the parallel flats between the ridges, decreasing in intensity towards the tops of the intervening ridges. Preferential headward erosion of the ridges by creeks northeast of KINGOONYA has resulted in inverted topography, formed by a series of distinctive, parallel, arcuate mesas centred on the strongly silicified flats. The silcrete, called the "ant nest" silcrete by Wells and Callen (1986), is characterised by the presence of burrows of termites or meat ants, and corresponds to the pedogenic silcretes of Callen (1983). Silicification was envisaged by Ambrose and Flint (1981a) to have resulted from intermixing of lake waters and groundwaters at the shoreline or in lagoons behind the strandline ridges, during pauses in the lake regression.

Prior theories for the formation of the arcuate ridges by Webb and Wopfner (1961), Jessup and Norris (1971) and Murrell (1977) were discussed and rejected by Ambrose and Flint (1981a). Another theory was proposed by Nicol (1979), who studied the Tertiary stratigraphy of the Coward Cliff area approximately 100 km to the northeast of KINGOONYA. He proposed that fluvial and lacustrine Tertiary sediments were deposited in and

> adjacent to Lake Billa Kalina in this region and later reworked into linear dunes in the arid period which brought about the drying of the lake. Continued aridity caused reworking of the upper levels of these sediments into linear dunes, with the remaining interdunal areas developing into a continental sabkha. Silicification was interpreted by Nicol to have occurred within these interdunal areas as a result of fluctuations in a shallow groundwater table under evaporitic conditions, but this model requires immobility of the dunes during the (perhaps protracted) silicification episode and their subsequent complete removal. This may have been the case in the Coward Cliff area where the ridges are strongly dissected, but Ambrose and Flint (1981a) have found that the sediments in the uneroded ridges to the west towards KINGOONYA are too coarse and poorly-sorted to be aeolian.

Silicified sandstone assigned to the Watchie Sandstone Member on KINGOONYA is found in three distinct geographic settings: a southwesterly extension of the arcuate ridge system on northeastern <u>Younghusband</u>; linear ridges west of Lakes Parakylia and Reynolds; and scattered occurrences on central and southern <u>Parakylia</u> whose precise correlations are obscure (see also Danae Conglomerate Member).

The arcuate ridge system continues from ANDAMOOKA onto eastern KINGOONYA but although the ridges are only poorly exposed through the overlying dunefield cover, their trends are visible on aerial photographs. Northeasterly trends dominate, but west of Harcus Hill (<u>Younghusband</u>), the ridges gradually curve around to an east-west orientation, where they are subparallel to the overlying dunes. In this region, they appear, from interpretation of aerial photographs, to comprise shorter segments of tighter curvature than to the northeast (see Palaeogeographic Sketch). They occur only as patches of silcreted sandstone float at the foot of some of the dunes.

Because of poor outcrop, the lithological sequence within the Watchie Sandstone Member on CURDIMURKA (described above) could not be verified on KINGOONYA. The ridges comprise low rises covered in float pebbles of fine to medium-grained, well sorted, pale grey, pale yellow and whitish sandstone which rarely contains scattered quartz granules; this may correspond to the lower portion of the upper sandstone interval of the Member on CURDIMURKA (Ambrose and Flint, 1981a; Wells and Callen, 1986). The sandstone has undergone variable silicification, but it typically weathers to small pale red to pale yellow-grey pebbles with a distinctive glassy appearance. Weakly-silicified, grey to pinkish, fine to medium-grained clayey sandstone exposed in a roadside quarry 2.8 km southeast of Beddome Hill (Younghusband) contains prominent tubes, probably insect burrows, filled with greenish-white silty clay. Tentative thicknesses of up to 20m are inferred from Dampier drillholes P-3 to P-6 in this area (Table 3).

Northeast-trending straight ridges evident on aerial photographs in an area west of Lake Reynolds (Younghusband) comprise the second grouping of the Watchie Sandstone Member (Plate 32). They are similar to the arcuate ridges in that they are composed of pale grey-yellow, well-sorted, very fine to medium-grained sandstone with scattered fine quartz granules, but the sequence overall appears to be fining-upwards, unlike the arcuate ridges of CURDIMURKA. On the western shore of Lake Younghusband, 7.5 km south of Parakylia Hill, fine to medium-grained sandstone grades downwards into fine to coarse-grained, off-white to yellowish micaceous sandstone with thin interbeds containing abundant well-rounded and polished quartz granules up to 6 mm in size. Its base is not exposed. The lower sandstone contains clay-filled ?insect burrows, and high angle cross-bedding which, together with the fine grainsize of the sandstone and the linear nature of its outcrops, suggests an aeolian (longitudinal dune) origin for these linear ridges.

The interpretation of the linear ridges here as aeolian may support Nicol's (1979) depositional model for the arcuate ridges north of Lake Torrens.

The third grouping of Watchie Sandstone Member outcrops occurs on central and southern Parakylia, at or below the level of the Millers Creek Dolomite Member. Typically they comprise well-sorted, well-bedded to cross-bedded, fine to medium-grained, off-white to pale grey sandstone, with scattered polished quartz granules and quartz granule beds, and rare silcrete granules. The sandstone is mostly cemented by massive to saccharoidal quartz-overgrowth silcrete, and then resembles quartzite. This silicified sandstone commonly occurs as large isolated boulders in which the bedding and cross-bedding is prominent. These boulders closely resemble the ?Eocene-Oligocene Willalinchina Sandstone of Wells and Callen (1986). In several localities south of Peephabie Swamp, the silicified sandstone grades abruptly into a calcite-cemented sandstone with local MnO_2 staining (Plate 33). These occurrences range up to granule sandstone, in which the granules are subangular, but finer grain-sizes are well-rounded. The sandstone described previously from 4 km southeast of Reedy Lagoon resembles the Watchie Sandstone Member of the arcuate ridges further southeast on <u>Younghusband</u>. If these sandstones are indeed correlatable, this locality may be a "missing link" between the Watchie Sandstone Member and the remainder of the Mirikata Formation, which otherwise crop out in different areas. Fossilised twigs were noted in silicified and calcareous sandstone beneath Millers Creek Dolomite Member 300 m southwest of Top Tank on southern <u>Parakylia</u>. In low breakaways west of Moondiepitchnie Water (southwest <u>Parakylia</u>) up to 6 m of off-white to greyish, fine to medium-grained weakly silicified clayey sandstone underlies a thin lag of porcellanised Millers Creek Dolomite Member and overlies silcreted Boorthanna Formation sandstone.

As all the occurrences of the third grouping are topographically below the Millers Creek Dolomite Member, it is probable that they were deposited very early in the history of the Billa Kalina Basin, and are equivalent to the lower, silty, lacustrine member of the Watchie Sandstone Member (Wells and Callen, 1986) and to part of the Danae Conglomerate Member, and may indeed form a continuum between these two units (see Fig. 14). An alternative correlation for some outcrops is with the ?Eocene-Oligocene Willalinchina Sandstone (Wells and Callen, 1986).

<u>Unnamed sandstone member (Tm)</u>

Widespread silicified coarse sandstone (Tm) on southern KINGOONYA is considered to be a time-equivalent of the remainder of the Mirikata Formation but is not directly related to the desiccation of Lake Billa Kalina. These outcrops commonly occur at 130-150 m ASL, providing a basis for distinguishing them from the Munjena Formation equivalent at 170-200+m ASL.

Unit Tm consists of grey to yellow-brown, moderately to poorly sorted, coarse-grained to granular quartz sandstone and pebbly sandstone, containing quartz, quartzite and local silcrete pebbles, which are often well-rounded and polished (Plate 34). Rarely, clasts of jaspilite and greenish-white and black chert are also present. The unit is typically silicified by quartz-overgrowth silcrete and is often ferruginised to yellow-brown or reddish-brown, most notably on central Vivian. Quartzite-like, silicified, prominently cross-bedded grey-white or pinkish sandstone is present southwest and northwest of Kultanaby Dam and 1 km west of Cattle Well (southern Vivian), 3 km northwest of "Big Tank" O.S. (Kingoonya), and 2.5 km west of Mt Ernest (Eba). These are virtually identical to quartzite-like silicified sandstone of the Watchie Sandstone Member. "Greybilly" silcrete is also commonly developed within the unit. Reed impressions up to 15 cm long were noted 6 km west of Butchers Well (Younghusband), and small pieces of fossil wood are present in ferruginous sandstone 2.5 km south of Dicks Well (Eba). Isolated silcreted sandstone outcrops on central and northwestern Bon Bon are considered equivalent.

The exposed thickness of Tm is generally less than 1.5 m, but the unit may be 4 m thick in Carpentaria Eba 1 (Darlington, 1978). Commonly, this silcreted sandstone appears to follow the present-day topography. Examples are found north of Lake Reynolds (Younghusband), where outcrops of Tm drop from 150 m ASL in the southwest to 130 m ASL near the southern end of Lake Parakylia; 2 km east of Boundary Hill (Vivian), where the unit lines both sides of a palaeovalley eroded into the Jurassic Algebuckina Sandstone; and, on a larger scale, on both sides of an unnamed creek system which drains an area surrounding Mount Ernest (Eba). How much of these occurrences is true outcrop, and how much is transported or lag material, is often unclear.

Nevertheless, it is evident that these parts of the present-day landscape date from the Late Tertiary.

In small gullies 10 km east of Mount Vivian, three metres of "greybilly"-silcreted pebbly sandstone (Tm) overlies 7 m of weakly silcreted medium-grained sandstone and siltstone. This lower unit is tentatively interpreted as part of unit Tm, but alternatively could be Boorthanna Formation, which underlies Watchie Sandstone Member near Moondiepitchnie Water to the southeast.

Two subparallel northwest-trending ridges of silcreted sandstone 8 km northeast of "Mount Vivian" are composed of medium-grained gritty sandstone and granule conglomerate, with interbeds containing well-rounded quartz and quartzite pebbles. Patches of clay matrix are silicified and ferruginised. The eastern ridge has a sharply-defined (?faulted) eastern edge, and the ridges may have arisen by preferential silicification along faults. Near Kowal Well (eastern Vivian), are straight and sharply-curved ridges of silcreted fine to coarse-grained sandstone of variable orientation. The straight ridges parallel the linear Watchie Sandstone ridges to the northeast, and possibly also have an aeolian origin. The curved ridges, one of which is perpendicular to the straight ridges, may represent fluvial channels.

Approximately 6.5 km northwest of Parakylia Hill, in an area several metres below the level of the Watchie Sandstone Member linear ridges, are outcrops of friable, coarse-grained, pebbly sandstone containing scattered to common highly polished quartz granules, well-rounded and polished pebbles of vein quartz, white quartzite, grey-black chert and foliated quartzite, and cobbles to boulders of mottled white, grey and pink chert and Arcoona Quartzite Member quartzite. Although this pebbly sandstone is not seen in contact with the ridges, it is likely that the dune ridges were reworked from this pebbly sandstone, which probably correlates with unit Tm.

Alongside a creek running northwards into Marshalls Swamp (Younghusband) are outcrops of medium-grained sandstone with interbeds containing scattered granules and small pebbles of quartz. The sandstone is weakly to strongly ("greybilly") silcreted and abundant ?insect burrows in roadside scrapes 3 km southwest of Marshalls Swamp. Superimposed on this sandstone southwest of Roxby Hill are ill-defined sinuous ridges composed of poorly-sorted coarse-grained to granule sandstone, aligned approximately east-west, and possibly fluvial in origin. This coarser sandstone also contains scattered quartz and quartzite pebbles to 5 cm in size and defines a coarsening-upward sequence. The outcrops drop gradually from about 150m ASL north of Hanson Hill to about 110m ASL at Marshalls Swamp and probably represent the remnants of a colluvial to fluvial blanket of sandstone deposited on the slopes bordering the southern shore of Lake Billa Kalina. It is likely that these sediments, together with those emanating from the Kingoonya Palaeochannel east of Lake Parakylia, were the major source for the sand redistributed into the arcuate strandline ridges of the Watchie Sandstone Member.

?Pliocene

Ferruginisation (Tfe_2) and silicification (Tsi_2)

Much of the unnamed sandstone member of the Mirikata Formation (Tm) on northern and central Vivian is ferruginised (Tfe_2), varying from red-brown to nearly black in colour, and is quite noticeable on aerial photographs. Elsewhere, ferruginisation is ubiquitous, but less intense, giving the rock a yellow-brown to yellow-grey colour.

Rarely, the Millers Creek Dolomite Member is ferruginised to pale to bright yellow colours. One outcrop 2.8 km south of Millers Creek Woolshed (Eba) is intensely ferruginised to dark brown, and is associated with small masses of clear, translucent opaline silica (Tsi_2). A small hill of Danae Conglomerate Member 1.3 km northwest of Moodlampnie Hill (Parakylia) is also ferruginised to dark brown.

Silicification (Tsi_2) postdating the Mirikata Formation is widespread and affects most of the arenaceous outcrops of this unit, but its intensity is more variable than that of the Palaeogene silicification Tsi_1. The silcrete is termed the "ant nest" silcrete on CURDIMURKA by Wells and Callen (1986), who stated that it is composed of microquartz and anatase. According to Callen (1983), "greybilly" silcrete in these units represent pedogenic silcrete developed at or very near a past ground surface, while quartz-overgrowth ("quartzitic") silcrete is considered to have formed in the zone of groundwater depth fluctuation, and may have formed at a significant depth below the contemporaneous ground surface.

The age of the Neogene ferruginisation (Tfe_2) and silcrete (Tsi_2) is probably Pliocene. Silcrete in equivalent Namba Formation of the Lake Eyre Basin is considered to be probably Late Pliocene in age by Callen (1983). A late Pliocene palaeomagnetic age has also been determined by An et al. (1986) for equivalent silcrete in the Murray Basin.

TERTIARY PALAEOGEOGRAPHIC INTERPRETATION

Because the silicified Tertiary sediments on KINGOONYA are either unfossiliferous or yield plant debris non-diagnostic of age, reconstruction of the Tertiary palaeogeographic history of the area relies heavily on the relative geomorphic position of these sediments in the present-day topography, on their pre-silcrete lithology, and on evidence from the Lake Eyre and Eucla Basins where the Tertiary units are better-exposed, have been palynologically dated, and where their relationships to one another are better understood. The Palaeogeographic Sketch and Figures 14 and 15 illustrate the following discussion for KINGOONYA.

Paleocene to Late Eocene

During this period, fluviatile sediments of the Eyre Formation accumulated within the Lake Eyre Basin (Birdsville Basin of Wells and Callen, 1986) in the northeastern part of the State. During this time, a pluvial climate prevailed, and sea-surface temperatures were warm (Truswell and Harris, 1982). In the Eucla Basin, southwest of KINGOONYA, marine Middle to Late Eocene Wilson Bluff Limestone and marine to fluvial Hampton Sandstone were deposited (Lindsay and Harris, 1975). At the same time, a well-developed palaeodrainage system drained a very large area of western South Australia and southeastern Western Australia, and emptied into the Eucla Basin (Benbow, 1988). Middle to Late Eocene Pidinga Formation was deposited within these channels, which may have even originated as early as Late Cretaceous in Western Australia (van de Graaff et al., 1977). The ?Eocene-Oligocene Willalinchina Sandstone may have been deposited in the upper reaches of the southwestern drainage of the Lake Eyre Basin at this time, in an area later to become the Billa Kalina Basin. Palaeocurrent measurements, however, (R.A. Callen, SADME, pers. comm., 1989) indicate dominantly westerly transport of sediments, perhaps indicating that the uplift between the Peake and Denison Inlier and Willouran Ranges may have already begun to cut off the Billa Kalina Basin from the Lake Eyre Basin.

Benbow (1988, fig. 2), places the divide between the Eucla Basin palaeodrainage and the Lake Eyre Basin along the Stuart Range north of KINGOONYA and thence west of the western margin of the sheet. Wells and Callen (1986) have proposed that a connection existed between the Lake Eyre and Eucla Basins via Lake Labyrinth on southern KINGOONYA.

The Stuart Range, at only 190-240 m present-day elevation, must have been of very low relief in the Paleocene-Eocene, being flanked by slopes of minimal gradient towards the Lake Eyre and Eucla Basins. The Munjena Formation equivalent (Tp-e) is interpreted to have originated on this divide as colluvial or residual deposits while the fluvial Eyre Formation accumulated in the Lake Eyre Basin. Remnants of the former unit on KINGOONYA appear to have been part of a plateau of low relief at 170-240 m ASL with subdued drainage into the Kingoonya Palaeochannel, which contains sediments whose base is generally at 90-110 m ASL (Fig. 15). This implies headward erosion of the Paleocene-Eocene plateau by the Eucla Basin palaeodrainage, which is partly filled by Middle to Late Eocene fluviatile Pidinga Formation on TARCOOLA (Daly, 1981, 1985). Whether this erosion captured the drainage of the Lake Eyre Basin as proposed by Wells and Callen (1986) is not known, as no palynological ages are available for the palaeochannel sediments between TARCOOLA and the Lake Eyre Basin.

The palaeochannel is tightly confined between outcrops of Adelaidean sediments northeast of Lake Reynolds (Younghusband), and contains an outcrop of probable Miocene-Pliocene Garford Formation resting directly on these Adelaidean sediments. This suggests that a connection did not exist until the Miocene. Hence it is likely that the Paleocene-Late Eocene divide between the Eucla Basin palaeodrainage and the Lake Eyre Basin lay further to the east than shown in Benbow (1988, fig. 2), instead continuing southeastwards along the Stuart Range to near Lake Reynolds, to form an effective barrier to external drainage of the Lake Eyre Basin to the Eucla Basin.

Oligocene to Early Miocene

Palynologically-dated sediments are not known from this time interval in inland South Australia, although Wells and Callen (1986) assign a tentative Eocene-Oligocene age to their Willalinchina Sandstone of the Billa Kalina Basin, based on stratigraphic interpretation. Instead, this time interval is better known for the widespread development of a silcrete duricrust in the northeast of the State, where it was termed by Wopfner (1978) the Cordillo silcrete.

On KINGOONYA, this event is considered responsible for the pedogenic silcrete (Tsi_1) developed in the Munjena Formation equivalent (Tp-e). It coincides with a period of low sea-surface temperatures and inferred aridity (Kemp, 1978; Truswell and Harris, 1982), reflected in the lack of stratigraphic record. Callen (1983) interpreted this episode of silcrete formation as resulting from an alternation of dry and wet periods, which coincides with the onset of a pronounced climatic gradient from the south pole to the equator, and with a general increase in atmospheric circulation at approximately this time (Kemp, 1978; Truswell and Harris, 1982).

During this period, uplift along the Stuart Range and between the Willouran Range and Peake and Denison Inlier isolated an area of internal drainage (Billa Kalina Basin) centred on northeastern KINGOONYA (Wells and Callen, 1986). Previously this area was near the southwestern rim of the catchment for the Lake Eyre Basin.

This tectonic activity coincided with a period of uplift and warping both within and around the southern margins of the Lake Eyre Basin (Wopfner, 1974) and initiated new cycles of deposition within this basin, the Billa Kalina Basin and the Eucla Basin palaeodrainage.

Middle Miocene to Pliocene

The Middle Miocene was a period of generally wet climate and elevated temperatures, with periods of superimposed aridity (Callen and Tedford, 1976). These arid periods increased in importance towards the end of the Miocene, at which time there was a marked drop in temperatures. This trend continued into the Pliocene, with a slight warming evident in the early part of this interval (Truswell and Harris, 1982). The seasonality and latitudinal differentiation of climate which commenced during the Oligocene-Early Miocene interval increased into the Miocene-Pliocene as Australia drifted away from Antartica. This resulted from the establishment of the Antarctic icecap and the circumpolar current, which in turn, increased the intensities of general atmospheric circulation and westerly wind systems (Kemp, 1978; Truswell and Harris, 1982).

Kingoonya Palaeochannel

By analogy with equivalent palaeochannels to the west (Barnes and Pitt, 1976b; Benbow and Pitt, 1978; Daly, 1981 and 1985), it is likely that sedimentation recommenced in the Kingoonya Palaeodrainage System during the Middle Miocene-Pliocene interval. The Garford Formation essentially filled the palaeochannel and comprises fluviolacustrine palygorskite clay and dolomite.

The dominance of fine clastics and chemical sediments in the Garford Formation compared with the largely arenaceous Pidinga Formation suggests that, although water was at times plentiful, the westerly flow was insufficiently vigorous to flush the clays out of the river system, and water was often ponded for extended periods. Stagnation and reversal of flow in the eastern portion of the palaeochannel, as indicated by Wells and Callen (1986, p. 88-89), is inferred from clastic sediments deposited within the southwestern Billa Kalina Basin (see later).

Unnamed member of Mirikata Formation

While the Kingoonya Palaeochannel was being filled with Garford Formation, erosion of the Munjena Formation equivalent plateau to the north and south left only isolated mesas and flat-topped ranges, with the intervening broad valleys mantled by the derived colluvium and fluvial sediments (Tm). The intensity of this dissection decreases from the "Millers Creek" area towards Kingoonya. Consequently, the difference between the topographic elevation of the Munjena Formation plateau remnants and the Tm blanket also decreases, and differentiation of the two units on geomorphic grounds becomes less certain. On eastern Kingoonya and central Vivian, the sediments of unit Tm coalesced into an extensive sheet (now largely covered by Quaternary aeolian sediments) on the gentle slopes leading towards the palaeochannel.

The relationship between the unnamed member Tm and the equivalent Garford Formation of the Kingoonya Palaeochannel has not been observed, due to the choking and burial of the palaeochannel sediments by Quaternary lacustrine and aeolian sediments. In the Tallaringa and Garford Palaeochannels, (Barnes and Pitt, 1976b) and around the Millers Creek plateau (Ambrose and Flint, 1981a) erosion has revealed intertonguing and gradational relationships between Garford Formation and Mount Sarah Sandstone (now the "lowland" portion of Munjena Formation; Benbow, 1986), and Millers Creek Dolomite Member and Danae Conglomerate Member, respectively. A similar relationship is inferred for the concealed margins of the Kingoonya Palaeodrainage System.

Mirikata Formation of Billa Kalina Basin

The pluvial climate of the Middle Miocene led to the filling of the enclosed depression of the Billa Kalina Basin with water. The subsequent drying of this Lake Billa Kalina led to deposition of the regressive clastic and lacustrine sediments of the Mirikata Formation (Ambrose and Flint, 1981a). As the lake shrank it withdrew from its shallow eastern portion towards its deepest part, centred over Parakylia (Fig. 14).

Early lacustrine and fluviatile sediments over which the lake transgressed are represented by the basal siltstone of the Watchie Sandstone Member to the east, and by the lower part of the Billa Kalina Clay Member in the west (Parakylia). Subsequent desiccation resulted in the westward progradation of beach and off-shore bar deposits of the upper part of the Watchie Sandstone Member over the lower part. This sandstone displays current directions indicative of longshore currents, probably driven by prevailing westerly winds, and of swash and wave activity perpendicular to the strandline (Krieg et al. in prep.). The pebbly sandstone forming the arcuate ridges at the top of the sequence is interpreted by Krieg et al. (in prep.) to represent strandline gravels (not dunes) formed by storm activity. During this time, Billa Kalina Clay Member continued to accumulate in the deeper water to the west. In the final stages of the drying of Lake Billa Kalina, deposition in the west eventually changed from clay to dolomite (Millers Creek Dolomite Member) as the lake waters became supersaturated and finally dried up. The prograding beach and ridge sediments stopped forming at this stage and this explains the absence of arcuate ridges west of a line curving northwards from near Gambier Hill (Younghusband), past Korea trig point (northeastern Younghusband) and the northeast corner of KINGOONYA to Emu Bluff (on BILLA KALINA) (see also Wells and Callen, 1986, fig. 15).

Callen (in Wells and Callen, 1986) considered that a confident correlation could not be made between the Watchie Sandstone Member and the remainder of the Mirikata Formation separated from it at Millers Creek plateau. The authors' mapping on KINGOONYA, however, supports the original correlation of Ambrose and Flint (1981a) as the expanded known outcrop area of Millers Creek Dolomite Member now spans the region between the two ends of the arcuate ridge system and a direct relationship is highly likely. In addition, the top of the arcuate ridge system and the top of the Millers Creek Dolomite Member together define a concordant surface at 110-130 m elevation, with a very gentle southward dip.

The western margin of Lake Billa Kalina was formed by uplands of Cretaceous sediments capped by mesas of Early Tertiary silcreted sandstone. To the south, the lake lapped onto a subdued landscape of Andamooka Limestone, with a possible connection to the Kingoonya Palaeochannel through the Lake Reynolds region. Colluvial to fluvial sediments of the Danae Conglomerate Member entered the lake from the western margin. Equivalent, finer sediments, mapped as Watchie Sandstone Member (third grouping), are inferred to represent clastic input to the lake from the southwest and south, transitional between the Danae Conglomerate Member and the lacustrine silt of the lower Watchie Sandstone Member of the arcuate ridges. This clastic input may have contributed much of the sand which was subsequently reworked into the regressive sand sheet of the upper Watchie Sandstone Member; some of it may have originated from reversed easterly flow within the eastern portion of the Kingoonya Palaeochannel.

While Lake Billa Kalina was drying up, some of the sediment (Tm) shed southward from the Stuart Range region was reworked into linear dunes by the wind west of Lake Reynolds.

QUATERNARY

The trend of increasing aridity dating from at least the Miocene continued into the Quaternary. Superimposed on this trend were cold, arid periods associated with glacial maxima alternating with more humid, warmer interglacials in a cyclic pattern of about 100 000 years (Bowler, 1982). Alluvial and lacustrine sediments laid down during the interglacials were extensively reworked by the wind during succeeding glacial periods, while playa-lake sediments succeeded those deposited during lake-full episodes (Belperio, in prep.).

On KINGOONYA, widespread clayey sand, the oldest Quaternary unit, has been mapped as **Qp_2** and **Qp_1**, differentiated largely by photo-interpretation on the intensity of calcrete profile developed. Unit Qp_1 is present over most of Kingoonya, Vivian and Younghusband, while the major development of Qp_2 is over Bon

Bon, Eba, parts of Kingoonya and probably Parakylia (partly mapped within unit Qs).

Unit **Qp_1** comprises indurated, red-brown to orange, fine to coarse-grained clayey sand and sandy clay characterised by the prominent development of nodular to massive and sheeted calcrete (Qca; Plate 35) which is intermittently exposed at the present-day surface as an abundance of calcrete chips. Coarse quartz sand is often scattered on the surface. The intensity of calcrete development decreases downwards, and the lower portions are lithologically similar to Qp_2. Rare tree trunk casts were noted in the calcrete. Where it overlies silcreted Tertiary sandstone, Qp_1 often encloses pebbles to boulders of the silcrete at the base; these are probably part of a residual weathering mantle on the silcrete, incorporated within the overlying sands and subsequently calcreted. A sparse to dense silcrete gibber veneer is sometimes present on the Qp_1 surface, transitional to Q_1; these areas are mapped as **Q_1/Qp_1**.

Unit **Qp_2** comprises weakly to strongly indurated red-orange to red-brown, fine to coarse-grained clayey sand to sandy clay, which commonly has a scatter of coarse, gritty quartz sand on the surface, resulting from deflation and erosion of the finer proportion. On Bon Bon and Eba, the unit often contains dispersed black-brown or red-brown ironstone granules to small pebbles and local ferruginous silcrete pebbles; in these areas the surface carries a dense carpet of ironstone gravel with desert varnish ("buckshot"), transitional to Q_2.

Calcrete is often developed within Qp_2 but is usually soft, and forms as thin horizontal sheets, crack-fillings and nodules (Plate 36). It rarely is exposed on the present-day surface except as small scattered float chips. The maximum thickness of Qp_2 probably does not greatly exceed 2 m, and a thickness of only 0.3 m has been seen to be sufficient in places to completely conceal underlying units.

Where Qp_2 is thin and overlies Bulldog Shale, it is occasionally characterised by prominent, regular contour striping visible on aerial photographs, probably resulting from a combination of sheet-wash erosion processes, and subsequent stabilisation and further sediment trapping by vegetation. Good examples can be seen near Saltash Bore (Bon Bon) and north to Studley Dam and Boolka Bore (Eba).

Where Qp_2 overlies Bulldog Shale on Bon Bon and Eba, it locally contains abundant fragments of bleached or porcellanised mudstone at the base, where it grades downwards into massive mudstone. In these areas, it is likely to be equivalent to the Russo Beds (Barker, et al., 1979; Ambrose and Flint, 1981b) and thus may range in age from latest Tertiary to Pleistocene. In a quarry 1.5 km west of "Mount Eba" red-brown sandy clay of Qp_2 is partly silicified to a pale-orange colour, and the enclosed Bulldog Shale clasts are rounded (?corroded) and have concentric alteration bands. This silicification supports a latest Tertiary age for the base of Qp_2, as the youngest known silcrete in South Australia is Late Pliocene in age (An et al., 1986). Elsewhere, Qp_2 is probably equivalent to only the uppermost Pleistocene portion of the Russo Beds, which is termed the Giddinna Formation and is equated with the lower part of the Pooraka Formation (Firman, 1969) by Benbow (1983).

On central Vivian and western Younghusband, Qp_1 forms irregular, east-west-trending mounds over which Qs dunes are draped in approximately the same direction; this area is mapped as **Qs/Qp_1**. These mounds probably represent Pleistocene dunes built during one or more of the Quaternary windy, arid, glacial cycles, with their present morphology largely determined by the major Late Pleistocene (18 000 to 16 000 yrs B.P., Bowler, 1976) arid phase. They were probably reworked from alluvial deposits, formed during the interglacial wet periods, which are now represented by the widespread blanket of Qp_2 and Qp_1 not organised into dunes. It is likely that the Qs dunes over most of Parakylia and Younghusband similarly overlie Pleistocene fluvial sediments and aeolian cores correlatable with Qp_2 although these have not been separately mapped.

The relationship of Qp_1 to Qp_2 is uncertain. Where the two units are mapped in close proximity, it is normally Qp_1 which occupies the higher ground, while Qp_2 forms broad depressions between these, and on the gentle slopes bordering salt lakes (e.g. Lake Labyrinth). In these areas, the unit mapped as Qp_2 is probably younger than Qp_1, and derived from it by fluvial and aeolian reworking; it is probably equivalent in this respect to Qha of TARCOOLA (Daly, 1981). Elsewhere, Qp_1 and Qp_2 are probably broadly equivalent in age, with Qp_2 locally including sediments as old as Pliocene at the base and the degree of calcrete development in the two units varying because of local conditions.

Because of the long-standing, subdued nature of the topography on KINGOONYA, there are few locations where relief has been sufficient to generate talus slope deposits (**Qt**) of Pleistocene to Holocene age. On northernmost Eba, vigorous dissection of the eastern edge of the Stuart Range has produced talus deposits in this area, equivalent to Qp_3 on BILLA KALINA (Ambrose and Flint, 1981b). They comprise pale red-brown clayey and sandy silts with abundant clasts of bleached Bulldog Shale, silcrete and "buckshot" ironstone, and display a prominent streaky appearance on aerial photographs. Several basement hills on Kingoonya are flanked by gravelly and sandy clay containing clasts of quartzite or banded iron formation, depending on locality.

Overlying units Qp_1 and Qp_2 and older rocks are thin colluvial sediments characterised by moderate to dense gibber (**Q_1**) or "buckshot" ironstone (**Q_2**) surface scatter. These sediments are the same as the units Q_1 and Q_2 on BILLA KALINA (Ambrose and Flint, 1981b) and also equate with the Benitos Clay of COOBER PEDY (Benbow, 1983) and to unit Qp_2 of GAIRDNER (Blissett, 1985). Units Q_1 and Q_2 are probably Pleistocene to Holocene in age but predate the latest (Holocene) aeolian dune-forming episode (see later).

Unit **Q_1** comprises red-brown sand, silt and clay, containing dispersed silcrete and ferruginous silcrete granules and pebbles, and mantled by a moderate to dense lag carpet of pebbles and cobbles of silcrete, ferruginous silcrete and minor quartzite (Plate 37). It is rarely weakly calcreted, and is not known to exceed 1 m in thickness. Characteristic features are the presence of gypsum within the unit, which renders the upper surface soft and powdery, and the common occurrence of gilgai microtopography, which often forms a distinctive striped pattern following the topographic contours on aerial photographs. On the upper flanks of silcrete-capped mesas, Q_1 is probably colluvial to alluvial with the silcrete clasts sourced from the disintegrating caps. In flat-lying areas it is more likely to be residual, resulting from lag concentration of silcrete and quartzite clasts from pre-existing sedimentary and regolithic deposits (possibly including Russo Beds). Where unit Q_1 overlies Tent Hill Formation, Ealbara Rhyolite, Tarcoola Formation and Labyrinth Formation it contains clasts and gibbers of the underlying unit.

Unit **Q_2** is similar to Q_1, in that it comprises a thin (<0.5 m) blanket of red-brown sand, silt and clay, but is more ferruginous and contains instead scattered ironstone ("buckshot") granules and a moderate to dense lag veneer of these granules on the surface (Plate 38). Q_2 commonly occurs overlying Qp_2, from which the "buckshot" was derived; in these areas it is mapped as **Q_2/Qp_2**. In places, such as the broad, ill-defined drainage lines passing through "Mount Eba", Q_2 has been redistributed by intermittent fluvial transport. With an increase in the content of ferruginous silcrete pebbles, Q_2 grades into Q_1; the two are considered lateral equivalents and have been largely differentiated by photo-interpretation.

The major development of gypsiferous leeside dunes (**Qpg**) resulting from deflation of playa lakes occurred during the major Late Pleistocene (18 000 to 16 000 yrs B.P.) arid interval (Bowler, 1976). Most of the saline playas now occupying the course of the Kingoonya Palaeochannel have large dunes of powder, seed and massive gypsum on their eastern (downwind) sides. Up to 4 m of unstructured, cross-bedded or rarely flat-bedded gypsiferous sediments have been noted, often with a gypcrete capping. Thin red aeolian sand (Qs) often veneers these dunes, and almost totally covers those fringing Lakes Younghusband, Reynolds and Parakylia.

On the western shore of the eastern arm of Lake Younghusband, a cliff exposure 4 m high displays interbedding of aeolian gypsiferous silt (Qpg) with red-orange indurated clayey sand (Qp_1) of the Late Pleistocene dunefield, indicating contemporaneous formation. They rest here on green clay with red mottling, possibly Garford Formation (Te-p).

No gypsiferous dunes flank the intermittent freshwater claypans of northern Parakylia. It is likely that the impervious, clayey Boorthanna Formation, which underlies these lagoons, prevented them from drying out as often as the playas in the Kingoonya Palaeochannel and, possibly more importantly, prevented efficient upward transport of sulphate-bearing groundwater to the lake surface to be evaporated (Bowler, 1976).

Following the cessation of deposition of the Miocene to Pliocene Garford Formation in the Kingoonya Palaeochannel due to increasing aridity, the inactive palaeochannel received only playa lacustrine (**Ql**) and aeolian (Qs) sediments. The playa sediments comprise grey-black to red-brown, gypsiferous and saline sand, silt and clay, often capped by a thin crust of halite. On adjacent TARCOOLA (Daly, 1985) several drillholes in the westerly extension of the Kingoonya Palaeochannel intersected up to 11 m of interpreted Quaternary playa sediments. A similar thickness (18 m) was obtained by Johns (1968) in Lake Gairdner on GAIRDNER. On KINGOONYA, drilling by SADME for the Highways Department near Glendambo (Read, 1982) and by BHP near Lake Labyrinth (PK-13 to 18; BHP Minerals Ltd, 1983), and seismic refraction work by Kendall (1966) on Lake Younghusband indicate thicknesses of 6-15 m. Krinsley et al. (1968) sampled and analysed red-brown sandy silt and sand from a pit excavated near the northeastern margin of Lake Harris (near the KINGOONYA - GAIRDNER boundary). The upper 0.5 m was gypsiferous, and the clay fraction contained subequal amounts of kaolinite, illite and montmorillonite, with the uppermost 5 cm containing some celestite ($SrSO_4$). The lower 1.5 m of the pit (below the water table) was non-gypsiferous, and contained mostly illite with minor kaolinite and no montmorillonite. Analyses of heavy mineral content were also presented, with particular interest focussed on detrital fragments of magnetic desert varnish.

Some playas on KINGOONYA appear to have contain little or no Cainozoic sediment. Lake Parakylia, for instance, has a surface composed of puffy, gypsiferous red silt and clay presumably derived from breakdown of the underlying Corraberra Sandstone Member by crystallisation of salts. Red Lake (Parakylia) and other claypans in the vicinity appear to be similarly floored by

Curdlawidny Siltstone Member, and Boorthanna Formation underlies other claypans to the north.

The most widespread Quaternary unit on KINGOONYA is the aeolian sand **Qs**, which covers approximately half of the sheet area. It comprises red-orange to pale orange, fine to coarse-grained quartz sand and clayey sand in spreads and east-west-oriented vegetated longitudinal dunes. The unit as mapped is interpreted to comprise Holocene dune sand reworked from, and overlying, dune cores of Pleistocene clayey sand equivalent to both Qp_1 and Qp_2. Where the obviously calcreted Qp_1 is present beneath the Holocene dunes, as is well displayed on Vivian and western Younghusband, the area is mapped as **Qs/Qp_1**. The intervening swales may be formed by Qp_1 or Qp_2 or locally by Mirikata Formation silcreted sandstone or dolomite, Bulldog Shale, or Andamooka Limestone. Areas mapped as Qs represent either thick Holocene sand or, as on Parakylia and Younghusband, Holocene sand resting on lithologically similar Pleistocene Qp_2 dune cores. Isolated, sharply demarcated single dunes or groups of dunes resting on units as young as Q_1 on northern Bon Bon and Eba, notably northeast of Mount Paisley and Coolarrikinna Cone, are probably entirely Holocene in age.

The east to east-northeasterly orientation of the dunes parallels the prevailing wind direction, which has varied little since at least the Late Pleistocene (Bowler, 1976).

The present-day drainage network on KINGOONYA is not well developed and therefore Holocene alluvial sediments (**Qha**) are uncommon and thin. The major river systems on the sheet are those draining the southern extension of the Stuart Range: Millers, No. 10 and Mulga Creeks. Sediments mapped as Qha comprise red and orange gravel, sand, silt and clay, with a large proportion of the bedload being red sand reworked from adjacent aeolian sands by water and wind erosion.

STRUCTURAL HISTORY AND GEOPHYSICS

Exposures of the Gawler Craton are confined to scattered outcrops on Kingoonya and northwestern Bon Bon. To the northeast the craton is buried by increasing thicknesses of younger cover, from Late Proterozoic to Cainozoic in age, hence its geophysical response is greatly subdued (Fig. 16). The tectonic interpretation of the craton on KINGOONYA (see Tectonic Sketch) therefore relies heavily on geophysical interpretation.

Detailed aeromagnetic surveys covering much of Kingoonya (Fig. 18) indicate the importance of northwesterly, northeasterly and north-south faulting in the Gawler Craton. These fault trends bound areas of low magnetic response attributed to thick Tarcoola and Labyrinth Formations in graben-like troughs. Zones of disorientated, high frequency anomalies on the central part of the sheet have been drill-tested in several localities, where they are demonstrably due to basic volcanics of the Konkaby Basalt (Gawler Range Volcanics); these zones are also bounded by the three fault sets. These faults are likely to have been important controlling structures during Middle Proterozoic sedimentation and volcanism, and may have been inherited from structures imposed during the Kimban Orogeny and possibly from those of the earlier Sleafordian Orogeny. A broad gravity high coincides with the area of outcropping and near surface Gawler Craton rocks on Kingoonya.

Magnetic anomalies associated with Hutchison Group iron formation outcrops have limited extent, indicating that the iron formation (and Hutchison Group?) was either originally a thin or discontinuous sequence, or was extensively eroded before the Middle Proterozoic. Mulgathing Complex on Kingoonya displays two aeromagnetic patterns: a prominent east to east-northeasterly alignment, with some anomaly trends persisting for tens of kilometres, is likely to represent interlayered Kenella and Christie Gneisses, with horizons of metabasic rocks and magnetite-bearing gneiss; and very subdued zones, such as that in the southwestern corner of the sheet, probably indicate the presence of Glenloth Granite. A large northeast-trending magnetic anomaly in the southwest quadrant of Kingoonya is tentatively attributed to a basic or ultrabasic intrusive, which has been downfaulted on the northern side of a northwesterly-trending fault which traverses it (see Tectonic Sketch). Its age is uncertain; it may be a Mulgathing Complex metabasic body or a Kimban Orogeny intrusive.

Petrographic examination of samples from the Archaean -Early Proterozoic Mulgathing Complex (Christie Gneiss) on TARCOOLA indicate that they have suffered prograde granulite-facies metamorphism estimated by Daly (1986a) as having occurred under conditions of 700-800°C and 7-9kb. This event is referred to as the Sleafordian Orogeny, dated at 2500-2400 Ma. A variable, northeasterly to east-southeasterly trending penetrative gneissic fabric is developed.

A single drillhole into a concealed block of shallow basement on northern Eba recovered little-deformed and weakly metamorphosed volcanics radiometrically dated as Arcahean (2558 Ma; Mulgathing Complex). These rocks contrast with the strongly deformed and metamorphosed remainder of the Mulgathing Complex on Kingoonya. The volcanics have not undergone the deep burial and high-grade metamorphism attributed to the Sleafordian and Kimban Orogenies in other basement regions on the northwestern Gawler Craton and may be an erosional (?fault block) remnant of a younger portion of the Mulgathing Complex not preserved elsewhere.

The Hutchison Group, of which only a few iron formation outcrops are known on KINGOONYA, was deposited on the Mulgathing Complex probably between 1960 and 1840 Ma (Fanning et al., 1988). The Kimban Orogeny deformed both these units at ca 1700-1580 Ma, and involved retrograde metamorphism, shearing and recrystallisation of the Mulgathing Complex, folding and variable metamorphism of the Hutchison Group, and intrusion of granitoid bodies, some of which were themselves deformed by later phases of the orogeny. Metamorphic conditions were estimated at 600-700°C and 4-6kb by Daly (1986a) on TARCOOLA. Mineral assemblages within Hutchison Group iron formations on KINGOONYA indicate metamorphism of greenschist to amphibolite grade, at somewhat lower temperatures (ca 300-700°) than indicated for TARCOOLA. Folding styles in the Hutchison Group vary from nearly isoclinal to very open (no fold hinges visible).

The latest Early Proterozoic and early Middle Proterozoic on KINGOONYA are marked by the deposition of two intracratonic sedimentary sequences separated by a period of faulting and erosion; the extrusion of basic and acid volcanics, most of which appear to postdate the sediments; and the later intrusion of granitoids, believed comagmatic with the volcanics. It represents a period of vigorous tectonic activity spanning the period 1660-1585 Ma. Outcrops of these units are few in number and isolated, and a detailed reconstruction of the Middle Proterozoic history of the area is not yet possible.

Outcrops of the oldest sequence on KINGOONYA and TARCOOLA, the Tarcoola Formation, define an east-west belt which may reflect the trend of the original depositional basin. Conglomerate at the base of the unit on Wallabyng Range contains only chemically and physically resistant, generally well-rounded clasts such as quartz, jasper and banded iron formation, and represents high-energy deposition of material eroded from nearby basement including Hutchison Group. This locality appears to reflect local deposition in a depression adjacent to an elevated area of iron formation, which is evident in outcrop to the east. The majority of the Tarcoola Formation on KINGOONYA is composed of a mature quartzite. Crossbedding is ubiquitous, indicating significant current activity during deposition, while the generally mature nature of the sediments is a result of vigorous or prolonged winnowing, possibly in a braided fluvial or shallow marine shelf environment.

An episode of crustal compression followed deposition of the Tarcoola Formation, as evidenced by reverse faulting at Mount Eba (Fig. 4). A number of north-south trending faults postdate this thrusting at Mount Eba, but predate the deposition of the overlying Labyrinth Formation; these faults show dominantly vertical movement.

Uplift of the Tarcoola Formation, prior to erosion and deposition of the Labyrinth Formation, appears to have only involved gentle tilting. The angle of discordance between the bedding in the two units of Mt Eba and Rocky Hill is less than 15°, and a major folding episode is not indicated.

The basal unit of the Labyrinth Formation is a stromatolitic and laminated chert (Ey_1), probably deposited in a shallow marine or lacustrine environment within a tectonically stable environment with little or no clastic input. The sudden resurgence of tectonic activity shortly afterwards resulted in the deposition of immature cross-bedded sandstone and polymict conglomerate (Ƀy_3) which makes up the bulk of the observed Labyrinth Formation. This unit probably represents rapid deposition of poorly-sorted debris in an alluvial fan environment where both fluviatile and debris-flow mechanisms operated, perhaps as a result of major block faulting. The clast suite of the conglomerate indicates erosion of Tarcoola Formation, Hutchison Group iron formation and reworking of the basal chert Ƀy_1. However, the source of stromatolitic limestone and dolomite clasts in the conglomerate is uncertain as no similar rocks outcrop nearby. They could be either unsilicified representatives of Ƀy_1 or equivalents of the Hutchison Group, analogous to the carbonate intervals contained within the Group on eastern Eyre Peninsula (Parker and Lemon, 1982).

Local volcanic activity associated with deposition of the Labyrinth Formation is represented by a lens of rhyolite (Ƀy_2) on Mount Eba and interbedded volcanics south of Mount Eba and in the subsurface on northeastern Kingoonya.

Following deposition of the Labyrinth Formation, a major deformational and folding event affected the region. Both the Tarcoola Formation and Labyrinth Formation display near-vertical northeasterly-trending cleavage, which infers megascopic upright folding, the only observed evidence for which on KINGOONYA is an arcuate series of outcrops south of Mount Eba (Fig. 4). Locally a second cleavage, or a crenulation of the first cleavage, is present in finer-grained sediments. This deformation event, together with the thrusting and tilting affecting the Tarcoola Formation, can possibly be attributed to waning phases of the Kimban Orogeny, which continued until ca 1580 Ma on TARCOOLA.

The Gawler Range Volcanics were extruded during a relatively short span of time around 1592 Ma. The outcrops on KINGOONYA are generally isolated, and are not known to be overlain by Tarcoola or Labyrinth Formation. It is suggested that they were deposited on and around a pre-existing topography developed on these formations and older rocks, although they may be in part time-equivalent to the Labyrinth Formation. The deformation suffered by the Tarcoola and Labyrinth Formations may be a result of crustal adjustment prior to or coinciding with the extrusion of the large volume of Gawler Range Volcanics, which themselves are block tilted. Following soon afterwards was the intrusion of granitoid bodies assigned to the 1600-1585 Ma Hiltaba Suite. These are considered comagmatic with the Gawler Range Volcanics.

Later in the Middle Proterozoic, clastics of the Pandurra Formation were deposited over virtually the entire KINGOONYA sheet area at about 1420 Ma. These sediments were largely eroded from the main mass of Gawler Range Volcanics south of the sheet area. The abundant kaolin content of the Pandurra Formation is indicative of the stripping of a weathered carapace from the Gawler Range Volcanics, developed during an extended period of exposure. Interpretation of aeromagnetic and gravity data (see Tectonic Sketch) indicates the presence of a system of northeasterly and northwesterly trending faults which delineate isolated blocks of shallow basement within areas more deeply covered by Pandurra Formation. It is believed (Cowley, in prep., a) that most of the faulting which now delineates the Pandurra Formation postdates its deposition but limited drilling on KINGOONYA leaves open the possibility of significant syndepositional faulting in this region. In either case, the faults are probably inherited from earlier northwest and northeast trends. Shallow basement on Kingoonya is linked by a northeasterly trend of relatively shallowly-buried basement to an isolated block (described previously) without Pandurra Formation cover on the northern boundary of Eba. Relatively shallowly-buried blocks are also interpreted on southeastern Vivian and northeastern Parakylia.

An episode of northeast-southwest-directed extension postdating deposition of the Pandurra Formation resulted in the intrusion of the northwest-trending Gairdner Dyke Swarm throughout much of KINGOONYA. Although concealed, they give rise to sharp, low-amplitude linear aeromagnetic anomalies. This event finalised the cratonisation of the Gawler Craton. Tectonic activity from this time (ca 1070 Ma) until the present has been limited to gentle tilting, subsidence and faulting, and all sediments are essentially flat-lying.

Adelaidean and Cambrian sedimentation took place on a stable platform, termed the Stuart Shelf, on the northeastern portion of the Gawler Craton. A transgressive-regressive-transgressive succession is indicated for the Adelaidean Wilpena Group. Gentle southeastward tilting and erosion of the Adelaidean sequence prior to Cambrian sedimentation resulted in the Andamooka Limestone resting on successively older members of the Tent Hill Formation from southeast to northwest.

A northwest-trending straight line of small hills of Arcoona Quartzite Member extends from near Arcoona Cave Dam to southeast of The Knoll on <u>Younghusband</u>. The Cambrian Andamooka Limestone appears to lap out against these hills near Arcoona Cave Dam, and the line of hills thus represents an isolated instance of faulting occurring between deposition of these two units. The normally flat-lying Arcoona Quartzite Member shows moderate dips on these hills, usually directed away from the crest of each individual hill. In a road cutting 3.6 km south of Marshalls Swamp, the quartzite dips at up to 45° away from a central disrupted and ferruginised area under the highest part of the hill. Evidence of both east and west-dipping thrust faulting is present but poor exposure limits observations. On other hills of this trend, fine veins of quartz and chalcedony (not seen elsewhere) support an origin for these hills by faulting. An origin by a simple thrust fault is not likely, as a shallowing-dipping fault would tend to have a sinuous, rather than straight, outcrop trace in flat terrain. Instead, the inferred thrust faults and "domed" hills are interpreted as features localised at the pre-Andamooka Limestone palaeosurface, and resulting from horizontal compression concentrated on a single northwest-trending near-vertical fracture. This linear feature coincides with a magnetic anomaly interpreted as a dyke of the Gairdner Dyke Swarm, and it is possible that the fracture or fault propagated upwards through the Adelaidean sediments from this dyke. The gentle sagging of the Adelaidean sequence, as portrayed on section A-A′, may be the cause of the compressive stress in the upper part of this brittle cover.

Minor syndepositional faulting within the Carboniferous-Permian Arckaringa Basin is inferred along a north-south lineament defined by a chain of lakes passing through 13 Mile Dam on central <u>Parakylia</u>. Boorthanna Formation to the west displays a 30° southwesterly dip and extensive reworking in response to this faulting. Faulting, possibly postdating the Stuart Range Formation, is thought responsible for the differences in depth of the Stuart Range Formation - Boorthanna Formation contact in Dampier MC-1 and MC-3 on northeastern Eba (see section B-B'). This faulting episode may also be responsible for the undulating dips of the Curdlawidny Siltstone Member at Red Lake.

KINGOONYA is located near the probable southwestern depositional limit of the Jurassic-Cretaceous Eromanga Basin. These sediments are believed to have been deposited onto older units here in response to elevated sea level and regional subsidence centred on northeastern South Australia, following a protracted period of exposure and weathering which provided the kaolin within the Algebuckina Sandstone. Uplift and erosion of the Gawler Ranges to the south of KINGOONYA is considered responsible for the sudden influx of acid porphyry clasts to the Mount Anna Sandstone Member. A further period of exposure and weathering followed deposition of the Bulldog Shale.

The Tertiary and Quaternary history of the KINGOONYA area is one of continued stability, but with an overall trend of slow uplift and erosion-redeposition contrasting with the subsidence and widespread deposition of the Mesozoic. Thin continental sediments deposited early in the Tertiary were uplifted, eroded and redeposited in the mid-Tertiary relatively close to their source. These later sediments in turn have been redistributed into Pleistocene and Holocene fluvial and lacustrine deposits, again without appreciable large scale lateral transport, as well as into aeolian sands.

Most of the lineaments and interpreted faults are portrayed on the Palaeogeographic Sketch are taken from aerial photographs, but several show relative movement from interpretation of mapping data. The set of northwest-trending faults near and southwest of Moondiepitchnie Hill (Parakylia) are inferred to postdate the Miocene Mirikata Formation, appearing to uplift this unit in steps from about 120m ASL at Moondiepitchnie Water to over 170m ASL elevation north of Hudson trig point. Independent evidence of movement is given by an outcrop of Millers Creek Dolomite Member south of Moondiepitchnie Water which, at 130m ASL, has been uplifted 15m above the remainder of the Member on southern Parakylia. A north-south fault near Open Hill on southern Vivian has juxtaposed Algebuckina Formation and Bulldog Shale, with eastern-side-down movement. It can be extrapolated about 50km northwards to a fault near Hudson trig point, where it is inferred to have moved in the opposite sense. A low-angle west-dipping fault was noted within Bulldog Shale 5.5km west-southwest of The Lookout (Eba), but the amount and sense of movement could not be ascertained. Bulldog Shale and Algebuckina Sandstone are also juxtaposed by an inferred east-west fault north of "Gosses" O.S. This fault may be pre-Tertiary in age as the level of the Munjena Formation outcrops to the west is not disrupted. Air-photo lineaments interpreted as faults bound the southwestern margin of the Munjena Formation plateau south of "Big Tank" O.S.

ECONOMIC GEOLOGY

Recorded mineral and fossil fuel exploration on KINGOONYA commenced in 1959 and is summarised in Table 2. It can be divided into three phases, based on the commodities sought and the level of activity. The earliest phase, lasting until 1976, is characterised by spasmodic exploration for a variety of commodities.

Increased activity followed the announcement, in 1976, of the discovery of the Olympic Dam Cu-Au-Ag-U orebody, with virtually all the KINGOONYA area under exploration licences from 1976 to 1983. During this second period, knowledge of the subsurface geology was greatly expanded, with over one hundred diamond and percussion holes drilled and several aeromagnetic surveys flown, mainly in the investigation of geophysical anomalies for Olympic Dam-style mineralisation. This work has made the evaluation of the subsurface geology of KINGOONYA much more accurate. Until Western Mining Corporation released details of the geology of Olympic Dam, companies were "blindly" drilling magnetic and gravity anomalies, at times guided by erroneous presumptions of the stratigraphic level they should be investigating. Later in this second phase, some exploration was directed towards coal, uranium, diamonds and precious and base metals.

The third phase of exploration, from 1984 to the present, has been marked by a much lower level of activity, with very little drilling being carried out. Exploration for diamonds was the most common pursuit.

Figure 17 illustrates the coverage of Special Mining Leases and Exploration Licences for KINGOONYA; geophysical surveys are located on Figure 18, and a summary of drillhole stratigraphic data appears as Table 3.

Groundwater

The occurrence and prospects of groundwater on KINGOONYA have been the subject of many reports (Jack, 1930; Ward, 1946; Anderson, 1949; O'Driscoll, 1952a and b; Bleys, 1958; Ker, 1963; Clarke and Fennell, 1979), underlining the essential role groundwater supplies play in the pastoral industry here. Over 600 wells and bores are present on the sheet area.

The most important aquifer on KINGOONYA is formed by the Cretaceous Cadna-owie Formation and underlying Jurassic Algebuckina Sandstone (Fig. 10). In this area, it has only a tenuous connection with the Great Artesian (Eromanga) Basin of the northeast of the State, and is non-artesian and mostly unconfined. The following hydrological summary is extracted largely from data presented in Clarke and Fennell (1979).

On northeastern KINGOONYA where the aquifer is partly confined by Bulldog Shale, consistent supplies of stock water (3 000-12 000 mg/l total dissolved solids) can be obtained. Better quality water is present where intake of surface water is concentrated by swamps, watercourses and other low-lying areas, and around the margins of the discontinuous impervious Bulldog Shale cover. Supplies are generally less than 50 kl/day, and are often much lower.

On the southwestern and central portions of KINGOONYA, the aquifer is unconfined, being largely covered by unconsolidated Tertiary and Quaternary sediments. Yields in this region are mostly less than 30 kl/day. Water quality is highly variable, with local patches of low salinity water closely related to surface recharge points such as swamps and creeks. For example, numerous bores and wells in low-lying areas between Kingoonya and "North Well" and near Paynters Well NE produce up to 550 kl/day of water of salinity less than 5 000 mg/l, with most under 3 000 mg/l. Several wells and bores near Marshall Hill and south of "Mt Vivian" (Vivian) which produce water of less than 1 500 mg/l may be tapping lenses of fresh water which have drained off nearby flat-lying impervious outcrops of silcreted sandstone (Tm).

Areas near the Kingoonya Palaeochannel are characterised by highly saline groundwater. Drilling for water supplies for construction of the new Stuart Highway (Read, 1982; Sibenaler, 1982) encountered salinities exceeding 100 000 mg/l southeast of "Mulga Well" O.S. (Vivian). These bores produced up to 440 kl/day from highly porous gypsum beds of probable Pleistocene age.

Groundwater supplies of low salinity are scarce on eastern KINGOONYA, where the Algebuckina Sandstone and Cadna-owie Formation aquifer is largely absent. In the northwestern part of this area, useful supplies (100-140 kl/day) of stock quality (7 000-12 000 mg/l) water are extracted from the Boorthanna Formation. Elsewhere, salinities range from 10 000 to 25 000 mg/l, except for a few wells tapping thin lenses of fresher water within Andamooka Limestone or Boorthanna Formation immediately below swamps or depressions.

Some difficulty has been encountered proving a source of potable water for the new township of Glendambo (Read, 1981, 1987). Eventually a limited supply of 1 600 mg/l water was discovered to replace the previous 4 600 mg/l supply; as this new well is very near the township, there is a distinct risk of pollution or salinisation. Pastoral homesteads on KINGOONYA generally rely on the collection of rainwater for human consumption.

Iron ore

Two outcrops of banded iron formation on Kingoonya have been evaluated for their potential for iron ore. The outcrop 12 km west-northwest of "Big Tank" O.S., termed by Whitten (1958) the Hicks Hill Prospect, was estimated to contain 1 million tons of

34-35% Fe above plain level, while the Big Tank Prospect, 3 km southwest of Mount Eba was not considered worthy of further investigation (Whitten, 1960). Low grade and tonnage together with isolation make these deposits currently uneconomic (Whitten, 1962).

Copper, Nickel, Chromium, Platinoids and Diamonds

Ultrabasic rocks penetrated in SADME ERD-3 and CRA DD88ME-2 (Kingoonya), although unmineralised, may be indicative of the subsurface presence of more widespread ultrabasic intrusions, with potential for copper, nickel, chromium, platinoids and diamonds.

Elevated chromium values (maximum 280 ppm; Palmer, 1989) in conglomeratic quartzite of the Tarcoola Formation at Wallabyng Range may be due to chromite eroded from ultrabasic rocks within basement; alternatively it may be related to the presence of green mica (?fuchsite) as noted at Mt Eba.

Despite extensive company exploration over most of the KINGOONYA sheet (Table 2) and the scattered occurrence of indicator minerals, only two microdiamonds have been recovered, from loam samples collected from 5 km southeast of Mt Paisley and 2 km northwest of Playfords Dam No.14 (Parakylia).

Tin and Gold

The Glenloth area (Blissett, 1985) on northeastern GAIRDNER and the Earea Dam area (Crettenden, 1989) on southeastern TARCOOLA have intermittently produced gold and tin from quartz veins and greisens of probable Hiltaba Suite derivation, intruding Glenloth Granite and Kenella Gneiss (Mulgathing Complex). Subsurface Mulgathing Complex on western Kingoonya (see Tectonic Sketch) may also host gold-tin mineralisation.

Anomalous tin values (maximum 230 ppm) recovered form conglomeratic quartzite on Wallabyng Range (Palmer, 1989) probably reflect cassiterite eroded from nearby basement rocks.

Copper, Lead and Zinc

Lead-zinc mineralisation is known from Hutchison Group carbonates and graphitic rocks on Eyre Peninsula (Parker, 1987), which are considered to be facies equivalents of the iron formations in this area. It is possible that analogous facies variants of the correlative iron formations on Kingoonya and Bon Bon are present nearby in the subsurface. Traces of chalcopyrite, covellite and galena were recorded from near the base of the Andamooka Limestone in Kennecott/Samedan Playford 1 (Warne, 1979). Asarco (Australia) Pty Ltd (1972) obtained 4400 ppm Pb and 280 ppm Cu from sand and limonite spoils from Birthday Bore, east of "Mt Eba", as well as weakly anomalous analyses from several other bores on KINGOONYA.

Olympic Dam-style Copper-Gold-Silver-Uranium Deposits

Cowley and Fanning (in prep.) identified several areas on eastern KINGOONYA in which depth to magnetic basement is of the order of 1000m. These may have potential for Olympic Dam-style deposits, as does the basement block around DP-1, where magnetic basement may also be as shallow as 275m below the surface.

Topaz and related minerals

Several samples of greisenised Hiltaba Suite microgranite and Tarcoola Formation quartzite collected during mapping from northeast of Lake Labyrinth contain topaz and/or fluorite. Limited petrological and geochemical sampling did not reveal the presence of cassiterite, wolframite or gem topaz; however, this area has not been adequately tested.

Samedan of Australia reported 0.2-0.3% W (0.25-0.38% WO_3) from granite collected from well spoils and small quarries on southwestern BILLA KALINA (David, 1978). This granite, assigned to the Balta Granite (Hiltaba Suite equivalent) by Ambrose and Flint (1981b) is likely to be present at shallow depth on northwestern Bon Bon.

Coal and Oil Shale

Limited potential exists on northern KINGOONYA for small deposits of coal or oil shale within the Arckaringa Basin sequence.

The Stuart Range Formation is interpreted to be non-marine in the Mulgathing Trough on TARCOOLA (Dewhurst, in Daly, 1981), and may also be non-marine and therefore coal-prospective on KINGOONYA.

Sub-bituminous coal deposits are known within the overlying Mt Toondina Formation on COOBER PEDY and WINTINNA (Hibburt, 1984), and thin coal beds have been recorded from the formation on eastern TARCOOLA (Samedan BDH-1 and BDH-2, Daly, 1985), but the formation is not known from KINGOONYA.

Oil shale has been discovered within Stuart Range Formation and Mt Toondina Formation in four drillholes on WARRINA and BILLA KALINA. Yields are usually in the order of 5-15 l/t, but some samples were believed to have the potential to yield greater than 300 l/t of high quality oil (Moore, 1982). The oil shale facies was considered to follow the marine/non-marine transition, which is located near the base of the Mt Toondina Formation here, but is possibly within the Stuart Range Formation on KINGOONYA. No analyses for oil shale have been carried out on KINGOONYA.

Extensive drilling on northern KINGOONYA indicates a relatively thin sequence of Arckaringa Basin sediments. A narrow, deep trough akin to the Mulgathing Trough on TARCOOLA (Daly, 1981), preserving a greater thickness of Stuart Range Formation and perhaps also Mt Toondina Formation, may be present between the drillholes so far completed.

Opal

No production of precious opal has been recorded from the KINGOONYA sheet, although the geological setting on Eba and northeastern Bon Bon is similar to that near Coober Pedy. Several small diggings are known near Wingilpin Bluff and Mt Vivian (Eba), while a cluster of pits noted during field mapping 4.5 km southwest of "Mt Eba" may have been dug in the search for opal. Because opal exploration and mining have not been permitted in the Woomera Prohibited Area, considerable potential still exists.

Celestite

Williams (1972) reports two samples of celestite to have been collected from 26 km southwest of "Billa Kalina". This locality would be between "Millers Creek" and Millers Creek Woolshed.

Palygorskite

Palygorskite, an absorbent, Mg-rich clay, has been identified within the Millers Creek Dolomite and Billa Kalina Clay Members at Millers Creek plateau (Jessup and Norris, 1971; Ambrose and Flint, 1981a), and is likely to be also present within equivalent sediments of the Kingoonya Palaeochannel (Te-p). High potential for economic deposits is inferred for the equivalent Garford Formation in the Garford Palaeochannel on COOBER PEDY (Robertson, 1988) but the potential on KINGOONYA has not been evaluated.

Road sealing aggregate

Rhyolite has been extracted from a quarry in Ealbara Rhyolite located 21 km west of Glendambo (Pain, 1980). This material was used as crushed aggregate to seal much of the new Stuart Highway on KINGOONYA.

Roadmaking materials

Calcreted and ferruginous red-brown clayey sand (Qp_1 and Qp_2) were extracted for use in base course and earthworks for the new Stuart Highway (R.J. Foord, Highways Dept, pers. comm., 1986). These pits, located close to the highway, are now rehabilitated.

Clay

Gaskin and Samson (1951) documented an analysis of plastic white clay collected from 26 km south of "Mt Eba", but considered the deposit to be of minor interest only due to the high content of fine quartz sand and soluble salts. The widespread kaolinised weathering profile (KTb) within the Bulldog Shale nevertheless remains prospective for kaolin deposits.

"Aquarium Rock"

Corraberra Sandstone Member has undergone honeycomb weathering at the margins of Lakes Reynolds and Parakylia. Similar material has been collected from Lake Hart (GAIRDNER, Blissett, 1985) and sold as ornamental rock for aquariums.

TABLE 2

MINERAL AND FOSSIL FUEL EXPLORATION SUMMARY

OEL SML OR EL	COMPANY	PERIOD	SADME ENVELOPE	TARGET	METHODS	DRILLHOLES
OEL 12	Clarence River Basin Oil Exploration Co. N.L.	1959	51,52,55	oil, gas	c,d,e	–
OEL 34	North Australian Petroleum Co. Ltd.	1965-66	493	oil, gas	c,e,h	–
SML 83	Australian Development N.L.	1965-67	650	Sn, Au	e	–
SML 436/ 680/EL 56	Abadon Holdings N.L.	1970-74	1409, 2071, 2276	Au, Cu, Pb Zn	e,g	–
SML 581/ 622/EL 14	Utah Development Co.	1971-74	–	coal	x	–
–	Asarco (Aust.) Pty Ltd	1971	1880	Cu, Pb, Zn, U	d	–
EL 70	Dampier Mining Co. Ltd	1973	2320	U, V, Cu	a,r,t,u	MC-1-MC-4
224	Dampier Mining Co. Ltd	1976	2698	phosphate	d,r	P-1 – P-9
300/515	Carpentaria Exploration Co. Pty Ltd	1977-80	2980, 3444, 3609	Olympic Dam Cu-U-Au	b,j,k,l,m, n,p,r,t	BDM-1,2; WB-01
305	Newmont Pty Ltd/Dampier Mining Co. Ltd	1977-78	3031	Olympic Dam Cu-U-Au	i,l,m,r,s	SR-7, 9, 15
306	Dampier Mining Co. Ltd	1977-78	3030	Olympic Dam Cu-U-Au	a,e,l,m,s,t	LY-1
316	Carpentaria Exploration Co. Pty Ltd	1977-79	3034	Olympic Dam Cu-U-Au	c,e,j,k,l,m, r,t	CLK-1
325	Kennecott Explorations (Aust.) Ltd/Samedan Oil Corp.	1977-79	3002	Olympic Dam Cu-U-Au	b,c,m,p	–
333	Kennecott Explorations (Aust.) Ltd/Samedan Oil Corp.	1977-79	3002, 3067	Olympic Dam Cu-U-Au; U in Mesozoic	b,c,e,h,j, l,m,n,p,s. t (SADME)	Playford 1, Peeweena 1, Price's Bore 1
358	Australian Selection (Pty) Ltd	1978-79	3152	Olympic Dam Cu-U-Au	r,t	PRE-1

390	Carpentaria Exploration Co. Pty Ltd	1978-79	3236	Olympic Dam Cu-U-Au	a,b,d,l,m, r,t,u	Eba 1- Eba 3
399/693	Samedan Oil Corp.	1978-82	3293, 3537	U, coal	c,d,e,h,j,k, l,m,p	-
458	Carpentaria Exploration Co. Pty Ltd	1979-80	3509	Base of Ꞓ*p*(U?)	d,e,i,r,t	BB-1 - BB-4
554/966/1232)) 594/1007)) 711/1086)	Amoco Mineral Aust. Co./ Broken Hill Proprietary Co. Ltd	1980-84	3726,3822 4033	Cu, Pb, Zn; precious metals; diamonds	b,d,e,f,g,i j,k,l,m,p,r	KRP-1 - KRP-8; PK-1 - PK-38
592/987	Esso Exploration and Production Aust. Inc./	1980-82	3772	Olympic Dam Cu-U-Au	l,m,r	HN-1 - HN-3; HN-6 - HN-9
600/986	Esso Exploration and Production Aust. Inc. Stockdale Prospecting Ltd	1980-85	3784	Olympic Dam Cu-U-Au; diamonds	f,g,h,i,l,m, o,r,s	DP-1, 2
607/988	Esso Exploration and Production Aust. Inc.	1980-82	3786	Olympic Dam Cu-U-Au	l,m,o	-
628/1015	Esso Exploration and Production Aust. Inc./ Aquitaine Aust. Minerals Pty Ltd	1980-82	3878	Olympic Dam Cu-U-Au	l,m,o,s,t	SSR-1001
680/1045	Esso Exploration and Production Aust. Inc.	1980-83	3942	Olympic Dam Cu-U-Au	m,o	-
710	Afmeco Pty Ltd	1980-82	3992	Olympic Dam Cu-U-Au; U in Ꞓ*p*	j,k,m,p	-
752	Santos Ltd	1980-82	4005	Sn, Au, Mo, U, Ni	x	-

774	Shell Co. of Aust. Ltd	1981-83	4113	Olympic Dam Cu-U-Au	i,l,m,s,t	RL-1
796/1120) 797/1121) 798/1122) 799/1123) /1347)	Agip Australia Pty Ltd/ Stockdale Prospecting Ltd	1981-87	4272, 6498, 6499, 6500, 6833	coal; Olympic Dam Cu-U-Au; diamonds	a,b,c,d,f,g j,k,l,m,p,q, r,t	MS-1-MS-4, MS-6,7,10,13, 16,17,20,22, SH-1-SH-11, SH-14,16,17, 20, 22-24, 26,27,37-39, DH-1,2,4,9-11
811/1143	Esso Exploration and Production Aust. Ltd	1981-82	4249	Olympic Dam Cu-U-Au	l,m,o	-
860/1167	Stockdale Prospecting Ltd	1981-86	4345	diamonds	a,b,c,e,f, g,l	-
941	Aquitaine Aust. Minerals Pty Ltd	1982	4541	Olympic Dam Cu-U-Au	c,p	-
1089	CRA Exploration Pty Ltd	1982-85	6128	diamonds; Olympic Dam Cu-U-Au	c	-
1184/1277	CRA Exploration Pty Ltd	1983-	----------------CONFIDENTIAL------------------			DD87/88HN1, PD87HN-2,3
1218	CRA Exploration Pty Ltd	1984	5587	Volcanics within Tarcoola Fmn.	x	-
1224	BHP Minerals Ltd	1984-85	5547	diamonds; Olympic Dam Cu-U-Au	j,k,l,m,p,r	PHH-1 - PPH-5
1315	CRA Exploration Pty Ltd	1986-	----------------CONFIDENTIAL------------------			DD88ME-2
1315(part)	CRA Exploration Pty Ltd	1986-1989	8155	Witwatersrand Au-U; Alligator River U	d,l	-

OEL	Oil Exploration Licence
SML	Special Mining Lease
EL	Exploration Licence
SML436/680/EL 56	Subsequent renewals of same area (or part thereof)

a	photogeology	l	ground magnetic survey
b	LANDSAT Study	m	gravity survey
c	geological reconnaissance/ interpretation	n	ground radiometric survey
		o	EM soundings
d	rock or well/bore cuttings sampling	p	geophysical interpretation
		q	auger drilling and sampling
e	geological mapping	r	rotary/percussion drilling and sampling
f	stream sediment sampling		
g	soil sampling	s	diamond drilling and sampling
h	water sampling	t	geophysical borehole logging
i	petrology	u	palynology
j	aeromagnetic survey	x	no work carried out on KINGOONYA
k	airborne radiometric/VLF survey		

NOTE: Further information is available from Metallic Exploration Index Series plans 79-881A,B,C,D and F (available from SADME).

TABLE 3

DRILLHOLE STRATIGRAPHIC SUMMARY

DRILLHOLE OR WATERBORE	EL	AMG COORDINATES	(ZONE 53)	APPROX. ELEVATION COLLAR (m)	STRATIGRAPHIC UNIT	DEPTH TO BASE (m)	THICKNESS (m)
MC-1	70	590138	6674805	124	Kc	6	6
					CPs	68	62
					CPb	116	48+
MC-2	70	588620	6674558	129	Kc	16	16
					CPs	48	32
					CPb	108	60+
MC-3	70	588533	6675236	127	Kc	14	14
					CPs	38	24
					CPb	96	58+
MC-4	70	584155	6672759	140	Q+Kmb	14	14
					Kc	28	14
					CPb	106	78+
P-1	224	634337	6615833	122	Q	5	5
					Tmw	15	10+
P-2	224	631657	6624775	107	Q	2	2
					Tmi	5	3
					Tmw	10	5
					Ꞓac	25	15
					Ꞓa	43	18+
P-3	224	632784	6620963	115	Tmi	6	6
					Tmw	19	13
					Ꞓac	32	13
					Ꞓa	34	2+
P-4	224	636209	6609889	120	Q	4	4
					Tmw	19	15
					Ꞓa	59	40
					Ᵽwx	84	25
					Ᵽws	99	15+
P-5	224	637598	6605300	115	Q	4	4
					Tmw	24	20
					Ꞓa	50	26+
P-6	224	638531	6602339	110	Tmw	16	16
					Ꞓa	45	29
					Ᵽws	50	5+
P-7	224	623478	6611403	118	Q	6	6
					?CPb	16	10
					Ꞓa	52	36
					Ᵽws	56	4+

P-8	224	619135	6619821	119	Tmi	2	2
					Tml	9	7
					Єac	24	15
					Єa	52	28
					Ꝑws	58	6+
P-9	224	612875	6620260	119	Tmi	6	6
					Єac	18	12
					Єa	40	22
					Ꝑws	49	9+

****

BDM-1	300	622720	6604728	109	Q	3	3
					Єa	16	13
					Ꝑws	48	32
					Ꝑwc	56	8
					Ꝑwt	244	188
					Ꝑwe	266	22
					Ꝑp	400	134+
BDM-2	300	622506	6608728	114	Q	3	3
					?CPb	9	6
					Єa	42	33
					Ꝑws	81	39
					Ꝑwc	96	15
					Ꝑwt	278	182
					Ꝑwe	294	16
					Ꝑp	400	106+
WB-01	300	635019	6584325	137	Kmb	9	9
					Ꝑws	52	43
					Ꝑwc	56	4
					Ꝑwt	72	16+
SR-7	305	513313	6679744	165	Kmb	15.9	15.9
					Ja	34.1	18.2
					Ꝑy$_5$	67.2	33.1+
SR-9	305	513188	6678515	165	Kmb	12.3	12.3
					Ja	49.9	37.6
					CPb	68.2	18.3
					Ꝑy$_5$	90.5	22.3+
SR-15	305	513293	6677310	165	Kmb	24.8	24.8
					Ja	47.0	22.2
					CPs	70.5	23.5
					CPb	104.5	34.0
					Ꝑy$_5$	111.5	7+

****

LY-1	306	584940	6584244	137	?Q	8	8
					?Tm	9	1
					Ꝑp	675	666+

****

CLK-1	316	594262	6672572	129	TmI+Tm	6	6
					Kc	16	10
					CPs	53	37
					CPb	152	99+

****

PRICES BORE 1	333	612656	6658434	109	CPb	48	48
					Ꞓa	118	70
					Ᵽws	140.6	22.6
					Ᵽwt	363.4	222.8
					Ᵽp	499.5	136.1+
PEEWEENA 1	333	620437	6674526	99	Q	1.3	1.3
					CPb	42	40.7
					Ꞓa	120	78
					Ᵽwt	324.3	204.3
					Ᵽp	652.6	328.3+
PLAYFORD 1	333	640089	6662826	103	CPb	33	33
					Ꞓa	155	122
					Ᵽwt	437.79	282.8
					Ᵽwn	438.18	0.4
					Ᵽp	586	147.8+
PRE-1	358	630535	6644151	112	Q	8	8
					CPb	50	42
					Ꞓa	130	80
					Ᵽws	178	48
					Ᵽwc	190	12
					Ᵽwt	200	10+

****

EBA-1	390	566900	6645394	150	Q	4	4
					Tm	~~1~~8	4
					Ja	26	18
					Ᵽwt	124	98
					Ᵽp	400	276+
EBA-2	390	561605	6665734	178	Kmb	40	40
					Ja	52	12
					CPs	68	16
					CPb	140	72
					Ᵽwt	150	10
					Ᵽp	400	250+
EBA-3	390	539025	6664223	191	Kmb	40	40
					Ja	68	28
					CPs	140	72
					CPb	250	110
					Ᵽp	400	150+

****

BB-1	458	535722	6600452	138	Q	8	8
					Te-p	40	32
					Ja	66	26
					?Ᵽp	72	6
					Ᵽa$_3$	94	22+

BB-2	458	536588	6608725	138	Q	11	11
					Te-p	41	30
					Ja	66	25
					Ᵽy_4	112	46
					Ᵽa_1	124	12
					Ᵽa_3	138	14
					Ᵽy_4	200	62+
BB-3	458	542155	6615443	150	Q	6	6
					Ja	55	49
					Ᵽy_4	280	225+
BB-4	458	539649	6612742	142	Q	1	1
					Ja	43	42
					Ᵽy_4	296	253
					Ᵽa_1	304	8+
********							
KRP-1	554/966	518810	6593131	147	Ᵽa_1	104	104+
KRP-2	554/966	512593	6594695	158	Q	2	2
					Ja	50	48
					?Ᵽ*p*	96	46
					Ᵽa_3	100	4+
KRP-3	554/966	515141	6595393	149	Q	4	4
					Ja	24	20
					Ᵽa_1	58	34+
KRP-4	554/966	506837	6581228	133	Q	18	18
					AᵽP*mc*	200	182+
KRP-5	554/966	507108	6580931	133	Q	18	18
					AᵽP*mc*	80	62+
KRP-6	554/966	525274	6595067	137	Q	8	8
					Ᵽa_1	58	50+
KRP-7	594/1007	518187	6610214	128	Q	3	3
					Te-p	18	15
					Ᵽa_1	80	62+
KRP-8	594/1007	518227	6609807	127	Q	6	6
					Te-p	22	16
					Ᵽa_1	138	116+
********							
PK-1	554/966	517218	6595317	145	Q	2	2
					Ᵽa_3	16	14+
PK-2	554/966	517226	6595505	145	Ᵽa_3	22	22+
PK-3	554/966	515254	6596921	147	Ja	12	12
					Ᵽa_3	30	18+
PK-4	554/966	515394	6596939	147	Q	2	2
					Ja	22	20
					Ᵽa_3	38	16+
PK-5	554/966	515089	6596919	147	Q	1	1
					Ja	20	19
					Ᵽa_3	24	4+
PK-6	554/966	503195	6600720	137	Q	3	3
					Ᵽa_3	22	19+

PK-7	554/966	507219	6601793	136	Q		1	1
					₽a$_3$		12	11
					₽γh		16	4+
PK-8	554/966	507223	6601585	136	Q		2	2
					₽a$_3$		14	12
					₽γh		22	8+
PK-9	554/966	514524	6604781	130	Q		18	18+
PK-10	554/966	514512	6604974	130	Q		16	16
					Te-p		24	8+
PK-11	554/966	520793	6600108	125	Q		2	2
					Te-p		30	28+
PK-12	554/966	520795	5599895	125	Q		2	2
					Te-p		16	14
					?₽y_3		20	4+
PK-13	554/966	525597	6602830	120	Q		15	15
PK-14	711/1086	530649	6599958	135	Q		6	6
					Te-p		27	21+
PK-15	711/1086	530629	6600135	135	Q		9	9
					Te-p		26	17+
PK-16	711/1086	529174	6600014	135	Q		12	12
					Te-p		30	18+
PK-17	711/1086	529168	6599864	135	Q		12	12
					Te-p		24	12+
PK-18	711/1086	592128	6600174	135	Q		12	12
					Te-p		33	21+
PK-19	554/966	528075	6608479	139	Q		18	18
					₽a$_3$		30	12+
PK-20	554/966	528044	6608349	139	Q		14	14
					₽a$_3$		27	13+
PK-21	554/996	528032	6608697	139	Q		10	10
					₽a$_3$		33	23+
PK-22	594/1007	526665	6610330	145	Q		10	10
					?₽y		36	26+
PK-23	594/1007	526863	6610434	145	Q		8	8
					?Ja		28	20
					₽a$_3$		30	2+
PK-24	594/1007	519498	6611658	144	Q		16	16+
PK-25	594/1007	519498	6611655	144	Q		18	18+
PK-26	594/1007	519507	6611518	144	Q		8	8+
PK-27	594/1007	519513	6611790	144	Q		18	18
					Te-p		21	3+
PK-28	594/1007	522299	6609659	132	Q		18	18
					₽γh		30	12+
PK-29	594/1007	519498	6611655	144	Q		18	18
					₽a$_1$+₽γh	₽a$_1$ → 24m, ₽γh → 33m	33	15+
PK-30	711/1086	533991	6597084	128	Q		4	4
					Ja		10	6
					₽a$_1$		36	26+

PK-31	711/1086	534989	6603932	143	Q	20	20
					Te-p	32	12
					Єa$_1$	42	10+
PK-32	711/1086	539477	6613362	144	Q	4	4
					Ja	9	5+
PK-33	711/1086	539464	6613197	144	Q	4	4
					Ja	9	5+
PK-34	711/1086	539455	6613489	144	Q	4	4
					Ja	39	35+
PK-35	711/1086	537299	6605285	138	Q	11	11
					Te-p	30	19+
PK-36	711/1086	538820	6602794	151	Q	4	4
					Єa$_3$	22	18+
PK-37	711/1086	538602	6604077	160	Q	6	6
					Єa$_1$	34	28+
PK-38	554/966	533129	6592635	152	Q	2	2
					Ja	42	40+

****

HN-1	592	514422	6680868	168	Q+Kmb	10	10
					Є*h*	60	50+
HN-2	592	514441	6680546	168	Q+Kmb	14	14
					Ja	22	8
					Єβ_3	48	26+
HN-3	592	514459	6681109	168	Q+Kmb	8	8
					Є*h*	60	52+
HN-6	592	514422	6680242	168	Q+Kmb	17	17
					Ja	32	15
					Є*h*	36	4+
HN-7	592	514378	6679910	168	Q+Kmb	14	14
					Ja	43	29
					Єy_5	72	29+
HN-8	592	514409	6680077	168	Q+Kmb	15	15
					Ja	38.5	23.5
					Є*h*	42	3.5+
HN-9	592	514407	6679661	168	Q+Kmb	14	14
					Ja	48	34
					CPs	55	7
					CPb	61	6
					Єy_5	78	17+

****

DP-1	600/986	581104	6679291	150	Q+K+CP	166	166
					A*v*	616.6	450.6+
DP-2	600/986	581057	6675290	139	Q+K+CP	204.5	204.5
					Є*p*	860	655.5+

****

SRR-1001	628/1015	628900	6587200	141	Q	6	6
					Ᵽws	43.6	37.6
					Ᵽwc	60.9	17.3
					Ᵽwt	215.71	154.81
					Ᵽwe	240.65	24.94
					Ᵽwn	242.39	1.74
					Ᵽp+Ᵽβ_3	499.5	257.11+

****

RL-1	774	602529	6644983	122	Q+Tmi+CPb	22.6	22.6
					Ꞓa	70	43.4
					Ᵽwt	236.9	166.9
					Ᵽwn	238.2	1.3
					Ᵽp+Ᵽβ_3	674.6	436.4+

****

MS-1	797/1121	537556	6649960	186	Q	0.3	0.3
					Kmb	31.3	31
					Ja	68.7	37.4
					CPs	70	1.3
					CPb	90	20+
MS-2	797/1121	534059	6631130	167	Q	5	5
					Ja	50	50
					?CPb	99	49+
MS-3	798/1122	542845	6637780	160	Q	3	3
					Ja	33.6	30.6
					CPs	72	38.4
					CPb	108	36+
MS-4	797/1121	549302	6651858	187	Kmb	39	39
					Ja	70.5	31.5
					CPs	83	12.5
					CPb	89	6+
MS-6	797/1121	560108	6651932	163	Q	2	2
					Kmb	10.8	8.8
					Ja	36	25.2
					CPb	100.6	64.6
					Ᵽwt	109	8.4+
MS-7	797/1121	552194	6647414	169	Kmb	15.5	15.5
					Ja	40.7	25.2
					CPb	78	37.3+
MS-10	797/1121	554311	6642944	155	Q	3	3
					Ja	34	31
					CPb	42	8
					Ᵽwt	57	15+
MS-13	797/1121	573669	6642301	190	Kmb	41.4	41.4
					Ja	68	26.6
					Ᵽwt	78	10+
MS-16	797/1121	550846	6633551	155	Q	1.1	1.1
					Ja	6	4.9
					Ᵽp	21	15+

MS-17	797/1121	564281	6637270	148	Q	2	2
					Tm	3	1
					Ja	20	17
					CPb	22	2
					Pwt	40	18
					Pp	72.2	32.2+
MS-20	797/1121	578518	6637322	154	Q	5	5
					Kmb	10.8	5.8
					Ja	40	29.2
					CPb	138	98+
MS-22	797/1121	564101	6632285	150	Q	1	1
					?Tm	5	4
					Ja	42	37+
SH-1	798/1122	579196	6662083	188	Q	0.2	0.2
					Kmb	27.5	27.3
					Ja	58.9	31.4
					CPs	97.9	39
					CPb	114.3	16.4+
SH-2	798/1122	523952	6656996	189	Q	1.1	1.1
					Kmb	32.7	31.6
					Ja	63.3	30.6
					CPs	106.9	43.6
					CPb	154	47.1+
SH-3	798/1122	528546	6653941	188	Kmb	30.2	30.2
					Ja	62.2	32
					CPs	104.1	41.9
					CPb	149.8	45.7+
SH-4	798/1122	531460	6639980	172	Q	4	4
					Kmb	5.8	1.8
					Ja	43.2	37.4
					CPs	106.2	63
					CPb	120	13.8+
SH-5	798/1122	519476	6640083	162	Kmb	4.2	4.2
					Ja	49.6	45.4
					CPs	63	13.4+
SH-6	798/1122	512505	6649783	187	Kmb	31.2	31.2
					Ja	71.6	40.4
					CPs	156	84.4+
SH-7	798/1122	527444	6667496	185	Kmb	32.5	32.5
					Ja	64.4	31.9
					CPs	87.5	23.1
					CPb	150	62.5+
SH-8	798/1122	532759	6667883	190	Kmb	41.6	41.6
					Ja	72.2	30.6
					CPs	84	11.8+
SH-9	798/1122	542074	6668643	182	Kmb	37.2	37.2
					Ja	65.7	29.5
					CPs	72	6.3+

SH-10	798/1122	545018	6670091	171	Q	0.4	0.4
					Kmb	35.6	35.2
					Ja	59.2	23.6
					CPs	162	102.8+
SH-11	798/1122	533158	6662327	178	Kmb	20.8	20.8
					Ja	56.5	35.7
					CPs	60	3.5+
SH-14	798/1122	548119	6662694	183	Kmb	31	31
					Ja	56.9	25.9
					CPs	138	81.1
					CPb	144	6+
SH-16	798/1122	543949	6657366	173	Q	4	4
					Kmb	15.3	11.3
					Ja	48	32.7
					CPs+CPb	66	18+
SH-17	798/1122	548565	6656717	178	Q	0.3	0.3
					Kmb	26	25.7
					Ja	57.5	31.5
					CPs	80.5	23
					CPb	97	16.5+
SH-20	798/1122	559182	6656952	185	Q	2.4	2.4
					Kmb	36.5	34.1
					?Ja+CPb	116	79.5+
SH-22	798/1122	533778	6672283	182	Q	1	1
					Kmb	37.1	36.1
					Ja	69	31.9
					CPs	96	27
					CPb	108	12+
SH-23	798/1122	537541	6669951	175	Q	0.2	0.2
					Kmb	28	27.8
					Ja	55	27
					CPs	66	11+
SH-24	798/1122	548606	6666997	168	Q	2.2	2.2
					Kmb	21.7	19.5
					Ja	47.6	25.9
					CPs	54	6.4+
SH-26	798/1122	534226	6679172	192	Kmb	46	46
					Ja	73	27
					CPs	162	89+
SH-27	798/1122	543798	6678194	195	Q	0.4	0.4
					Kmb	54	53.6
					Ja	78.5	24.5
					CPs	130	51.5+
SH-37	798/1122	515101	6657026	169	Kmb	11.1	11.1
					Ja	50.3	39.2
					CPs	54	3.7+

SH-38	798/1122	510336	6667427	179	Kmb	17.4	17.4
					Ja	51.9	34.5
					CPs	92.2	40.3
					CPb	102	9.8+
SH-39	797/1121	510755	6631032	148	Q	9.8	9.8
					Ja	26	16.2
					CPs	34.5	8.5
					CPb	54	19.5+

* * *

DH-1	799	618512	6675981	103	Q	0.75	0.75
					ЄPb	54.5	53.75
					Єa	68	13.5+
DH-2	799	618473	6676174	105	Q	4.5	4.5
					CPb	54	49.5
					Єa	87.5	33.5+
DH-4	799	618512	6676377	107	Q	4.5	4.5
					CPb	54.5	50
					Єa	93.5	39+
DH-9	799	629045	6676377	110	Q	1.5	1.5
					CPb	129	127.5+
DH-10	799	629295	6676236	107	Q	3	3
					CPb	138	135
					Єa	138.5	0.5+
DH-11	799	628944	6676541	112	Q	4.5	4.5
					CPb	69	64.5+

* * *

PHH-1	1224	603522	6579789	130	Q	8	8
					Te-p	16	8+
PHH-2	1224	603540	6579995	130	Q	6	6
					Te-p	12	6+
PHH-3	1224	602763	6579118	130	Q	4	4
					Te-p	39	35+
PHH-4	1224	602755	6579263	130	Q	4	4
					Te-p	7	3+
PHH-5	1224	602790	6578991	130	Q	6	6
					Te-p	20	14+
DD88ME-2	1315	501912	6607712	122	Q	3	3
					Te-p+Ja	72	69
					Ꝑβ_1	112.9	40.9
					Ꝑa_4	158.1	45.2
					Ꝑβ_1	302.5	144.4+

* * *

ERD-1	-	518180	6603230	130.8	Q	16	16
					Te-p	21	5
					Ꝑa_3	39.5	18.5+
ERD-2	-	519660	6601430	121.2	Q	2.5	2.5
					Te-p	5	2.5
					Ꝑy_3	17	12+

ERD-3	–	520360	6600390	123.8	Q	3	3
					Te-p	9.5	6.5
					₽β_2	48	38.5+
ERD-4	–	531010	6596980	130.8	Q	9	9
					Te-p	10.5	1.5
					₽a_3	18	7.5+
ERD-5	–	527540	6598650	125.0	Q	4	4
					Te-p	80	76
					₽y_3	91.6	11.6+
ERD-6	–	533870	6595200	133.2	Q	4	4
					Ja	44	40
					₽p	111	67+
ERD-7	–	536530	6595840	122.6	Q	2	2
					Te-p	10	8
					Ja	34	24
					₽p	126	92+
ERD-8	–	525270	6598650	122.6	Q	10	10
					₽y_3	69.33	59.33+
ERD-9	–	521370	6598890	127.4	Q	5	5
					Te-p	6	1
					₽β_3	24.3	18.3+

****

5936WW74	–	546644	6603376	142	Q	3	3
					Ja	30.5	27.5
					₽p	86.6	56.1+
6036WW36	–	584598	6617210	147	Q	3.7	3.7
					Ja	37.8	34.1
					CPs	74.1	36.3
					CPb	75.9	1.8+
6036WW72	–	570910	6621315	152	Q	1.2	1.2
					Ja	45.4	44.2
					CPs	53	7.6
					CPb	54.3	1.3+
6036WW78	–	565232	6616842	165	Q	5.5	5.5
					Ja	26.2	20.7
					CPs	61	34.8
6036WW81	–	565203	6613965	151	Q	3.7	3.7
					Ja	31.4	27.7
					CPs	46.3	14.9+
6036WW97	–	550834	6589312	149	Q	1.2	1.2
					Ja	21.6	20.4
					₽p	84.4	62.8+
6036WW101	–	583687	6572455	150	Q	1.5	1.5
					Tm	3.4	1.9
					Ja	16.8	13.4
					₽p	30.5	13.7+

6036WW116	–	551797	6591972	134	Q	9	9
					Ja	27	18
					Ᵽp	30	3+
6036WW117	–	549329	6594940	130	Q	3	3
					Ja	20	17
					Ᵽp	24	4+
6036WW118	–	548785	6596514	141	Q	3	3
					Ja	24	21
					Ᵽp	80	56+
6036WW119	–	549873	6594654	130	Q	6	6
					Te-p	20	14
					Ja	27	7
					Ᵽp	36	9+
6036WW121	–	553785	6585350	130	Q	6	6
					Ja	24	18
					Ᵽp	60	36+
6036WW131	–	566147	6581299	133	Q	9	9
					Te-p	35	26
					Ᵽp	36	1+
6036WW133	–	574648	6573547	152	Q+Tm	3	3
					Ja	33	30
					Ᵽβ_3	72	39+
6036WW134	–	574648	6573547	152	Q+Tm	3	3
					Ja	33	30
					Ᵽp	72	39+
6036WW135	–	552516	6583828	130	Q	9	9
					Te-p	26	17+
6036WW136	–	552534	6583021	128	Q	3	3
					Te-p	21	18+

****

6037WW34	–	594355	6666137	117	Q	3	3
					Kc	4.6	1.6
					?CPb	140.5	135.9
					?Ᵽws	169.8	29.3
					?Ᵽwt	171.5	1.7+
6037WW35	–	588620	6661272	130	Q	4.6	4.6
					?Tmi	7.6	3
					?Tml	9.4	1.8
					Kc	40.8	31.4
					CPb	126.1	85.3
					Ᵽwt	148.4	22.3+
6037WW70	–	576882	6666938	150	Q	0.6	0.6
					Kmb	11	10.4
					Ja/Kc	24.4	13.4
					CPs	51.2	26.8
					CPb	93	41.8+

6037WW72	-	560645	6670135	181	Q	5.2	5.2
					Kmb	35.4	30.2
					?CPs	38.4	3
					?CPb	96.9	58.5+
6037WW118	-	595605	6650956	130	Q	3.4	3.4
					Kc	13.2	9.8
					CPs	19.3	6.1
					CPb	61.6	42.3+
6037WW133	-	588415	6660957	130	Q	3	3
					Kc	20	17
					CPb	106	86+
6137WW29	-	602783	6636624	108	Q	0.9	0.9
					CPb	25.9	25
					Ꞓac	26.5	0.6
					Ꞓa	42	15.5
					Ᵽwc	49.3	7.3
					Ᵽwt	53.6	4.3+
6137WW30	-	602167	6639242	113	Q	3.7	3.7
					CPb	26	22.3
					Ᵽwc	29.4	3.4+

NOTE:
1) Q = undifferentiated Quaternary.
2) Holes without EL listed are either SADME holes (ERD-1 to 9) or water bores.
3) Water bores listed are those used on cross-sections together with selected bores giving useful stratigraphic data. Numbers are abbreviations of those used in the SADME Bore General File.
4) Stratigraphic interpretations by W M Cowley; many holes (including water bores) have been relogged.
5) AMG coordinates digitised from best available location plans (except ERD-1 to 9, surveyed).
6) Elevations estimated from topographic contour plans (except ERD-1 to 9, surveyed).

BIBLIOGRAPHY

A complete bibliography of the KINGOONYA 1:250 000 sheet area can be obtained from the SAMREF database, which can be queried at this Department, or can be accessed on-line through INFO-ONE International (formerly CLIRS Information Services).

AGIP Australia Pty Ltd, 1981. Exploration Licences 796-9, Arckaringa Basin, South Australia. Report for the quarter ended 11th December, 1981. South Australia. Department of Mines and Energy. Open file Envelope, 6498: 11-141 (unpublished).

Alley, N.F., 1983. Palynology of selected Cainozoic samples from Tarcoola 1:100 000 sheet. South Australia. Department of Mines and Energy. Report Book, 83/76.

Alley, N.F., 1985. Preliminary report on the palynostratigraphy of SADME Toodla No.1 well, southwestern Eromanga Basin. South Australia. Department of Mines and Energy. Report Book, 85/55.

Alley, N.F., 1986a. Preliminary palynostratigraphy of SADME Finniss 2 well, southwestern Eromanga Basin. South Australia. Department of Mines and Energy. Report Book, 86/20.

Alley, N.F., 1986b. Permian palynofloras from SADME Bulgunnia 1 and 2 wells, Arckaringa Basin. South Australia. Department of Mines and Energy. Report Book, 86/88.

Alley, N.F., 1987. Palynological dating and correlation of Late Jurassic and Early Cretaceous sediments around part of the southern margin of the Eromanga Basin. South Australia. Department of Mines and Energy. Report Book, 87/59.

Ambrose, G.J., 1980. Southern Eromanga Basin Excursion. South Australia. Department of Mines and Energy. Report Book, 79/143.

Ambrose, G.J., Callen, R.A. and Flint, R.B., 1979. Eucalyptus fruits in stratigraphic context in Australia. Nature, 280(5721): 387-389.

Ambrose, G.J. and Flint, R.B., 1981a. A regressive Miocene lake system and silicified strandlines in northern South Australia: implications for regional stratigraphy and silcrete genesis. Geological Society of Australia. Journal, 28: 81-94.

Ambrose, G.J. and Flint, R.B., 1981b. BILLA KALINA, South Australia. Sheet SH/53-7. South Australia. Geological Survey. 1:250 000 Geological Series - Explanatory Notes.

An, Z., Bowler, J.M., Opdyke, N.D., Macumber, P.G. and Firman, J.B., 1986. Palaeomagnetic stratigraphy of Lake Bungunnia: Plio-Pleistocene precursor of aridity in the Murray Basin, southeastern Australia. Palaeogeography, Palaeoclimatology, Palaeoecology, 54: 219-240.

Anderson, C.G., 1978a. Magnetic and gravity interpretation on the Kingoonya 1:250 000 sheet. South Australia. Department of Mines and Energy. Report Book, 78/80.

Anderson, C.G., 1978b. Magnetic interpretation in the northwestern Stuart Shelf area, South Australia. South Australia. Geological Survey. Quarterly Geological Notes, 68: 4-7.

Anderson, C.G., 1980. Magnetic and gravity interpretation on the Stuart Shelf. Australian Society of Exploration Geophysics. Bulletin, 11(3): 115-120.

Anderson, E., 1949. Report on the geology and hydrology of the area north and northwest of Tarcoola covered by L.R.W.O. reconnaissance trip April-May 1949. South Australia. Department of Mines. Report Book, 25/177.

Asarco (Australia) Pty Ltd, 1972. Bore material-survey and analysis. South Australia. Department of Mines and Energy. Open file Envelope 1880: 415-436 (unpublished).

Babbage, B.H., Warburton, P.E. and Burtt, A.P., 1858. Northern Explorations. Reports from Messrs Babbage and Warburton, and Police Trooper Burtt, on exploration into the north and northwestern interior of South Australia. South Australia. Parliamentary Papers, 151.

Baglin, G.R. and David, L.J., 1977. Progress report for EL 333, Billa Kalina, South Australia, for the period July 1 to September 30, 1977, for Samedan Oil Corporation. South Australia. Department of Mines and Energy. /*Open file Envelope, 3067: 9-54 (unpublished).

Bailey, D.P. and Hungerford, H.N., 1982. Reedy Lagoon EL 774. Quarterly report for period ending 12th October, 1982, for The Shell Company of Australia Limited - Metals Division. South Australia. Department of Mines and Energy. Open file Envelope, 4113: 126-173 (unpublished).

Balme, B.E., 1980. Palynology and the Carboniferous-Permian boundary in Australia and other Gondwana continents. Palynology, 4: 43-55.

Barker, I.C., 1980. The Geology of the Coober Pedy Opalfield, with special reference to the precious opal deposits. University of Adelaide. M.Sc. thesis. South Australia. Department of Mines and Energy. Open file Envelope, 3697 (unpublished).

Barker, I.C., Barnes, L.C. and Benbow, M.C., 1979. The Russo Beds. South Australia. Geological Survey. Quarterly Geological Notes, 71: 2-7.

Barnes, L.C. and Pitt, G.M., 1976a. The Mirackina Conglomerate. South Australia. Geological Survey. Quarterly Geological Notes, 59: 2-6.

Barnes, L.C. and Pitt, G.M., 1976b. The Tallaringa Palaeodrainage System. South Australia. Geological Survey. Quarterly Geological Notes, 59: 7-10.

Barnes, L.C. and Pitt, G.M., 1976c. Silcretes, sediments and stratigraphy. South Australia. Department of Mines. Report Book, 76/119.

Belperio, A.P. (compiler), in prep. The Quaternary. in Handbook of South Australian Geology, revised edition. Geological Survey of South Australia.

Benbow, M.C., 1983. COOBER PEDY, South Australia. Sheet SH/53-6. South Australia. Geological Survey. 1:250 000 Geological Series - Explanatory Notes.

Benbow, M.C., 1986. TALLARINGA, South Australia. Sheet SH/53-5. South Australia. Geological Survey. Geological Atlas, 1:250 000 series.

Benbow, M.C., 1988. Tertiary coastal dunes of the Eucla Basin, Australia. South Australia. Department of Mines and Energy. Report Book, 88/69.

Benbow, M.C. and Pitt, G.M., 1978. The Garford Formation. South Australia. Geological Survey. Quarterly Geological Notes, 68: 8-15.

Bennett, C.J., 1968. Preliminary report on 1:250 000 scale photogeological maps of KINGOONYA, GAIRDNER, YARDEA and CHILDARA sheet areas. South Australia. Department of Mines. Report Book, 67/98.

BHP Minerals Ltd., 1983. BHP - Amoco Minerals Joint Venture. Exploration Licences 711, 966 and 1007, Kingoonya, South Australia. Final Report. South Australia. Department of Mines and Energy. Open file Envelope, 3726: 199-325 (unpublished).

Binks, P.J. and Hooper, G.J., 1984. Uranium in Tertiary palaeochannels, "West Coast Area", South Australia. Australasian Institute of Mining and Metallurgy. Proceedings, 289: 271-275.

Bleys, C., 1958. Report on the prospects of obtaining additional groundwater, Parakylia station. South Australia. Department of Mines. Report Book, 46/129.

Blissett, A.H., 1980. CHILDARA, South Australia. Sheet SH/53-14. South Australia. Geological Survey. 1:250 000 Geological Series - Explanatory Notes.

Blissett, A.H., 1985. GAIRDNER, South Australia. Sheet SH/53-15. South Australia. Geological Survey. 1:250 000 Geological Series - Explanatory Notes.

Blissett, A.H. and Radke, F., 1979. The Gawler Range Volcanics - a regional review. in: Parker, A.J. (compiler). Symposium on the Gawler Craton - Extended Abstracts. Geological Society of Australia, South Australian Division: 45-48.

Bowering, O.J.W., 1975. A summary of the groundwater resources within the proposed study corridors - Stuart Highway Improvement Project. South Australia. Department of Mines. Report Book, 75/107.

Bowler, J.M., 1976. Aridity in Australia: age, origins and expression in aeolian landforms and sediments. Earth Science Reviews, 12: 279-310.

Bowler, J.M., 1982. Aridity in the late Tertiary and Quaternary of Australia. in: Barker, W.R. and Greenslade, P.J.M. (Eds.). Evolution of the Flora and Fauna of Arid Australia. Peacock Publications, Adelaide: 35-45.

Brown, H.Y.L., 1885. Report on geological character of country passed over from Port Augusta to Eucla. South Australia. Parliamentary Papers, 45.

Brown, H.Y.L., 1894. Report on the geology of the country along the route from Strangways Springs to Wilgena and on the gold discovery near Wilgena. in: Report of Government Geologist for the year ended June 30th, 1894. South Australia. Parliamentary Papers, 25: 10-12.

Brown, H.Y.L., 1899. Geological Map of South Australia. South Australia. Geological Survey. Maps of South Australia Series, 16 miles to 1 inch.

Brown, H.Y.L., 1905. Report on Geological Explorations in the west and northwest of South Australia. South Australia. Parliamentary Papers, 71.

Brown, R. and Steveson, B., 1978a. AMDEL Report GS 720/79 (unpublished).

Brown, R. and Steveson, B., 1978b. AMDEL Report GS 1890/79 (unpublished).

Callen, R.A., 1983. Late Tertiary "grey billy" and the age and origin of surficial silicifications (silcrete) in South Australia. Geological Society of Australia. Journal, 30: 393-410.

Callen, R.A. and Tedford, R.H., 1976. New Late Cainozoic rock units and depositional environments, Lake Frome area, South Australia. Royal Society of South Australia. Transactions, 100(3): 125-168.

Clarke, D.K. and Fennell, R.J., 1979. Kingoonya 1:250 000 sheet water well survey. South Australia. Department of Mines and Energy. Report Book, 79/137.

Clarke, J.D.A., 1986. Subdivision of the lower part of the Wilkawillina Limestone, eastern Flinders Ranges. South Australia. Geological Survey. Quarterly Geological Notes, 97: 12-17.

Cockburn, R., 1984. What's in a Name? Nomenclature of South Australia. Ferguson Publications, Adelaide.

Cooper, B.J., 1981. Carboniferous and Permian sediments in South Australia and their correlation. South Australia. Geological Survey. Quarterly Geological Notes, 79: 2-6.

Cooper, B.J., 1984. Palynology of trench samples from the region of Millers Creek Woolshed, KINGOONYA 1:250 000 sheet. South Australia. Department of Mines and Energy. Report Book, 84/24.

Cowley, W.M., 1990. Early Cambrian Andamooka Limestone and Yarrawurta Shale of the Stuart Shelf. South Australia. Department of Mines and Energy. Report Book, 90/17.

Cowley, W.M., in prep, a. The Pandurra Formation. in: Handbook of South Australian Geology, revised edition. Geological Survey of South Australia.

Cowley, W.M., in prep, b. Definition - Curdlawidny Siltstone Member of the Andamooka Limestone near 'Parakylia', west of Roxby Downs. South Australia. Geological Survey. Quarterly Geological Notes.

Cowley, W.M., in prep. c. Beda Volcanics and Backy Point Formation of the eastern Gawler Craton. South Australia. Department of Mines and Energy. Report Book.

Cowley, W.M. and Fanning, C.M., in prep. Weakly deformed, low grade Archaean volcanics near "Millers Creek", northeast of Kingoonya. South Australia. Geological Survey. Quarterly Geological Notes.

Cowley, W.M. and Martin, A.R., 1988. Kingoonya geophysical and stratigraphic drilling project: well completion report. South Australia. Department of Mines and Energy. Report Book, 88/81.

Cowley, W.M. and Martin, A.R., in prep. Definition - the Proterozoic Labyrinth Formation, north of Kingoonya. South Australia. Geological Survey. Quarterly Geological Notes.

Creaser, R.A., 1989. The geology and petrology of Middle Proterozoic felsic magmatism of the Stuart Shelf, South Australia. La Trobe University. Ph.D. thesis. (unpublished).

Crettenden, P.P., 1989. Geological investigations, Earea Dam Goldfield, South Australia. South Australia. Department of Mines and Energy. Report Book, 89/75.

Daily, B., 1976. The Cambrian of the Flinders Ranges. in: Thomson, B.P., Daily, B., Coats, R.P. and Forbes, B.G. Late Precambrian and Cambrian Geology of the Adelaide Geosyncline and Stuart Shelf, South Australia. 25th International Geological Congress. Excursion Guide, 33A.

Dalgarno, C.R. (compiler), 1982. ANDAMOOKA, South Australia, (second edition). Sheet SH/53-12. South Australia. Geological Survey. Geological Atlas, 1:250 000 series.

Daly, S.J., 1979. The Wilgena Hill Jaspilite. Proposed article for inclusion in Report of Investigations on ornamental stones of South Australia. South Australia. Department of Mines and Energy. Report Book, 79/28.

Daly, S.J., 1981. The stratigraphy of the TARCOOLA 1:250 000 sheet area. South Australia. Department of Mines and Energy. Report Book, 81/5.

Daly, S.J., 1983. Intracontinental Middle Proterozoic Sediments. *in*: South Australia - Exploration Potential. South Australia. Department of Mines and Energy. Open file Envelope, 5271 (unpublished).

Daly, S.J., 1984. Wilgena 1 stratigraphic drillhole, Tarcoola. South Australia. Geological Survey. Quarterly Geological Notes, 91: 3-9.

Daly, S.J., 1985. TARCOOLA, South Australia. Sheet SH/53-10. South Australia. Geological Survey. Geological Atlas, 1:250 000 series.

Daly, S.J., 1986a. The Mulgathing Complex. South Australia. Department of Mines and Energy. Report Book, 86/41.

Daly, S.J., 1986b. Excursion Guide, TARCOOLA 1:250 000 map sheet area. South Australia. Department of Mines and Energy. Report Book, 86/42.

Daly, S.J., 1988. Bulgunnia 1 and 2 Well Completion Report. South Australia. Department of Mines and Energy. Report Book, 88/38.

Daly, S.J., Benbow, M.C. and Blissett, A.H., 1979. Archaean to Early Proterozoic geology of the northwestern Gawler Craton. Geological Society of Australia. Journal, 27:47.

Daly, S.J., Parker, A.J. and Flint, R.B., 1986. Middle Proterozoic sediments of the Gawler Craton. Geological Society of Australia. Abstracts, 15:227.

Dampier Mining Co. Ltd., 1974. Millers Creek, EL 70. Reports for period 1/7/73 - 31/12/73. South Australia. Department of Mines and Energy. Open file Envelope, 2320 (unpublished).

Darlington, R.E., 1978. Exploration Licence No. 390 "Mount Eba". Progress report for quarter ended November 22, 1978, for Carpentaria Exploration Co. Pty Ltd. South Australia. Department of Mines and Energy. Open file Envelope, 3236: 8-33 (unpublished).

Darlington, R.E., 1979. Exploration Licence No. 390 "Mt Eba". Final report, for Carpentaria Exploration Co. Pty Ltd. South Australia. Department of Mines and Energy. Open file Envelope, 3236: 34-35 (unpublished).

Darlington, R.E., 1980. Exploration Licence No. 458 "Bon Bon". Progress report for the quarter ended December 29, 1978, for Carpentaria Exploration Co. Pty Ltd. South Australia. Department of Mines and Energy. Open file Envelope, 3509: 13-36 (unpublished).

David, L.J., 1978. Quarterly progress report for Exploration Licence 399, Bulgunnia, S.A., November 1978, for Samedan of Australia. South Australia. Department of Mines and Energy. Open file Envelope, 3293: 22-27 (unpublished).

Douglas, J.G. and Williams, G.E., 1982. Southern polar forests: the early Cretaceous floras of Victoria and their palaeoclimatic significance. Palaeogeography, Palaeoclimatology, Palaeoecology, 39: 171-185.

Emslie, D.P., 1983. Exploration Licence No. 986, Esso Joint Venture - report for the quarter ended 28th September, 1983, for Stockdale Prospecting Ltd. South Australia. Department of Mines and Energy. Open file Envelope, 3784: 503-525 (unpublished).

Esso Australia Ltd - Minerals Department, 1982. Exploration Licence 986 - Devils Playground. Report for the first quarter ending June 29, 1982. South Australia. Department of Mines and Energy. Open file Envelope, 3784: 443-495 (unpublished).

Esso Exploration and Production Australia Inc., 1985. Millers Creek Homestead, EL 600, 968. Reports for period 13/3/80 - 28/12/85. South Australia. Department of Mines and Energy. Open file Envelope, 3784 (unpublished).

Evans, P.R., 1969. Upper Carboniferous and Permian palynological stages and their distribution in eastern Australia. in: Gondwana Stratigraphy, 2. IUGS Symposium, Buenos Aires, 1-15 October 1967 (UNESCO, Paris): 41-54.

Fanning, C.M., 1984. AMDEL Report GS 5944/84 (unpublished).

Fanning, C.M., 1987a. AMDEL Report G 6861/87 (unpublished).

Fanning, C.M., 1987b. AMDEL Report G 6968/87 (unpublished).

Fanning, C.M., 1990. Single grain U-Pb zircon dating of two tuffaceous horizons from Wilgena #1. Australian National University. Research School of Earth Sciences. Prise Report, 89-020 (unpublished).

Fanning, C.M., Flint, .B., Parker, A.J., Ludwig, K.R. and Blissett, A.H., 1988. Refined Proterozoic evolution of the Gawler Craton, South Australia, through U-Pb zircon geochronology. Precambrian Research, 40/41: 363-386.

Fanning, C.M., Flint, R.B. and Preiss, W.V., 1983. Geochronology of the Pandurra Formation. South Australia. Geological Survey. Quarterly Geological Notes, 88: 11-16.

Farrand, M.G., 1986a. The petrography of eighteen rocks from the Gawler Craton near Kingoonya, South Australia. South Australia. Department of Mines and Energy. Report Book, 86/6.

Farrand, M.G., 1986b. Petrography of twenty three specimens from the Gawler Craton near Kingoonya, South Australia. South Australia. Department of Mines and Energy. Report Book, 86/64.

Farrand, M.G., 1986c. Petrography of forty two rocks from near Kingoonya. South Australia. Department of Mines and Energy. Report Book, 86/73.

Farrand, M.G., 1987. Petrography of sixteen rocks from the Kingoonya area. South Australia. Department of Mines and Energy. Report Book, 87/104.

Farrand, M.G., 1988. Petrology of outcrop and drillcore specimens from the Kingoonya district, South Australia. South Australia. Department of Mines and Energy. Report Book, 88/8.

Finlayson, B., 1981. Exploration of the Arckaringa Basin - outline of a work programme to upgrade knowledge of this Permian intracratonic basin. South Australia. Department of Mines and Energy. Report Book, 81/51.

Firman, J.B., 1969. in: Parkin, L.W. (Ed.). Handbook of South Australian Geology. Geological Survey of South Australia: 204-233.

Firman, J.B., 1981. Regional stratigraphy of the regolith on the southwest margin of the Great Australian Basin Province, South Australia. Flinders University, M.Sc. thesis. South Australia. Department of Mines and Energy. Report Book, 81/40.

Flint, R.B., in prep. Gairdner Dyke Swarm. in: Handbook of South Australian Geology, revised edition. Geological Survey of South Australia.

Flint, R.B., Ambrose, G.J. and Campbell, K.S.W., 1980. Fossiliferous lower Devonian boulders in Cretaceous sediments of the Great Australian Basin. Royal Society of South Australia. Transactions, 104(3): 57-65.

Forbes, B.G., 1968. Officer - Eucla Basin geological reconnaissance. South Australia. Department of Mines. Report Book, 67/97.

Forbes, B.G., 1977. Notes on the KINGOONYA 1:250 000 preliminary geological map. South Australia. Department of Mines. Report Book, 77/7.

Forbes, B.G., 1986. Margin of the Eromanga Basin, South Australia: a review. in: Gravestock, D.I., Moore, P.S. and Pitt, G.M. (Eds.). Contributions to the geology and hydrocarbon potential of the Eromanga Basin. Geological Society of Australia. Special Publication, 12: 85-95.

Forbes, B.G., 1988. Pre-Mesozoic geology of the Curdimurka region. South Australia. Department of Mines and Energy. Report Book, 88/51.

Frakes, L.A. and Francis, J.E., 1988. A guide to Phanerozoic cold polar climates from high-latitude ice-rafting in the Cretaceous. Nature, 333(6173): 347-349.

Frakes, L.A. and Rich, P.V., 1982. Palaeoclimatic setting and palaeogeographic links of Australia in the Phanerozoic. in: Rich, P.V. and Thompson, E.M. (Eds.). The fossil vertebrate record of Australasia. Monash University. Offset Printing Unit: 27-52.

Freytag, I.B., 1966. Proposed rock units for marine Lower Cretaceous sediments in the Oodnadatta region of the Great Artesian Basin. South Australia. Geological Survey. Quarterly Geological Notes, 18: 3-7.

Gaskin, A.J. and Samson, H.R., 1951. Ceramic and refractory clays of South Australia. South Australia. Geological Survey. Bulletin, 28.

Gerdes, R.A., 1972. A helicopter gravity survey of the Gawler Platform. Mineral Resources Review, South Australia, 133: 137-145.

Giles, C.W., 1981. A comparative geochemical study of acid and basic volcanic rocks from drillholes DP-1, BD-1 and JD-1, Stuart Shelf, South Australia. in: South Australia. Department of Mines and energy. Open file Envelope, 3784 (unpublished).

Giles, C.W., 1988. Petrogenesis of the Proterozoic Gawler Range Volcanics, South Australia. Precambrian Research, 40/41: 407-427.

Giles, C.W., Goode, A.D.T. and Lemon, N.M., 1979. Middle Proterozoic volcanism and sedimentation on the northeastern Gawler Block. Geological Society of Australia. Journal, 27: 53.

Giles, E., 1889. Australia Twice Traversed. (facsimile reprint, Macarthur Press (Books) Pty Ltd, Sydney). Sampson Low, Marston, Searle and Rivington, London.

Greig, D., 1980. Exploration Licence 592, Hawks Nest, South Australia. Quarterly Report of exploration to South Australian Department of Mines and Energy for the period August 20 to November 19, 1980, for Esso Australia Limited - Exploration Department. South Australia. Department of Mines and Energy. Open file Envelope, 3772: 144-148 (unpublished).

Greig, D., 1981. Exploration Licence 592, Hawks Nest, South Australia. Quarterly report of exploration to South Australian Department of Mines and Energy, for the period ending February 19, 1981, for Esso Australia Ltd - Minerals Department. South Australia. Department of Mines and Energy. Open file Envelope, 3772: 149-154 (unpublished).

Griffiths, M., 1980. Well Completion Report, Toodla No. 1. South Australia. Department of Mines and Energy. Report Book, 80/128.

Harris, W.K., 1966. New and redefined names in South Australian Lower Tertiary stratigraphy. South Australia. Geological Survey. Quarterly Geological Notes, 20: 1-3.

Harris, W.K., 1970. An Upper Jurassic microflora from the western margin of the Great Artesian Basin, South Australia. South Australia. Geological Survey. Quarterly Geological Notes, 35: 3-8.

Heath, G.R., 1965. Permian sediments of the Mt Dutton Inlier. South Australia. Geological Survey. Quarterly Geological Notes, 14: 3-5.

Hibburt, J.H., 1984. Review of exploration activity in the Arckaringa Basin region. South Australia. Department of Mines and Energy. Report Book, 84/1.

Haskins, P.G., 1983. EL 1015, Roxby Hill, South Australia. Final report, period ending 30/6/83, for Aquitaine Australia Minerals Pty Ltd. South Australia. Department of Mines and Energy. Open file Envelope, 3878: 108-127 (unpublished).

Idnurm, M. and Senior, B.R., 1978. Palaeomagnetic ages of Late Cretaceous and Tertiary weathered profiles in the Eromanga Basin, Queensland. Palaeogeography, Palaeoclimatology, Palaeoecology, 24: 263-277.

Jack, R.L., 1930. Geological structure and other factors in relation to underground water supply in portions of South Australia. South Australia. Geological Survey. Bulletin, 14.

Jackson, M.J. and van de Graaff, W.J.E., 1981. Geology of the Officer Basin, Western Australia. Bureau of Mineral Resources, Geology and Geophysics, Australia. Bulletin, 206.

James, N.P. and Gravestock, D.I., 1990. Lower Cambrian shelf and shelf margin carbonate buildups, Flinders Ranges, South Australia. Sedimentology, 37 (3): 455-480.

Jenkins, R.J.F. and Gravestock, D.I. (compilers), 1988. Proterozoic Ediacara Fauna and Cambrian Archaeocyatha of the Flinders Ranges, South Australia. 5th International Symposium on Fossil Cnidaria, Brisbane. Excursion Handbook, A2.

Jensen, A. and Wilson, A. 1980. An Environmental Profile Study of the Stuart Shelf - Central Tablelands - Western Sandplains-Nullarbor Plain region in South Australia. Assessments Section, South Australian Department for the Environment.

Jessup, R.W., 1951. Soils, geology and vegetation of northwestern South Australia. Royal Society of South Australia. Transactions, 74(2): 189-273.

Jessup, R.W. and Norris, R.M., 1971. Cainozoic stratigraphy of the Lake Eyre Basin and part of the arid region lying to the south. Geological Society of Australia. Journal, 18(3): 303-331.

Johns, R.K., 1955. Geological reconnaissance for Long Range Weapons Establishment, Mt Vivian, Parakylia and Bon Bon pastoral area. South Australia. Department of Mines. Report Book, 41/98.

Johns, R.K., 1968. Geology and mineral resources of the Andamooka-Torrens area. South Australia. Geological Survey. Bulletin, 41.

Johns, R.K., Hiern, M.N., Nixon, L.G., Forbes, B.G. and Olliver, J.G., 1981. TORRENS, South Australia (second edition). Sheet SH/53-16. South Australia. Geological Survey. Geological Atlas, 1:250 000 series.

Kemp, E.M., 1978. Tertiary climatic evolution and vegetation history in the southeast Indian Ocean region. Palaeogeography, Palaeoclimatology, Palaeoecology, 24: 169-208.

Kendall, G.W., 1966. Seismic refraction investigation of lake sediments in Lake Younghusband - Weapons Research Establishment. South Australia. Department of Mines. Report Book, 62/136.

Ker, D.S., 1963. Hydrology of the Great Artesian Basin in South Australia. A preliminary report. South Australia. Department of Mines. Report Book, 57/52.

Krieg, G.W., Forbes, B.G., Belperio, A.P., Rogers, P.A., Callen, R.A. and Macdonald, P.J., in prep. CURDIMURKA, South Australia, Sheet SH/53-8. South Australia. Geological Survey. 1:250 000 Series - Explanatory Notes.

Krinsley, D.B., Woo, C.C. and Stoertz, G.E., 1968. Geologic characteristics of seven Australian playas. in: Neal, J.T. (Ed.) Playa Surface Morphology: Miscellaneous Investigations. Air Force Cambridge Research Laboratories. Office of Aerospace Research. United States Air Force. Environmental Research Papers, 283.

Laut, P., Heyligers, P.C., Keig, G., Löffler, E. and Margules, C., 1977. Environments of South Australia. Province 7. Western Pastoral. CSIRO Division of Soils. Soils and Land Use Series, CSIRO, Canberra.

Lemon, N.M., 1972. A sedimentological approach to the geology of the Corunna area. University of Adelaide. B.Sc thesis (unpublished).

Lindsay, J.M., and Harris, W.K., 1975. Fossiliferous marine and non-marine Cainozoic rocks from the eastern Eucla Basin, South Australia. Mineral Resources Review, South Australia, 138: 29-42.

Ludbrook, N.H., 1966. Cretaceous biostratigraphy of the Great Artesian Basin in South Australia. South Australia. Geological Survey. Bulletin, 40.

Ludbrook, N.H., 1980. Non-marine molluscs from dolomitic limestones in the north of South Australia. Royal Society of South Australia. Transactions, 104(4): 83-92.

Mason, M.G., 1978a. Reedy Lagoon, EL 358. Fourth quarterly report, 17th July - 16th October, 1978, For Australian Selection (Pty) Ltd. South Australia. Department of Mines and Energy. Open file Envelope, 3152: 9-19 (unpublished).

Mason, M.G., 1978b. Portulacca Ridge, EL 291. Sixth quarterly report, 16th June to 15th September, 1978, for Australian Selection (Pty) Ltd. South Australia. Department of Mines and Energy. Open file Envelope, 2991: 43-61 (unpublished).

McCulloch, M.T., 1987. Sm-Nd isotope constraints on the evolution of Precambrian crust in the Australian continent. In: Kröner, A. (Ed.). Proterozoic Lithospheric Evolution. American Geophysical Union. Geodynamics Series, 17: 115-130.

Miller, G.C., 1982. Report on Exploration Licences 554, 594 and 711, Kingoonya, for Amoco Minerals Aust. Co. South Australia. Department of Mines and Energy. Open file Envelope, 4033: 9-70 (unpublished).

Miles, K.R., 1956. Report on reconnaissance geological survey of Oil Exploration Licence No. 12, South Australia, for Clarence River Basin Oil Exploration Co. N.L. South Australia. Department of Mines and Energy. Open file Envelope, 51 (unpublished).

Moore, P.S., 1982. Oil shale potential of the Arckaringa region. South Australia. Department of Mines and Energy. Open file Envelope, 4878: 729-738 (unpublished).

Moore, P.S., 1986. Jurassic and Triassic stratigraphy and hydrocarbon potential of the Poolowanna Trough (Simpson Desert region), northern South Australia. in: Gravestock, D.I., Moore, P.S. and Pitt, G.M. (Eds.). Contributions to the geology and hydrocarbon potential of the Eromanga Basin. Geological Society of Australia. Special Publication, 12: 39-52.

Moore, P.S. and Pitt, G.M., 1985. Cretaceous subsurface stratigraphy of the southwestern Eromanga Basin: a review. South Australia. Department of Mines and Energy. Special Publication, 5: 269-286.

Murrell, B., 1977. Stratigraphy and tectonics across the Torrens Hinge Zone. University of Adelaide. Ph.D thesis, (unpublished).

Nicol, G.J., 1979. The Tertiary geology of the Coward Cliff area between Lake Eyre and Lake Torrens, South Australia. South Australia. Department of Mines and Energy. Open file Envelope, 3600 (unpublished).

O'Driscoll, E.P.D., 1952a. Mount Eba water supply. South Australia. Department of Mines. Report Book, 34/32.

O'Driscoll, E.P.D., 1952b. Hydrology and geology of the Mt Eba district. South Australia. Department of Mines. Report Book, 34/88.

Offler, C.E., 1964. The plausibly coniferous shoots from the Mt Eba - Haggard Hill - Jacks Jill fossil plant assemblages of South Australia. Adelaide University, Botany Department. B.Sc. (Hons) thesis (unpublished).

Offler, C.E., 1969. The external morphology of extant and fossil vegetative shoots as a basis for palaeobotanical studies (exemplified by a study of silicified Tertiary floras from central South Australia). University of Adelaide, Botany Department. Ph.D. thesis. (unpublished).

Pain, A.M., 1980. Rhyolite sealing aggregate deposit, Kingoonya. South Australia. Department of Mines and Energy. Report Book, 80/113.

Pain, A.M. and Johnson, P.D., 1979. Potential sealing aggregate sites for the Stuart Highway. South Australia. Department of Mines and Energy. Report Book, 79/128.

Palmer, D.C., 1988. Tenth quarterly report for Mount Eba, EL 1315, South Australia, for the period ending 9th July, 1988, for CRA Exploration Pty Ltd. South Australia. Department of Mines and Energy. Open file Envelope, 6532: 178-240 (unpublished).

Palmer, D.C., 1989. Partial relinquishment report for Mt Eba EL 1315, South Australia, May 1989, for CRA Exploration Pty Ltd. South Australia. Department of Mines and Energy. Open file Envelope, 8155 (unpublished).

Parker, A.J., 1987. Archaean to Middle Proterozoic mineralisation of the Gawler Craton (including the Stuart Shelf region), South Australia. South Australia. Department of Mines and Energy. Report Book, 87/84.

Parker, A.J., Fanning, C.M., Flint, R.B., Martin, A.R. and Rankin, L.R., 1988. Archaean - Early Proterozoic granitoids, metasediments and mylonites of southern Eyre Peninsula, South Australia. Geological Society of Australia. Specialist Group in Tectonics and Structural Geology. Field Guide Series, 2.

Parker, A.J. and Lemon, N.M., 1982. Reconstruction of the Early Proterozoic stratigraphy of the Gawler Craton, South Australia. Geological Society of Australia. Journal, 29: 221-238.

Pitt, G.M., Benbow, M.C., Barnes, L.C., Harris, W.K. and Lindsay, J.M., 1978. Report on drilling in the Tallaringa Palaeodrainage System, 1976. South Australia. Department of Mines and Energy. Report Book, 78/38.

PNC Exploration (Aust.) Pty Ltd, 1985. Report for quarter ending 24th January, 1985. Exploration Licence 1058, Ealbara area, South Australia. South Australia. Department of Mines and Energy. Open file Envelope, 4943: 207-220 (unpublished).

PNC Exploration (Aust.) Pty Ltd, 1986. Report for quarter ending 24th January, 1986. Exploration Licence 1058, Ealbara area, TARCOOLA 1:250 000 sheet. South Australia. Department of Mines and Energy. Open file Envelope, 4943: 234-276 (unpublished).

Preiss, W.V., 1987a. Mid-Proterozoic stromatolites and stromatolite-like concretions from the Tarcoola Formation near Mount Eba. KINGOONYA 1:250 000 area. South Australia. Department of Mines and Energy. Report Book, 87/76.

Preiss, W.V. (compiler), 1987b. The Adelaide Geosyncline. Late Proterozoic stratigraphy, sedimentation, palaeontology and tectonics. South Australia. Geological Survey. Bulletin, 53.

Price, P.L., 1983. A Permian palynostratigraphy for Queensland. in: Permian Geology of Queensland. Geological Society of Australia, Queensland Division: 155-211.

Quilty, P.G., 1984. Mesozoic and Cainozoic history of Australia as it affects the Australian biota. in: Cogger, H.G. and Cameron, E.E. (Eds.). Arid Australia. Australian Museum, Sydney.

Radke, F., 1980. Petrology of 5 drill cutting samples. AMDEL report GS 4179/80 (unpublished).

Radke, F., 1986. AMDEL report G 6732/86 (unpublished).

Rankin, L.R., Flint, R.B. and Fanning, C.M., 1990. Palaeoproterozoic Nuyts Volcanics of the western Gawler Craton. South Australia. Department of Mines and Energy. Report Book, 90/60 (unpublished).

Read, R.E., 1981. Proposed township near Glendambo water supply project. South Australia. Department of Mines and Energy. Report Book, 81/80.

Read, R.E., 1982. Stuart Highway, Baker Well to Gosses section. Drilling for construction water. South Australia. Department of Mines and Energy. Report Book, 81/99.

Read, R.E., 1984. Stuart Highway, Gosses to Mirikata section. Drilling for construction water. South Australia. Department of Mines and Energy. Report Book, 84/85.

Read, R.E., 1987. Glendambo town water supply. 1985 and 1986 investigations. South Australia. Department of Mines and Energy. Report Book, 87/33.

Reeve, J.S., Cross, K.C., Smith, R.N. and Oreskes, N., 1990. The Olympic Dam copper-uranium-gold-silver deposit, South Australia. in: Hughes, F.C. (Ed.). Geology of the mineral deposits of Australia and Papua New Guinea. Australasian Institute of Mining and Metallurgy. Monograph Series, 14.

Rich, T.H.V. and Rich, P.V., 1988. Polar dinosaurs from south Australia. Episodes, 11(3): 223.

Richardson, N.A., 1925. The Pioneers of the North-West of South Australia, 1856 to 1914. Libraries Board of South Australia, Adelaide (facsimile edition).

Robertson, R.S., 1988. Reconnaissance sampling of palygorskitic clay in Garford Palaeochannel. Mineral Resources Review, South Australia, 156: 104.

Rutland, R.W.R., Parker, A.J., Pitt, G.M., Preiss, W.V. and Murrell, B., 1981. Precambrian of South Australia. in: Hunter, D.R. (Ed.). Developments in Precambrian Geology, 2. Precambrian of the Southern Hemisphere. Elsevier, Amsterdam.

Samedan of Australia, 1982. Bulgunnia, EL 399, 693. Reports for period 1/6/78 - 10/8/81. South Australia. Department of Mines and Energy. Open file Envelope, 3293 (unpublished).

Scheibnerova, V., 1971. Foraminifera and their Mesozoic biogeoprovinces. New South Wales. Geological Survey. Records, 13: 135-174.

Segnit, R.W., 1939. The Pre-Cambrian - Cambrian succession. The general and economic geology of these systems in portions of South Australia. South Australia. Geological Survey. Bulletin, 18.

Senior, B.R. and Mabbutt, J.A., 1979. A proposed method of defining deeply weathered rock units based on regional geological mapping in southwest Queensland. Geological Society of Australia. Journal, 26: 237-254.

Sibenaler, X.P., 1982. Stuart Highway water well replacement drilling program, Mulga Well area. South Australia. Department of Mines and Energy. Report Book, 82/8.

Specht, R.L., 1972. The Vegetation of South Australia (second edition). Government Printer, Adelaide.

Sprigg, R.C., 1953. Geological Map, South Australia. South Australia. Geological Survey. Maps of South Australia Series, 32 miles to 1 inch.

Stirton, R.A., Tedford, R.H. and Miller, A.H., 1961. Cainozoic stratigraphy and vertebrate palaeontology of the Tirari Desert, South Australia. South Australian Museum. Records, 15: 427-462.

Stuart, J.M., 1858. Mr Stuart's Exploration. Journal of an Expedition into the unexplored country to the Northwest and Southwest of Port Augusta. South Australia. Parliamentary Papers, 119.

The Broken Hill Proprietary Co. Ltd - Exploration Department, 1976. Exploration Licence 224. Portulacca Ridge Area, Andamooka, South Australia. South Australia. Department of Mines and Energy. Open file Envelope, 2698 (unpublished).

The Broken Hill Proprietary Co. Ltd, 1978a. Exploration Licence 306, Lake Younghusband, South Australia. Report for the quarter ended 30th March, 1978. South Australia. Department of Mines and Energy. Open file Envelope, 3030: 96-126 (unpublished).

The Broken Hill Proprietary Co. Ltd, 1978b. Exploration Licence 306, Lake Younghusband, South Australia. Final Report. South Australia. Department of Mines and Energy. Open file Envelope, 3030: 127-143 (unpublished).

Thomson, B.P., 1966. Stratigraphic relationships between sediments of Marinoan age - Adelaide Region. South Australia. Geological Survey. Quarterly Geological Notes, 20: 7-9.

Thomson, B.P., 1969. Precambrian Crystalline Basement. in: Parker, L.W. (Ed.). Handbook of South Australian Geology. Geological Survey of South Australia: 21-48.

Thomson, B.P. (compiler), 1980. Geological Map of South Australia. South Australia. Geological Survey. Maps of South Australia series, 1:1 000 000 scale.

Thomson, B.P., Forbes, B.G. and Daly, S.J., 1972. Preliminary report of sample area. Skylark 1081 Remote Sensing Project. South Australia. Department of Mines. Report Book, 72/43.

Threadgill, B., 1922. South Australian Land Exploration, 1856 to 1880. Board of Governors of the Public Library, Museum and Art Gallery of South Australia. Adelaide.

Tindale, N.B., 1940. Results of the Harvard-Adelaide Universities Anthropological Expedition, 1938-1939. Distribution of Australian Aboriginal tribes: a field survey. Royal Society of South Australia. Transactions, 64(1): 140-231.

Townsend, I.J., 1976. Stratigraphic drilling in the Arckaringa Basin, 1969-71. South Australia. Geological Survey. Report of Investigations, 45.

Townsend, I.J. and Ludbrook, N.H., 1975. Revision of Permian and Devonian nomenclature of four formations in and below the Arckaringa Basin. South Australia. Geological Survey. Quarterly Geological Notes, 54: 2-7.

Truswell, E.M. and Harris, W.K., 1982. The Cainozoic palaeobotanical record in arid Australia: fossil evidence for the origins of an arid-adapted flora. in: Barker, W.R. and Greenslade, P.J.M. (Eds.). Evolution of the Flora and Fauna of Arid Australia. Peacock Publications, Adelaide: 67-76.

van de Graaff, W.J.E., Crowe, R.W.A., Bunting, J.A. and Jackson, M.J., 1977. Relict Early Cainozoic drainages in arid Western Australia. Zeitschrift für Geomorphologie N.F. 21, 4: 379-400.

Veevers, J.J. (Ed.), 1984. Phanerozoic Earth History of Australia. Clarendon Press, Oxford.

Ward, L.K., 1946. The occurrence, composition, testing and utilisation of underground water in South Australia, and the search for further supplies. South Australia. Geological Survey. Bulletin, 23.

Ward, L.K., 1954. Fluorine in South Australian underground waters. South Australia. Geological Survey. Report of Investigations, 1.

Warne, S.B., 1979. Final report on EL 325 - Nickil area (Kennecott Exploration (Australia) Ltd) and EL 333 - Billa Kalina area (Samedan Oil Corporation), for Kennecott Explorations (Australia) Ltd and Samedan Oil Corporation. South Australia. Department of Mines and Energy. Open file Envelope, 3002: 28-123 (unpublished).

Webb, A.W., 1977. Geochronology of stratigraphically significant rocks from South Australia. Progress report No. 16, to 14 January 1977. South Australia. Department of Mines and Energy. Open file Envelope, 1689: 140-143 (unpublished).

Webb, A.W., 1978. Geochronology of the younger granites of the Gawler Craton and its northwest margin. AMDEL report No. 1215 for project 1/1/122. South Australia. Department of Mines and Energy. Open file Envelope, 1582: 453-617 (unpublished).

Webb, A.W., Coats, R.P., Fanning, C.M. and Flint, R.B., 1983. Geochronological framework of the Adelaide Geosyncline. in: Adelaide Geosyncline Sedimentary Environments and Tectonic Settings Symposium, Adelaide. Geological Society of Australia. Abstracts, 10: 7-9.

Webb, A.W. and Fanning, C.M., 1983. AMDEL report GS 4986/83 (unpublished).

Webb, A.W., Thomson, B.P., Blissett, A.H., Daly, S.J., Flint, R.B. and Parker, A.J., 1986. Geochronology of the Gawler Craton, South Australia. Australian Journal of Earth Sciences, 33: 119-143.

Webb, B.P. and Crawford, A.R., 1961. Report on northern Eyre Peninsula stratigraphic relationships and Gawler Range Porphyry reconnaissance. South Australia. Department of Mines. Report Book, 53/24.

Webb, B.P. and Wopfner, H., 1961. Plio-Pleistocene dunes northwest of Lake Torrens, S.A. and their influence on erosional patterns. Australian Journal of Science, 23(11): 379-381.

Wells, R.T. and Callen, R.A. (Eds.), 1986. The Lake Eyre Basin - Cainozoic sediments, fossil vertebrates and plants, landforms, silcretes, and climatic implications. Geological Society of Australia. Australian Sedimentologists Group Field Guide Series, 4.

Whitehead, S.G., 1977. AMDEL report, MP 2111/77, 2112/77 (unpublished).

Whitford, C.L., 1978. Palaeontological examination of material from Moodlampnie Hill area, Arckaringa Basin. South Australia. Department of Mines and Energy. Report Book, 78/119.

Whitten, G.F., 1958. First summary report on iron ore claims and aeromagnetic anomalies near Tarcoola. South Australia. Department of Mines. Report Book, 46/77.

Whitten, G.F., 1959. Iron ore deposits and aeromagnetic anomalies near Tarcoola. Mining Review, South Australia, 108: 22-27.

Whitten, G.F., 1960. Report on geological reconnaissance of Tarcoola 4-mile sheet and 11 adjacent 1-mile sheets. South Australia. Department of Mines. Report Book, 50/162.

Whitten, G.F., 1962. Summary report on known ore deposits, Central Province. South Australia. Department of Mines. Report Book, 54/121.

Whitten, G.F., 1966a. Suggested correlation of iron ore deposits within South Australia. South Australia. Geological Survey. Quarterly Geological Notes, 18: 7-11.

Whitten, G.F., 1966b. Notes on the Tarcoola-Kingoonya area. South Australia. Department of Mines. Report Book, 62/54.

Whitten, G.F., 1968. Type Section of iron formations, Tarcoola district. South Australia. Geological Survey. Quarterly Geological Notes, 26: 4-7.

Williams, G.E. and Tonkin, D.G., 1985. Periglacial structures and palaeoclimatic significance of a late Precambrian block field in the Cattle Grid copper mine, Mount Gunson, South Australia. Australian Journal of Earth Sciences, 32: 287-300.

Wopfner, H., 1963. Post-Winton sediments of probable Upper Cretaceous age in the central Great Artesian Basin. Royal Society of South Australia. Transactions, 86: 247-253.

Wopfner, H., 1969. Mesozoic Era. in: Parkin, L.W. (Ed.). Handbook of South Australian Geology. Geological Survey of South Australia: 133-171.

Wopfner, H., 1970. Permian palaeogeography and depositional environment of the Arckaringa Basin, South Australia. Second International Gondwana Symposium, South Africa, 1970. Papers and Proceedings: 273-291.

Wopfner, H., 1974. Post-Eocene history and stratigraphy of northeastern South Australia. Royal Society of South Australia. Transactions, 98:1-12.

Wopfner, H., 1978. Silcretes of northern South Australia and adjacent regions. in: Langford-Smith, T. (Ed.). Silcrete in Australia. University of New England, Armidale: 93-141.

Wopfner, H., Callen, R.A. and Harris, W.K., 1974. The Lower Tertiary Eyre Formation of the southwestern Great Artesian Basin. Geological Society of Australia. Journal, 21(1): 17-51.

Wopfner, H., Freytag, I.B. and Heath, G.R., 1970. Basal Jurassic-Cretaceous rocks of western Great Artesian Basin, South Australia: stratigraphy and environment. AAPG Bulletin, 54(3): 383-416.

Wopfner, H., 1974. Post-Eocene history and stratigraphy of northeastern South Australia. Royal Society of South Australia. Transactions, 98:1-12.

Wright, R.G., 1978. Report for quarterly periods July 1 - September 30, 1977 and October 1 - December 31, 1977, Exploration Licence No. 305, for Newmont Pty Ltd and Dampier Mining Co. Ltd. South Australia. Department of Mines and Energy. Open file Envelope, 3031: 40-69 (unpublished).

Young, G.A. and Gerdes, R.A., 1966. Central South Australia airborne magnetic and radiometric survey, South Australia. Bureau of Mineral Resources, Geology and Geophysics, Australia. Record, 66/224.

Take out

PLATE CAPTIONS

(Photographs by W.M. Cowley unless noted otherwi

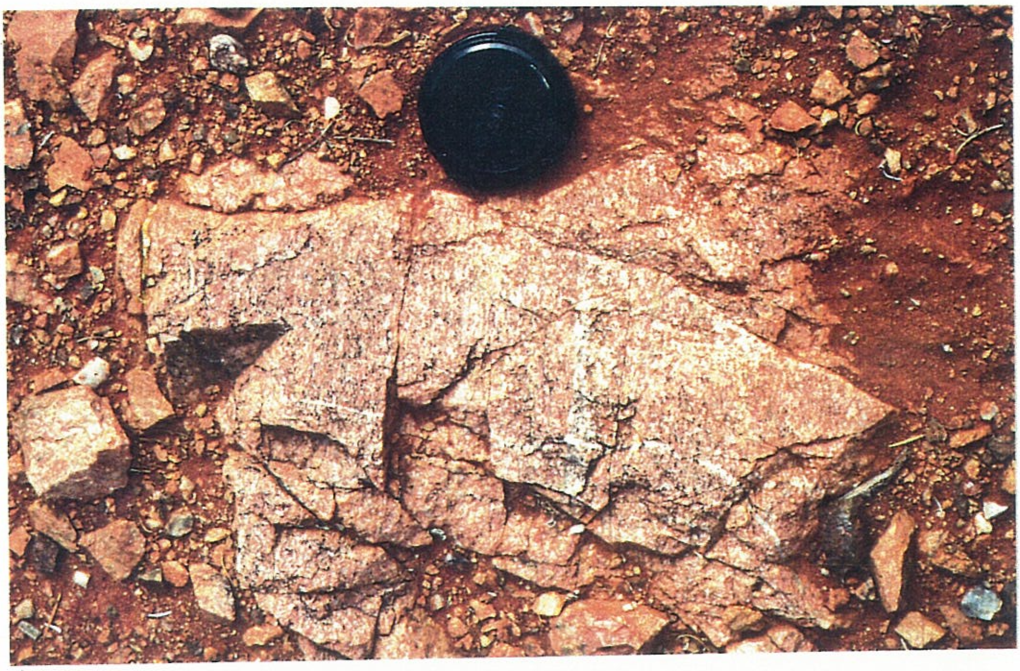
PLATE NO.		SLIDE PHOTO NO.	COWLEY COLLECTION NO.
1.	Kenella Gneiss, AƂ*mk*: strongly foliated pink-orange quartzofeldspathic gneiss. Lens cap 55mm diameter. 7km west of Mt Eba, photo location 1382/054/32.	39369	89/4/28
2.	ESSO DP-1, 373.6-376.5m, 6037 RS 31. Rhyodacite with quartz and altered plagioclase phenocrysts, Av. Geochronology sample, U-Pb = 2558 ± 6 Ma. Scale bar 1 mm. 7.5 km northeast of Mt Paisley.	39370	89/7/10
3.	Wilgena Hill Jaspilite, Ƃ*h*: finely banded red and black iron formation. East of Wallabyng Range, 1359/032/59.	39371	89/4/21
4.	Lincoln Complex, Ƃ*l*: foliated and lineated quartz + microcline + plagioclase ± biotite gneiss. 12.5 km northwest of Mt Eba, 1382/040/8.	39372	89/4/9
5.	Tarcoola Formation, Fabian Quartzite Member, Ƃtf, lower part: conglomeratic quartzite with clasts of milky quartz, red to grey chert and jasper and black iron formation. East end of Wallabyng Range, 1359/032/1.	39373	89/4/17
6.	Tarcoola Formation, Fabian Quartzite Member, Ƃtf, upper part: milky silicified quartzite, dips southeast (to left). Northwestern side of Mt Eba.	39374	89/2/10
7.	Tarcoola Formation, Sullivan Shale Member, Ƃts: inter- bedded buff to red-brown shale, siltstone and fine-grained sandstone. Prominent subvertical cleavage. Mt Eba, 0.5km southeast of trig point.	39375	85/1/16
8.	Labyrinth Formation, Ƃy_1: large, rounded, silicified stromatolites 0.9 km southeast of Rocky Hill, 1359/032/3.	39376	85/1/4
9.	Labyrinth Formation, Ƃy_3: crossbedded, pink-purple, coarse-grained lithic sandstone. Hammer 32 cm long. 1.2 km south of Mt Eba.	39377	87/1/10
10.	Gawler Range Volcanics, Konkaby Basalt, Ƃa_1: dark green-black, amygdalodial metabasalt. 5 km west of Mt Eba, 1382/054/7.	39378	89/4/26

11.	Gawler Range Volcanics, Ealbara Rhyolite, Ꝑa_2 , 5936 RS 77B: concentric banding in chert concretion within ?tuffaceous sediment. Note bedding passing through concretion. Scale bar 1 mm. 4.5 km south of Mt Eba, 1382/058/12.	39379	89/7/8
12.	Gawler Range Volcanics, Ealbara Rhyolite, Ꝑa_3: rhyolitic ignimbrite displaying flattened pumice clasts, numerous chloritic clots and pink-orange feldspar phenocrysts. Coin 19 mm diameter. Quarry, 21 km west of Glendambo, 1358/050/3. R. B. Flint.	39380	R.B.F.
13.	Hiltaba Suite, Ꝑγh, 5936 RS 74: porphyritic microgranite, with quartz and feldspar phenocrysts in a granular to graphic intergrowth of quartz and feldspar. Scale bar 1 mm. 18 km west-northwest of "Gosses", 1382/040/22.	39381	89/7/2
14.	Hiltaba Suite greisen, Ꝑγh: greisenised porphyritic microgranite. Note relict feldspar phenocrysts weathering out. 15.5 km west-northwest of "Gosses", 1382/040/25.	39382	87/3/2
15.	Kennecott/Samedan Playford 1, 433.15-440.15m: top, red-brown to grey-green laminated shale of Tent Hill Formation, Tregolana Shale Member, Ꝑwt. Centre right, pink, bedded dolomite of Nuccaleena Formation, Ꝑwn. Bottom, haematitic, coarse-grained to pebbly sandstone, Pandurra Formation, Ꝑp.	39383	89/6/11
16.	Gairdner Dyke Swarm, Ꝑβ_3, 6036 RS 28: ophitic dolerite comprising laths of labradorite and interstitial altered pyroxene, including pigeonite and pigeonitic augite. Scale bar 1mm. Waterbore 6036WW133, 69-72m, 3.5 km east of Glendambo.	39384	89/7/4
17.	Aquitaine SSR-1001, 234.1-238.9m, Seacliff Sandstone, Ꝑwe: faintly graded or crossbedded to massive, very fine grained red-brown sandstone. Some fine bleached spotting.	39385	89/6/2

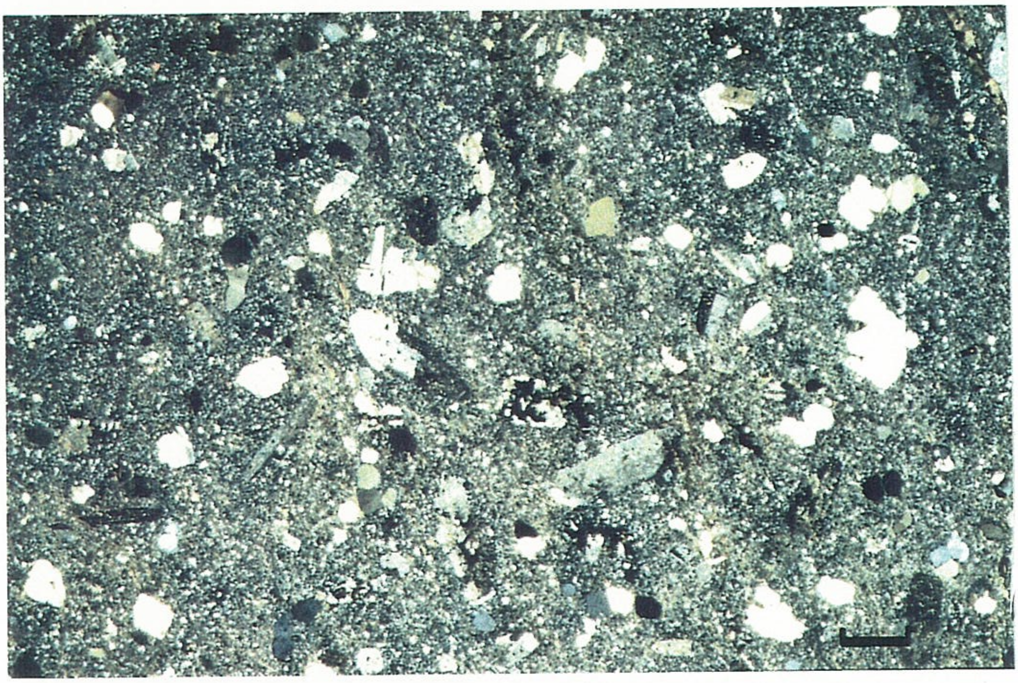
18.	Kennecott/Samedan Playford 1, 200.92-202.85m: reworked interval within Tent Hill Formation, Tregolana Shale Member, Ewt. Note: conglomerate intervals with clasts of red-brown shale, reddish to grey-green fine-grained sandstone and pale green limestone in a matrix of green silt, sand and reworked siltstone sand and granules; near top, greenish siltstone granule conglomerate; part of large reddish limestone clast at right; normal Ewt top and bottom.	39386	89/6/14
19.	Tent Hill Formation, Corraberra Sandstone Member, Ewc: flaggy pinkish to red-brown sandstone interbedded with red-brown siltstone. Shallow dip away from observer. Northwest shore of Lake Reynolds, 1382/078/10.	39387	86/2/32
20.	Tent Hill Formation, Simmens Quartzite Member, Ews: crossbedded off-white sandstone. Western shore of Lake Parakylia, 1382/078/35.	39388	86/3/3
21.	Andamooka Limestone, Ꞓa: brown-weathering, brown-grey limestone with interbed (near hammer head) of pale brown, laminated, soft limestone. 6km west-southwest of Majendie Mound, 1382/016/17. A.R. Martin.	38880	ARM
22.	Andamooka Limestone, Curdlawidny Siltstone Member, Ꞓac: mud-cracked, pale reddish-brown silty limestone and calcareous siltstone. Western tip of Red Lake, 1354B/006/56.	38881	87/1/26
23.	Boorthanna Formation, CPb: poorly-sorted, friable greenish conglomerate with clasts of quartzite, reddish sandstone and reworked greenish sandstone and siltstone. 1 km west of 13 Mile Dam, 1357/105/26.	39389	86/3/24
24.	Algebuckina Sandstone, Ja: crossbedded kaolinitic coarse-grained sandstone. 2.5 km east of Boundary Hill, 1358/050/7.	39390	86/1/24
25.	Cadna-owie Formation, Kc: whitish, well-bedded very fine to fine-grained micaceous sandstone and siltstone. Pen (13 cm long) rests on quartz granule sandstone interbed. 1 km north of "South Vivian", 1354B/018/8.	39391	86/1/18
26.	Bulldog Shale, Kmb, basal part: massive to bedded kaolinitic mudstone with greyish poorly sorted quartz sandstone interbeds below quartzite cobble 30 cm across. 4.5 km south of Hanson Hill, 1360/042/29. A.R. Martin.	39392	ARM.

27.	Munjena Formation equivalent, Tp-e: silicified medium-grained sandstone with insect burrows. Jacks Hill, 1357/056/3.	39393	89/3/24
28.	Garford Formation, Te-p: green and red-brown-mottled, gypsified clay. Overlain by Qpg aeolian gypsiferous sand with large gypsum crystals. 13 km northwest of Mt Eba, 1382/044/3.	39394	89/3/36
29.	Mirikata Formation, showing at top white dolomite of Millers Creek Dolomite Member (Tmi, in centre greyish sandstone of Danae Conglomerate Member (Tms), and at bottom white to yellowish siltstone of Cadna-owie Formation (Kc). Moodlampnie Hill. R.B. Flint.	39395	RBF.
30.	Mirikata Formation, Billa Kalina Clay Member, Tml: green, palygorskitic clay. 0.6 km northeast of Moodlampnie Hill, 1357/027/44.	39396	86/3/33
31.	Mirikata Formation, Danae Conglomerate Member, Tms: conglomerate with clasts of grey silcrete and pink quartzite. Silicified to blue-grey "greybilly". 4.5 km southwest of Peephabie Cliff, 1357/048/18.	39397	86/3/27
32.	Mirikata Formation, Watchie Sandstone Member, Tmw: straight linear ridge of fine-grained sandstone, possibly aeolian dune. 6.5 km south-southwest of Parakylia Hill, 1359/016/12.	39398	86/2/2
33.	Mirikata Formation, Watchie Sandstone Member, Tmw: fine to medium-grained well-sorted sandstone, showing both silica (reddish) matrix and limestone (cream) matrix in individual boulders. 1 km northeast of Top Tank, 1354B/006/4.	39399	87/1/2
34.	Mirikata Formation, unnamed sandstone member, Tm: weakly silcreted, coarse-grained sandstone with highly polished pebbles of white quartz, and minor quartzite and chert. Cobbles of Simmens Quartzite Member in middle distance. 3 km south of "Lochs Well", 1382/078/29.	39400	86/2/37
35.	Qp_1: strongly calcreted red-brown clayey sand. Hammer rests in tree trunk mould. 1.7 km northeast of Roxby Hill 1360/058/37.	39401	86/2/10

36.	Qp_2: red-brown clayey sand with diffuse and horizontal platy calcrete. Rests on Bulldog Shale at hammer. 2.5 km northwest of Margaret Bore, 1357/060/1.	39402	86/1/6
37.	Q_1: gibbers of quartzite and silcreted sandstone on puffy, gypsified soil. 0.5 km west of The Lookout, 1357/089/35.	39403	89/3/25
38.	Q_2: gravel of black ironstone ("buckshot") on red-brown sandy soil. 0.8 km north of Jacobs Bore, 1357/068/18.	39404	89/3/29



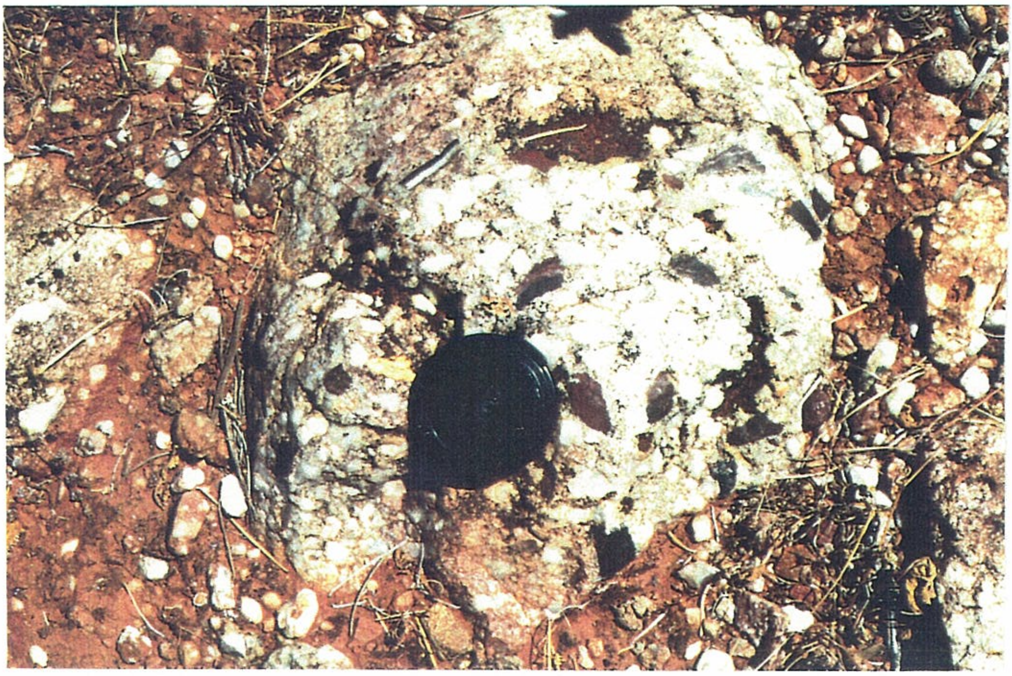
1



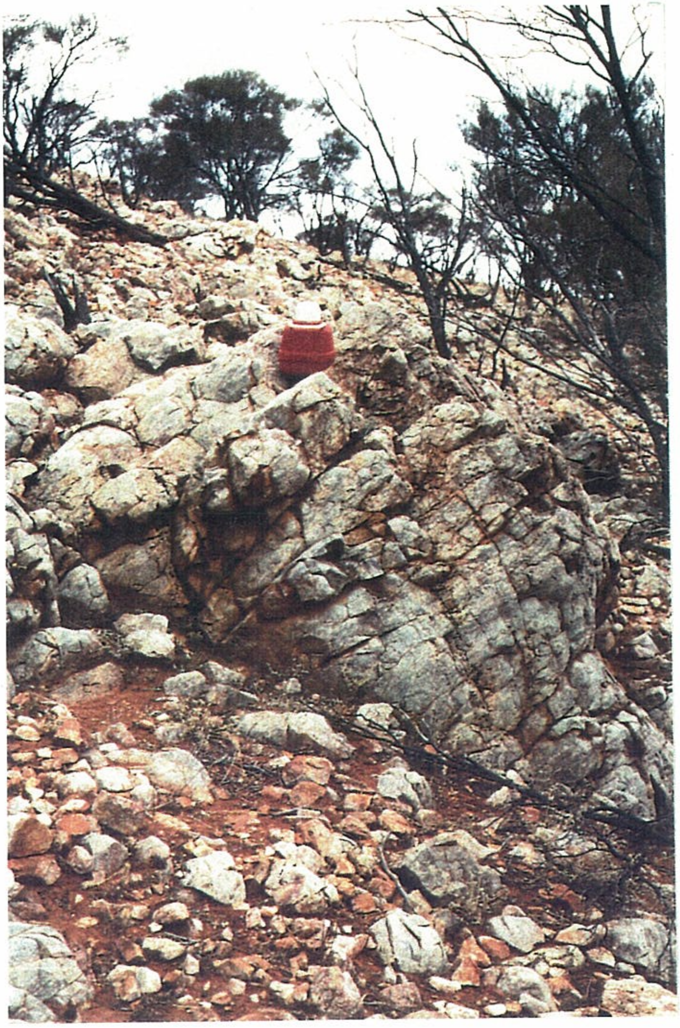
2

3

4



5



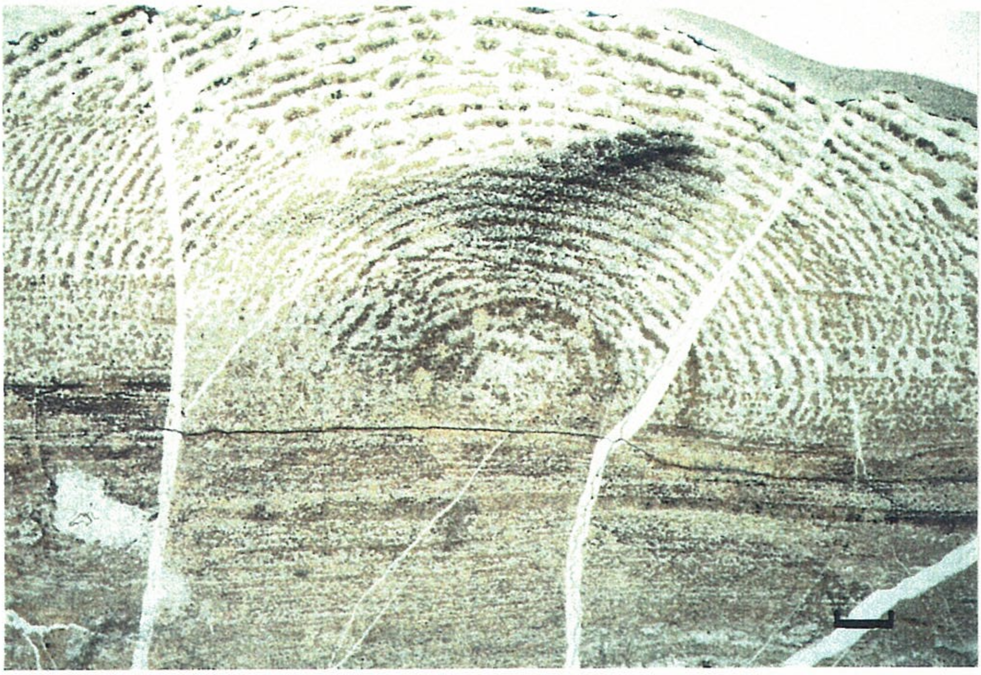
6

7

8

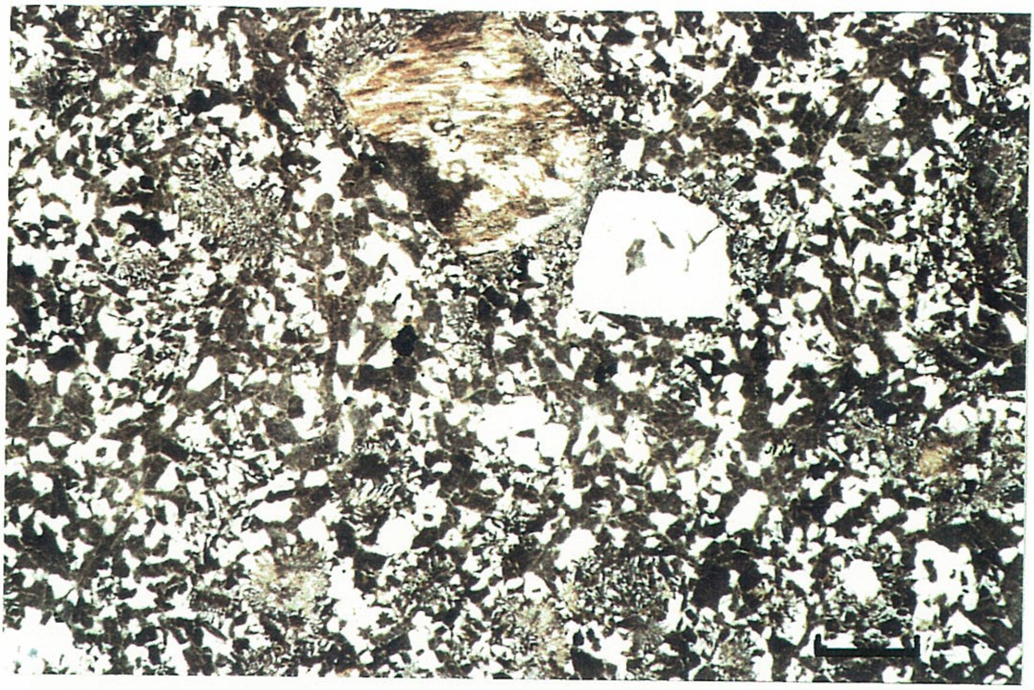
9

10



11

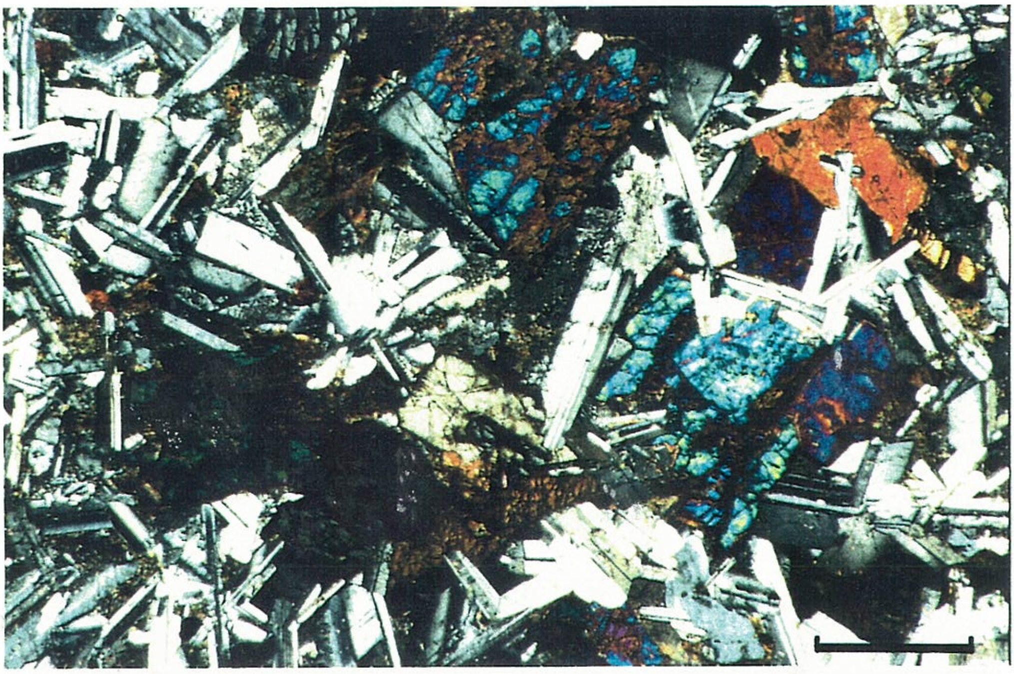
12



13

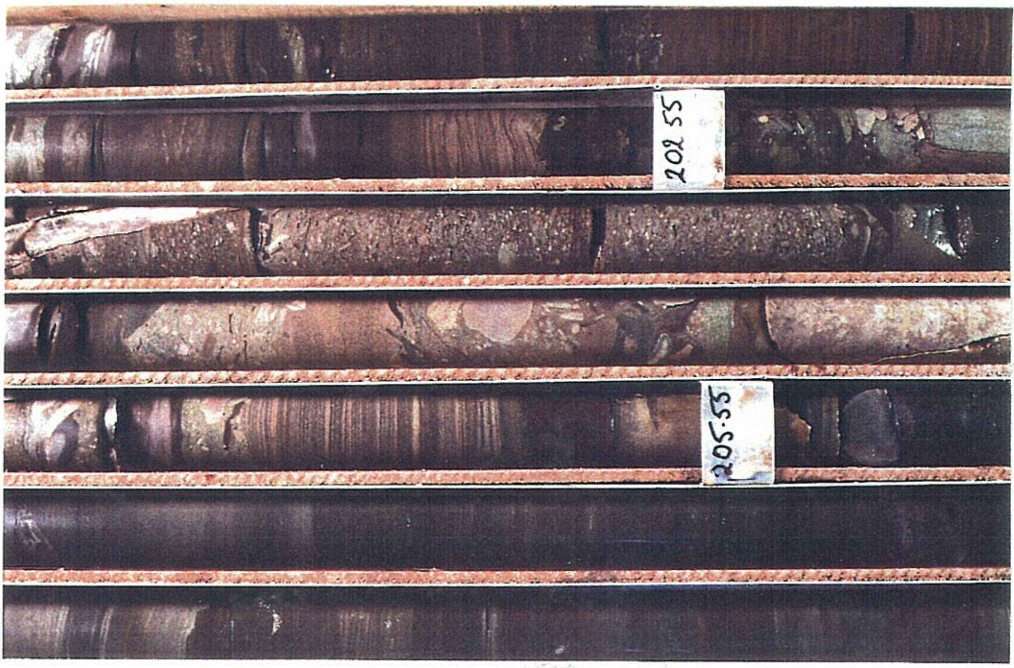
14

15



16

17



18

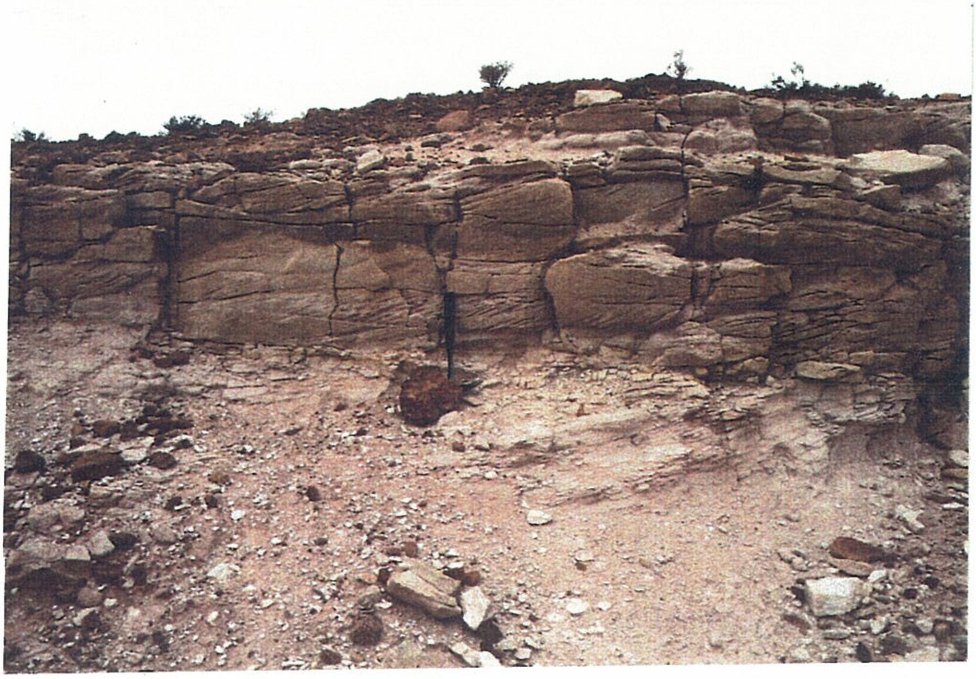
19

20

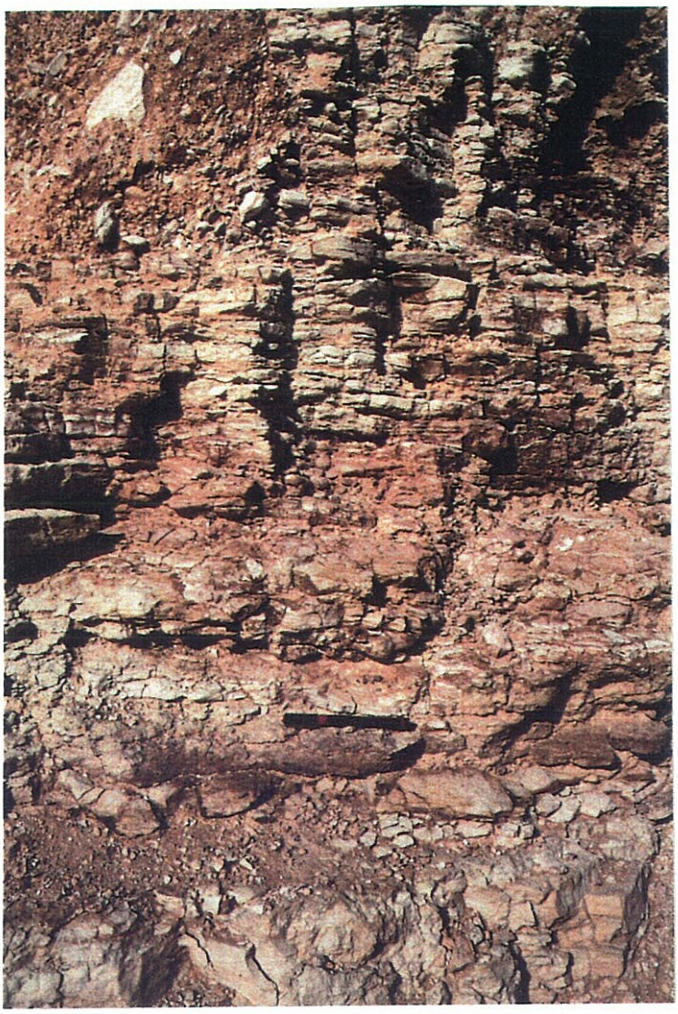
21

22

23

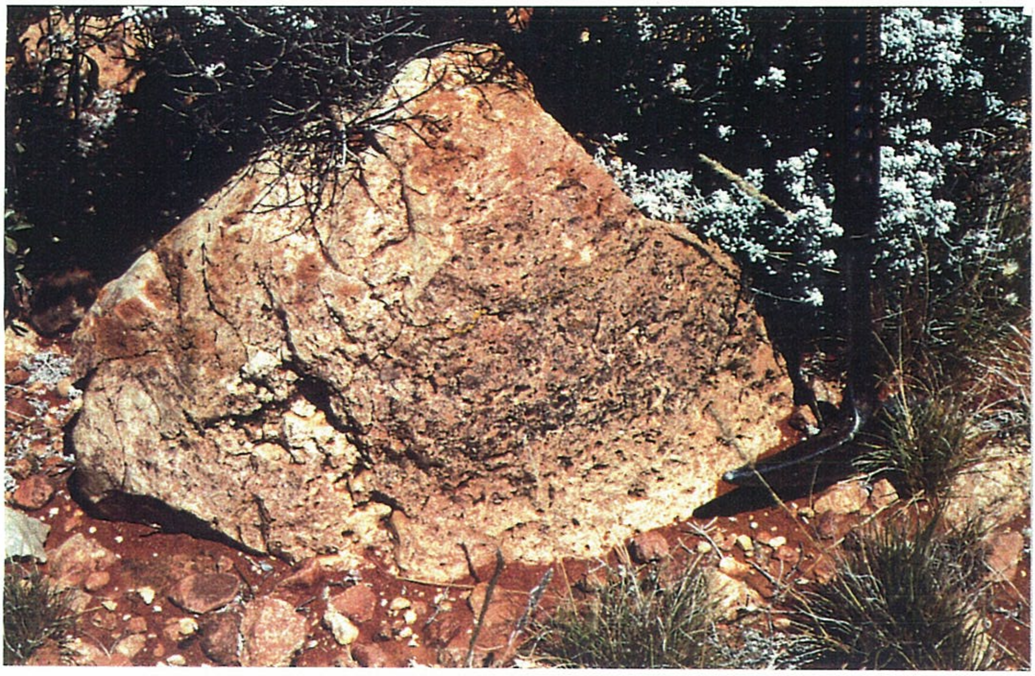


24



25

26



27

28

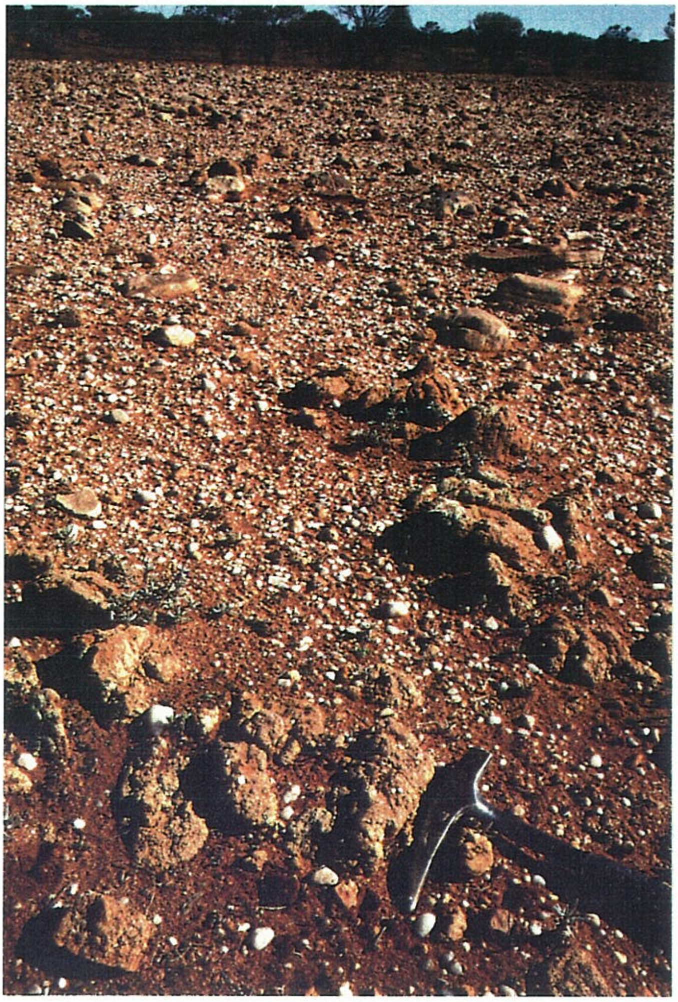
29

30

31

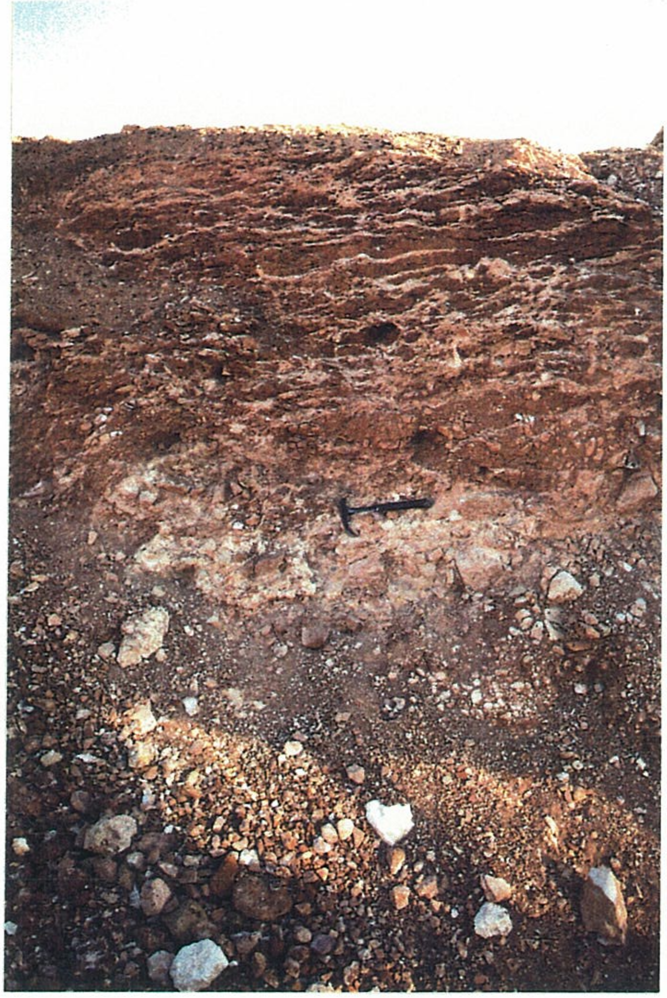
32

33

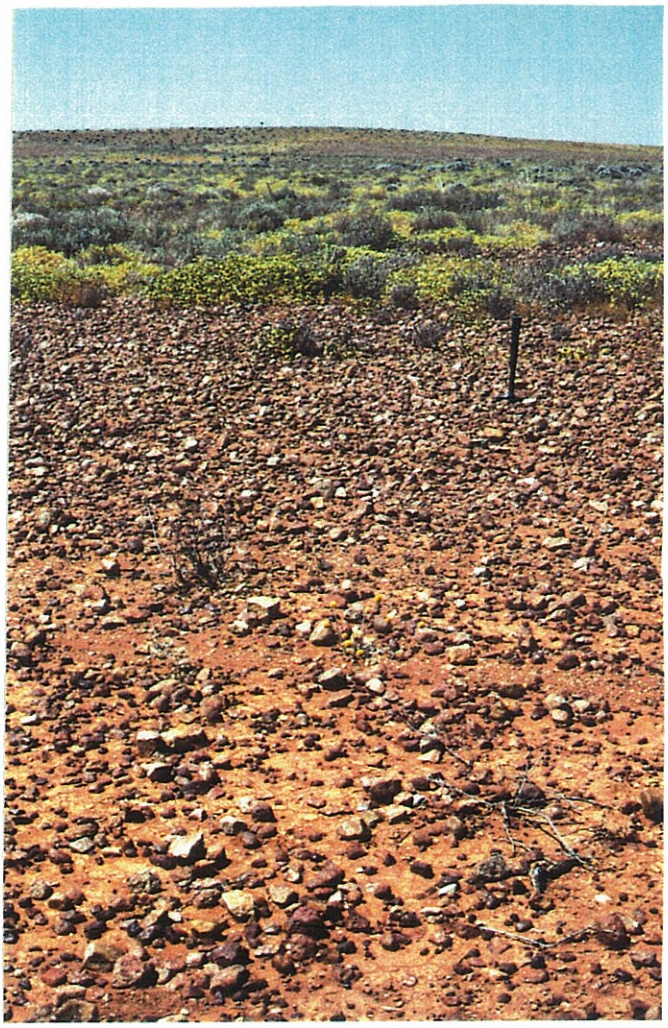


34

35

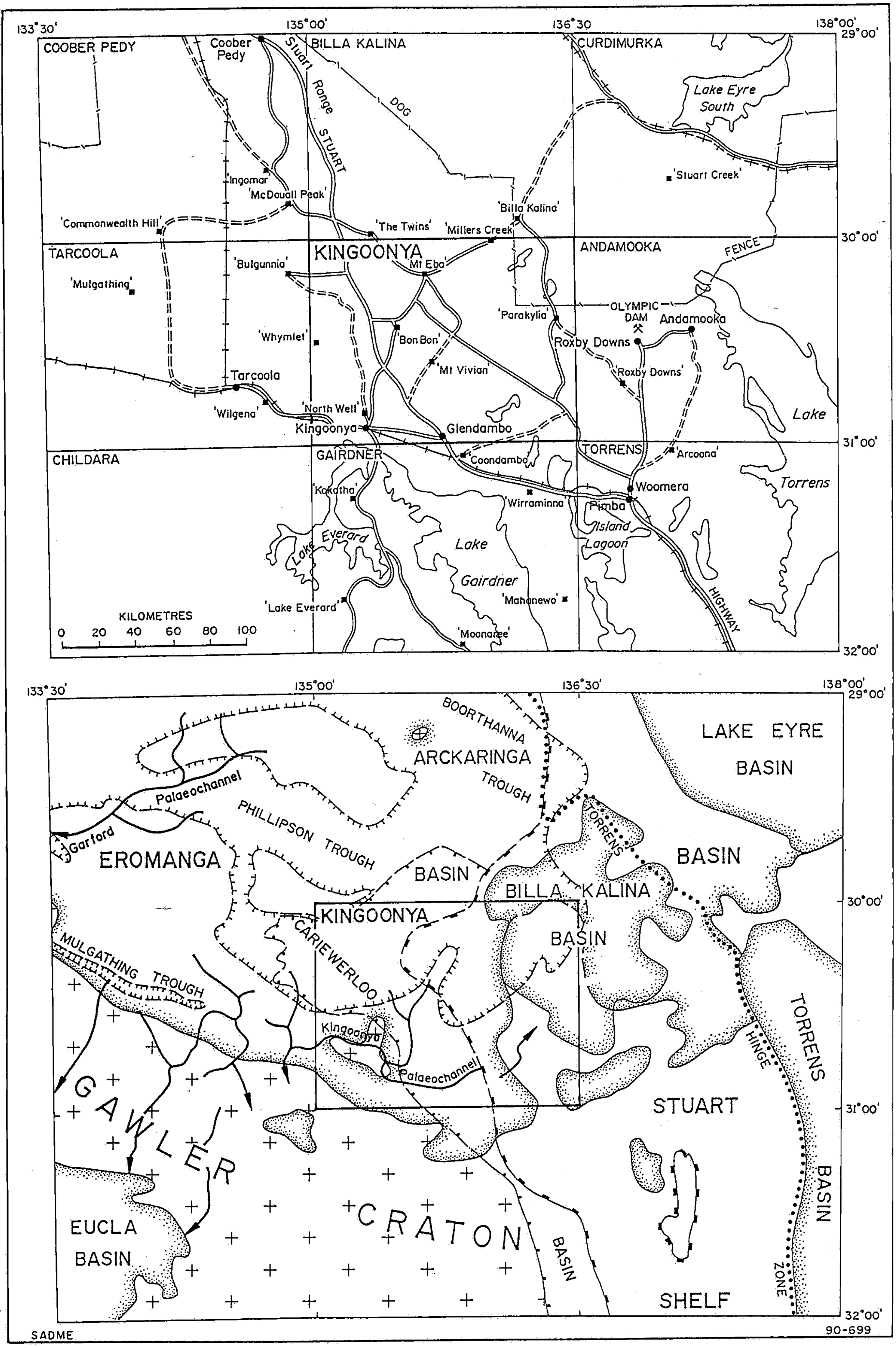


36



37

38

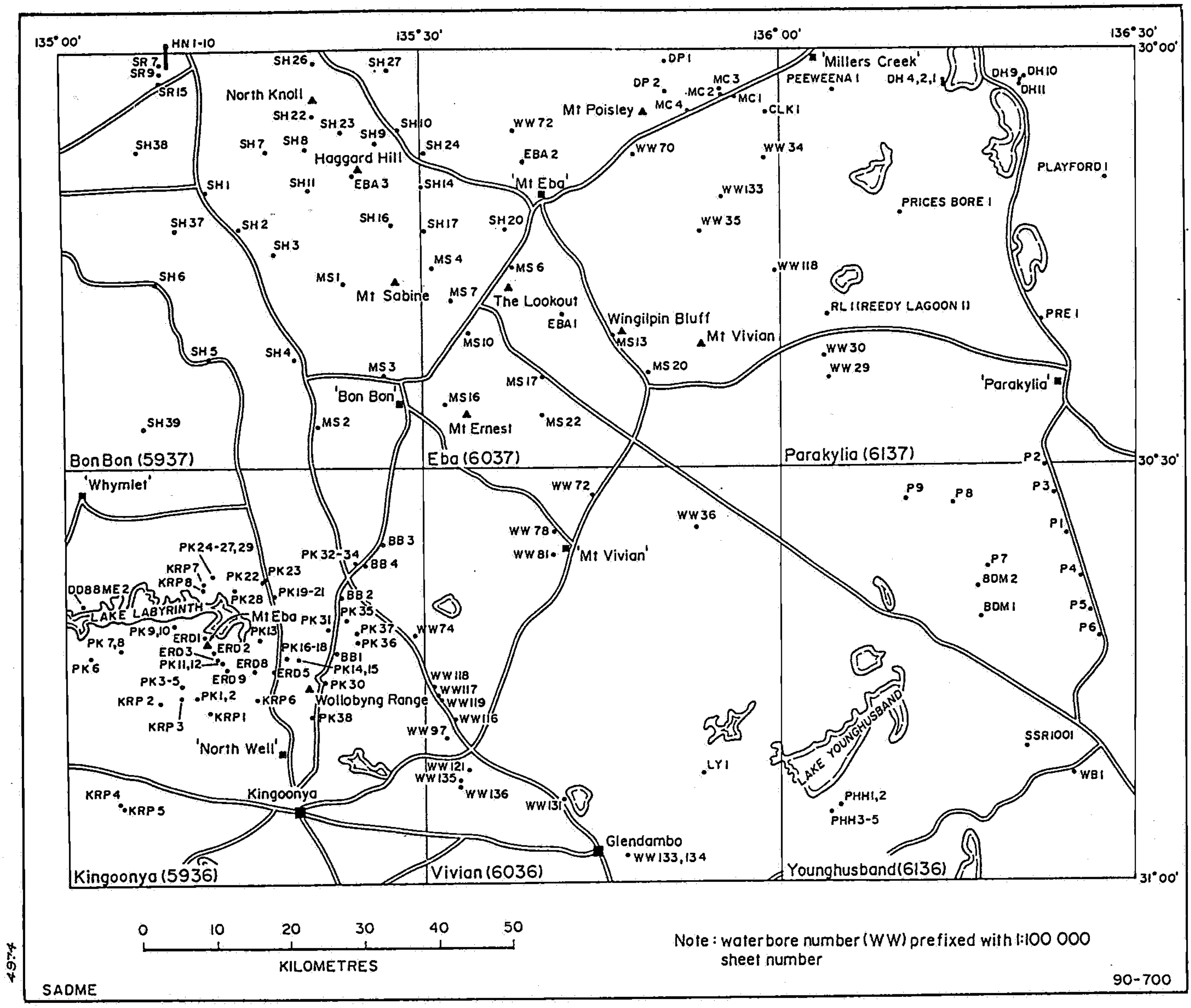


4974

FIG. 1 KINGOONYA EXPLANATORY NOTES

S22359

Regional location and tectonic setting.



Note: waterbore number (WW) prefixed with 1:100 000 sheet number

FIG. 2 KINGOONYA EXPLANATORY NOTES

S22360

Drillhole locations.

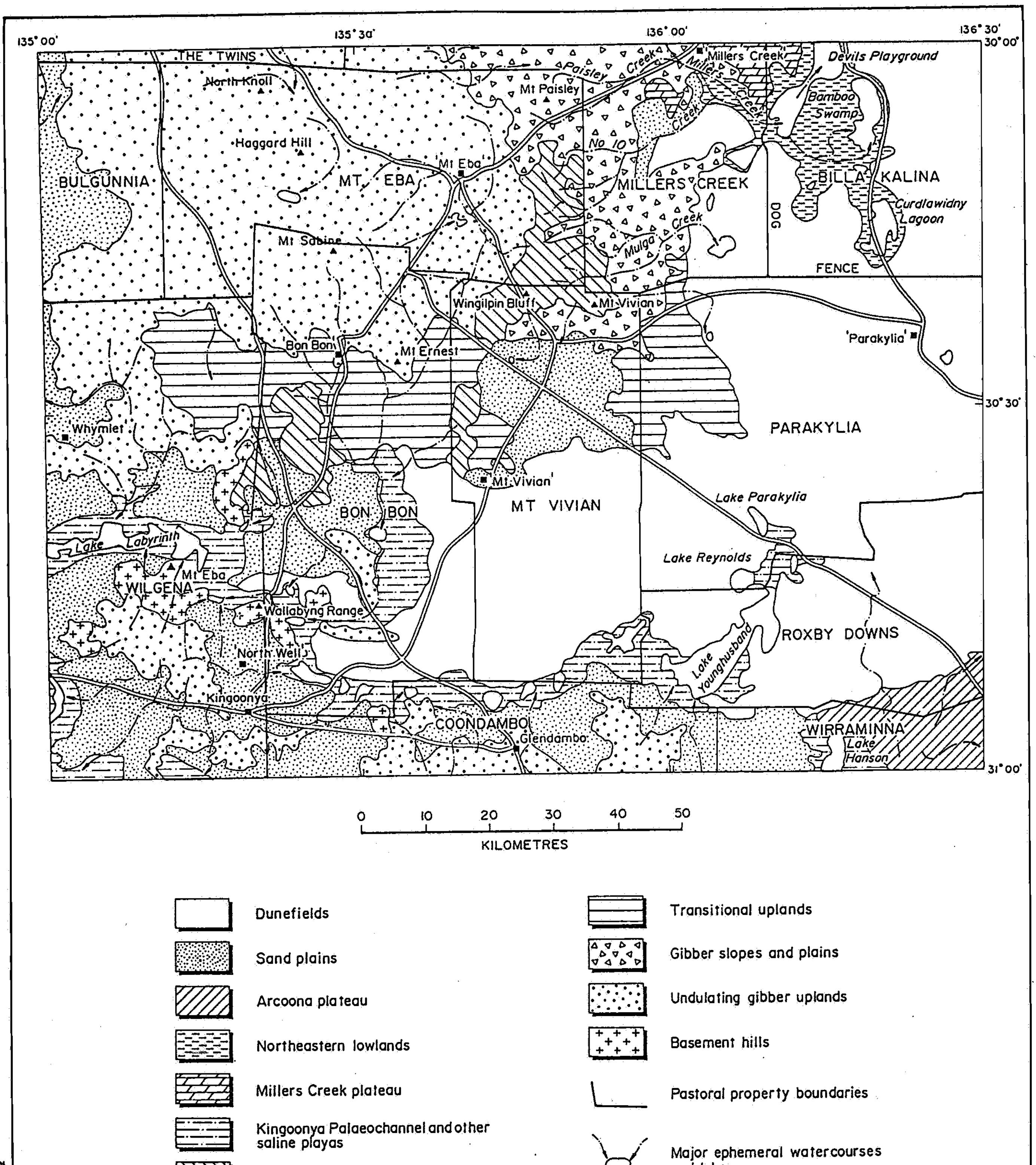


FIG. 3 KINGOONYA EXPLANATORY NOTES

S22361

Physiographic Divisions and pastoral properties

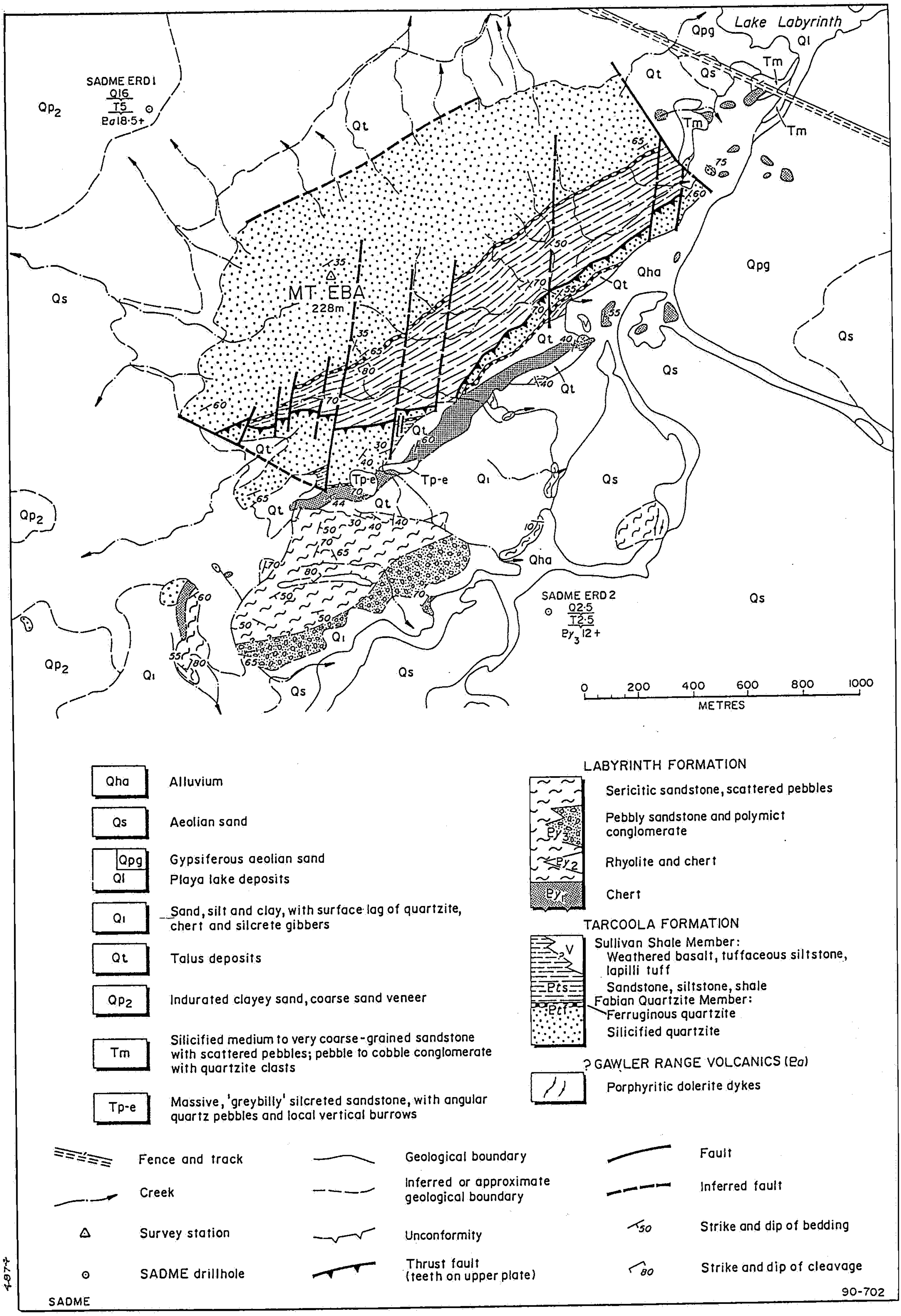
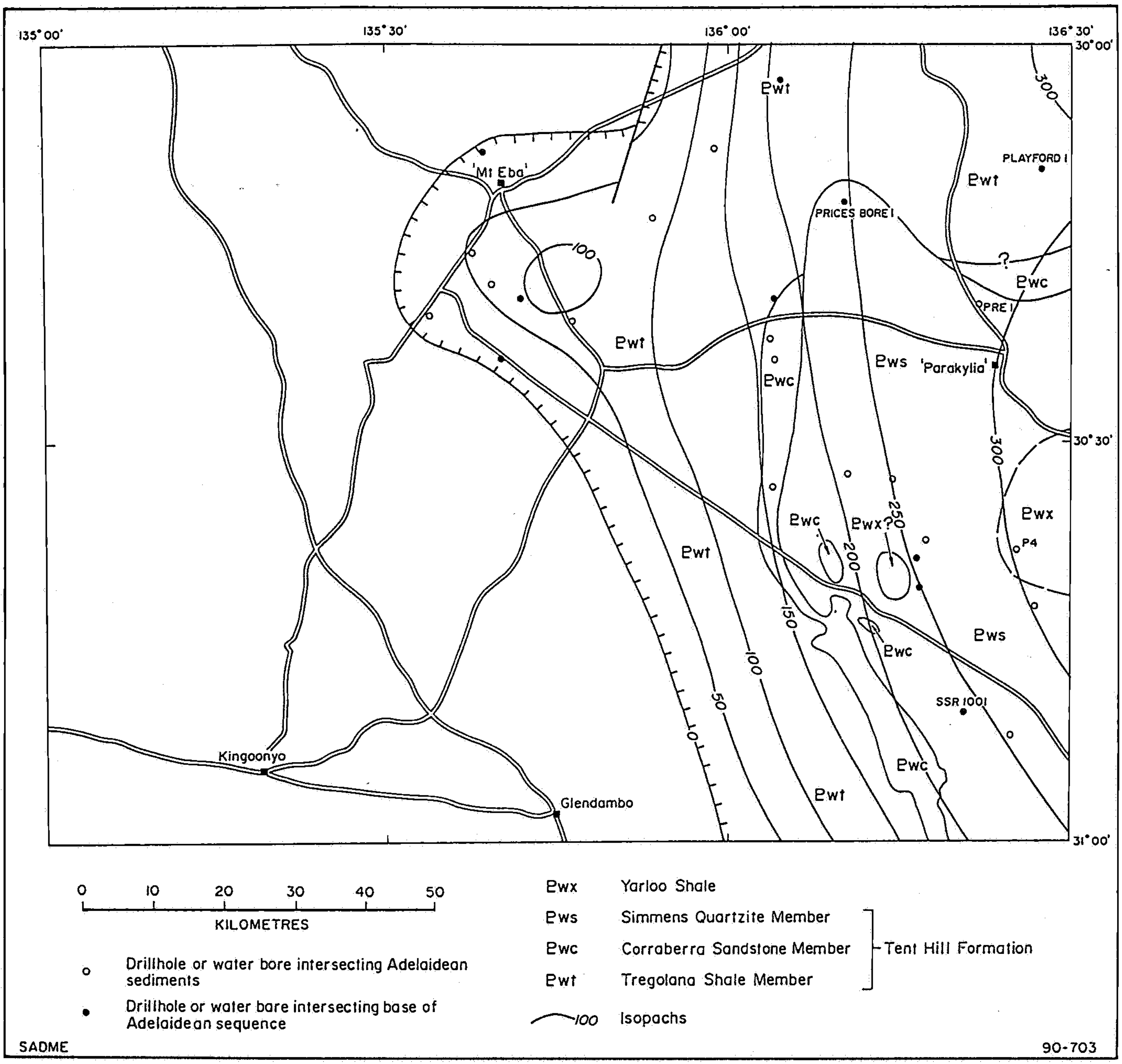


FIG. 4 KINGOONYA EXPLANATORY NOTES

S22362

Geology of Mt Eba.

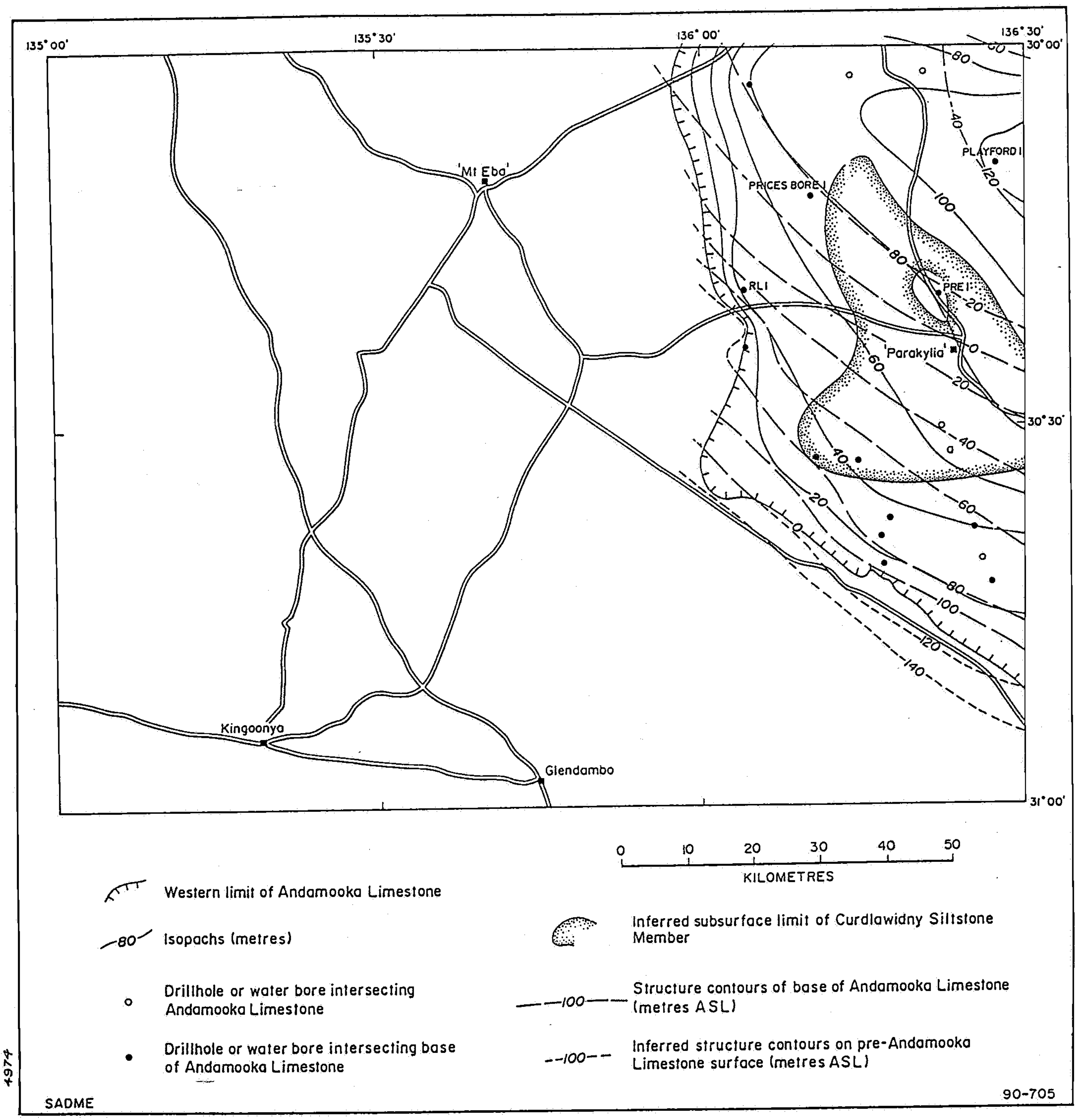


4974

FIG. 5 KINGOONYA EXPLANATORY NOTES

S22363

Isopachs of Adelaidean sediments.



4974

FIG. 6 KINGOONYA EXPLANATORY NOTES S22364

Structure contours (basal) and isopachs of Andamooka Limestone.

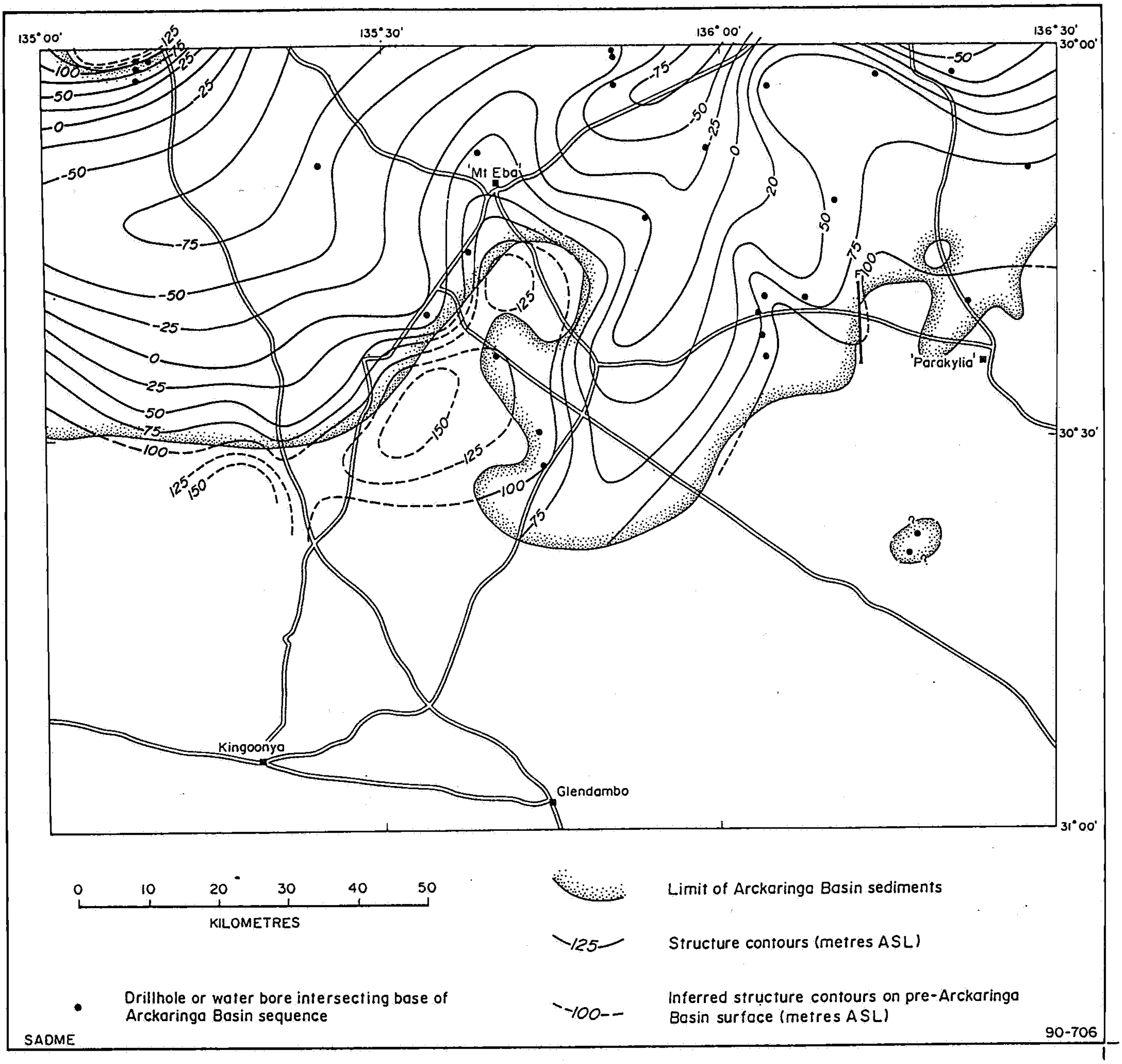
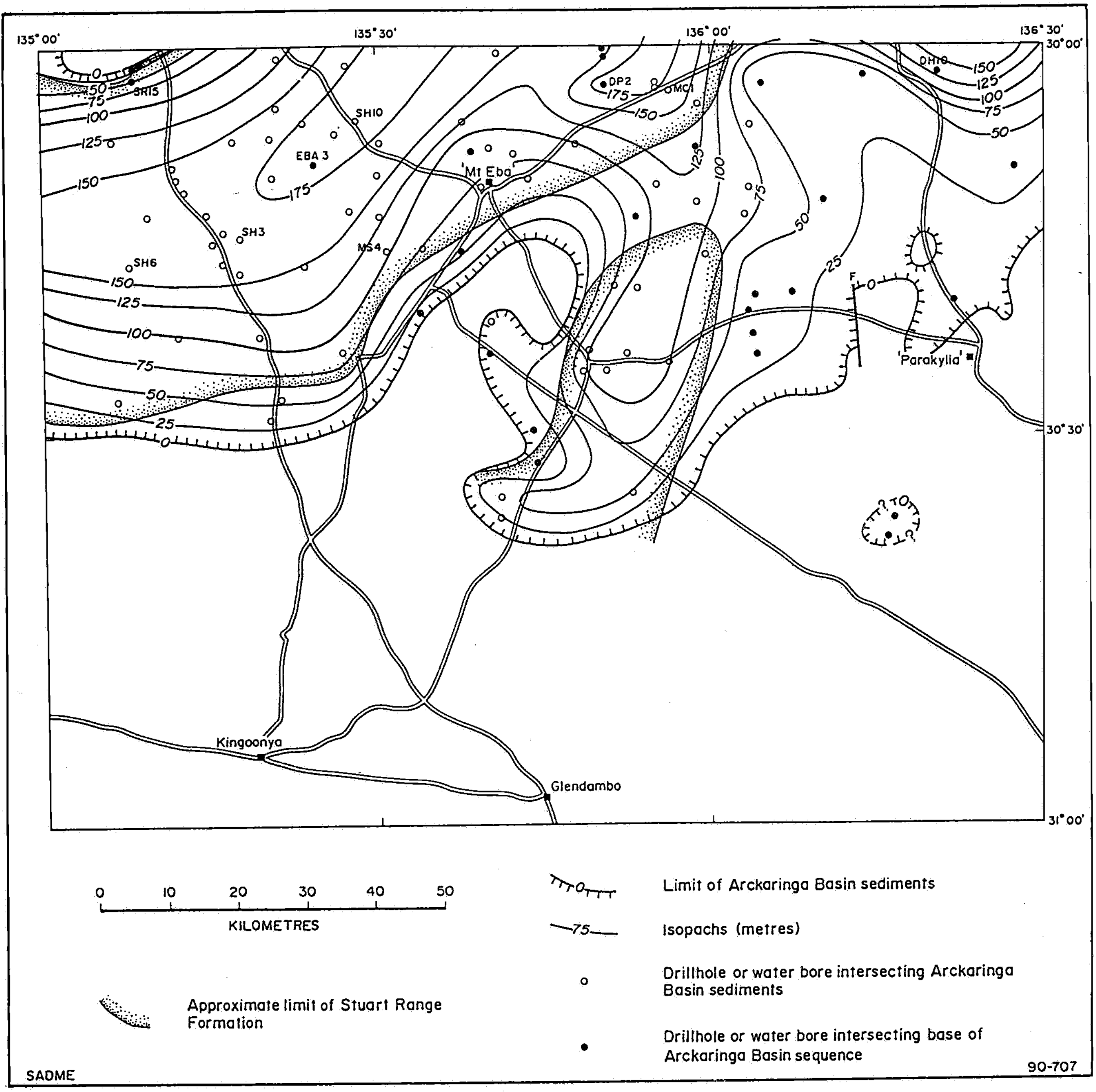


FIG. 7 KINGOONYA EXPLANATORY NOTES S22365

Structure contours, base of Arckaringa Basin sequence.



4974

FIG. 8 KINGOONYA EXPLANATORY NOTES S22366

Isopachs of Arckaringa Basin sediments.

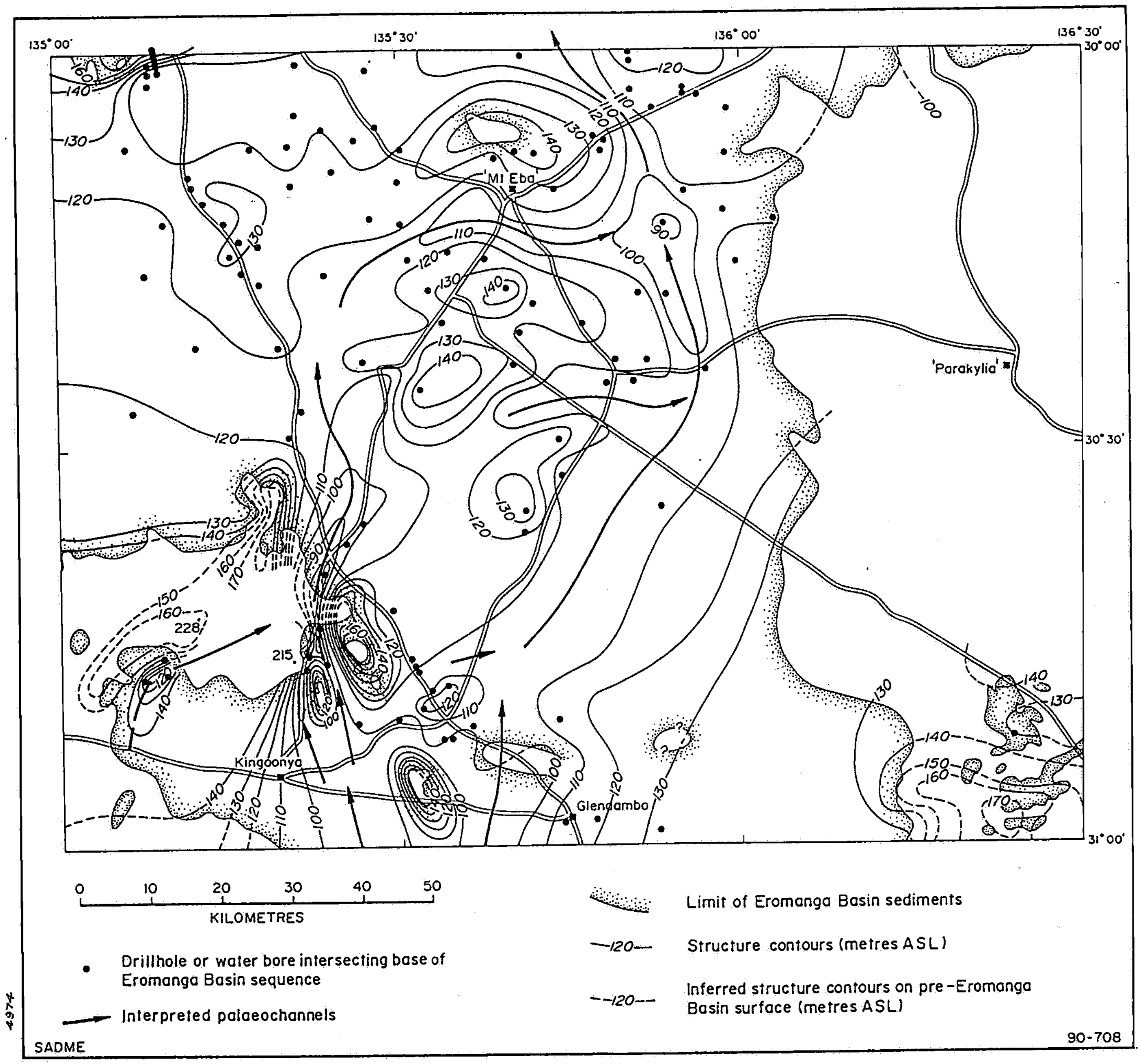


FIG. 9 KINGOONYA EXPLANATORY NOTES S22367

Structure contours, base of Eromanga Basin sequence.

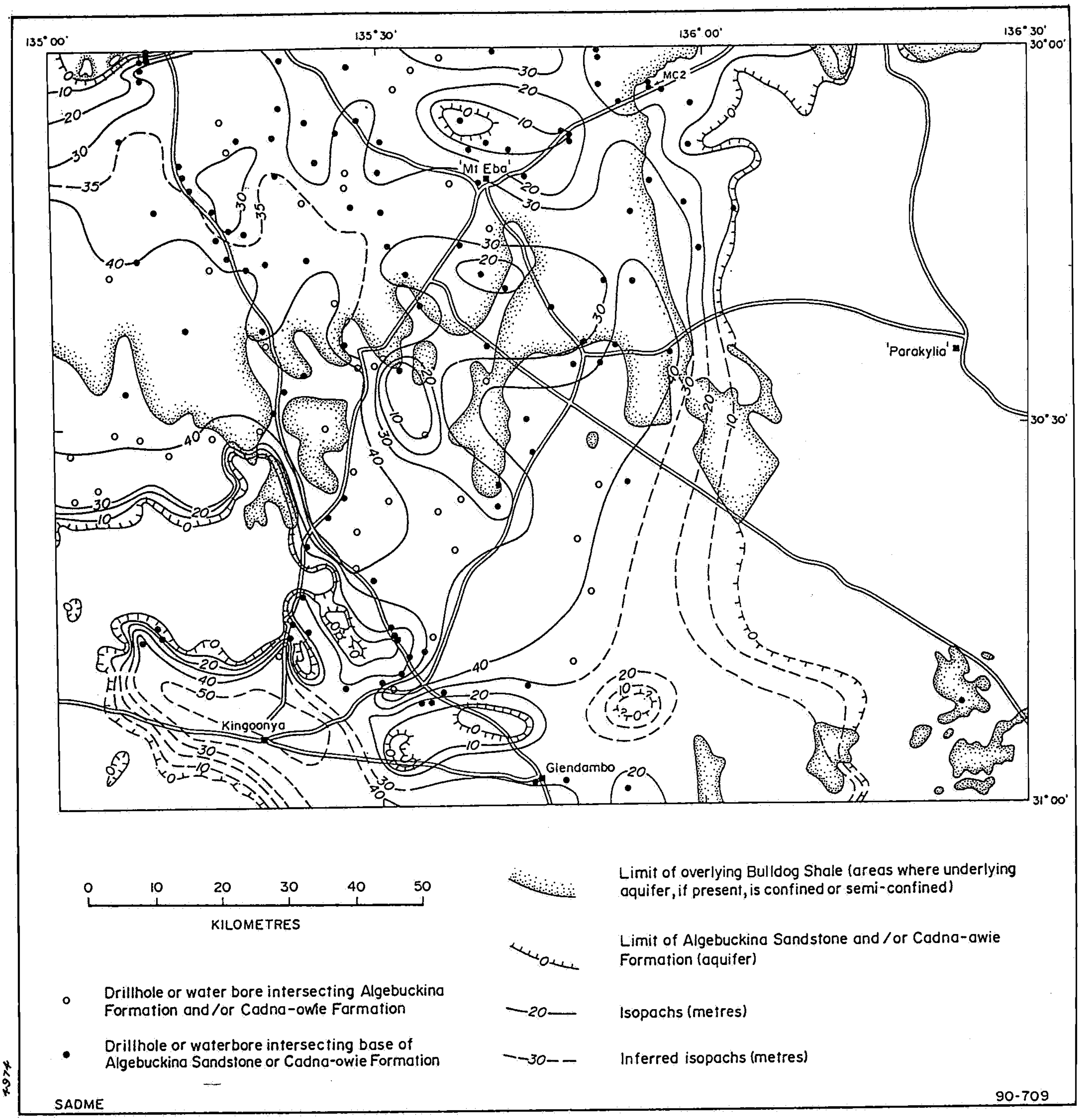
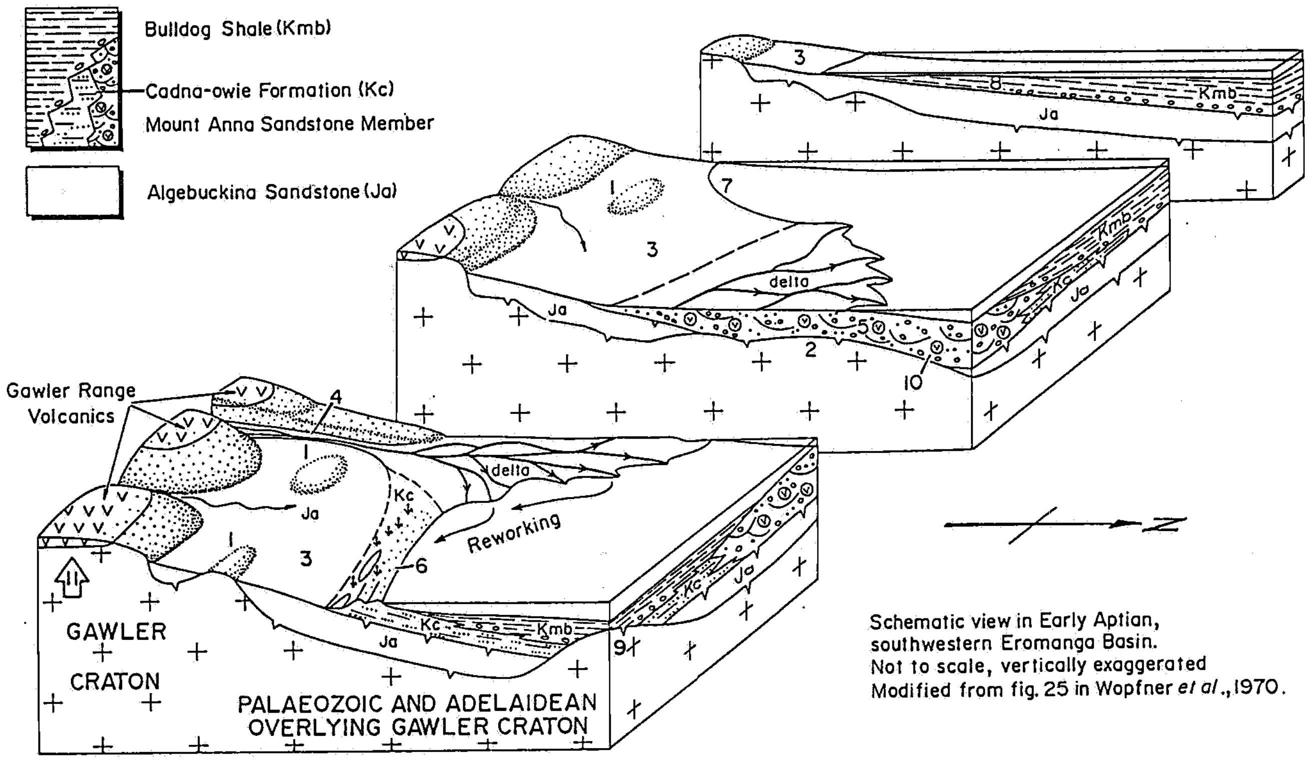


FIG. 10 KINGOONYA EXPLANATORY NOTES S22368

Isopachs of Algebuckina Sandstone and/or Cadna-owie Formation.



Schematic view in Early Aptian,
southwestern Eromanga Basin.
Not to scale, vertically exaggerated
Modified from fig. 25 in Wopfner *et al.*, 1970.

1 Ja deposited around basement highs near Kingoonya and on TARCOOLA

2 Ja missing from basement high, BILLA KALINA sheet area

3 Possible kaolinisation and silicification of exposed Ja

4 Mount Anna Sandstone Member confined to incised channels near 'Millers Creek', and opening out to braid-plain or delta on BILLA KALINA, where Ja absent : 5

6 Fluvio-deltaic Mount Anna Sandstone Member reworked into Kc marginal marine facies

7 Sediment-starved shorelines (eastern KINGOONYA and TARCOOLA): Kc not developed, instead marine Kmb transgresses directly on Ja : 8

9 More prominent basement highs (eastern KINGOONYA, Mt Woods on BILLA KALINA) transgressed only by Kmb

10 Porphyry pebbles in Mount Anna Sandstone Member derived from Gawler Ranges to south in headwaters of rivers such as 4

11 Uplift, possibly involving faulting, of Gawler Ranges region providing detritus for Mount Anna Sandstone Member

SADME 90-711

FIG. 11 KINGOONYA EXPLANATORY NOTES S22369

Mesozoic palaeogeographic interpretation.

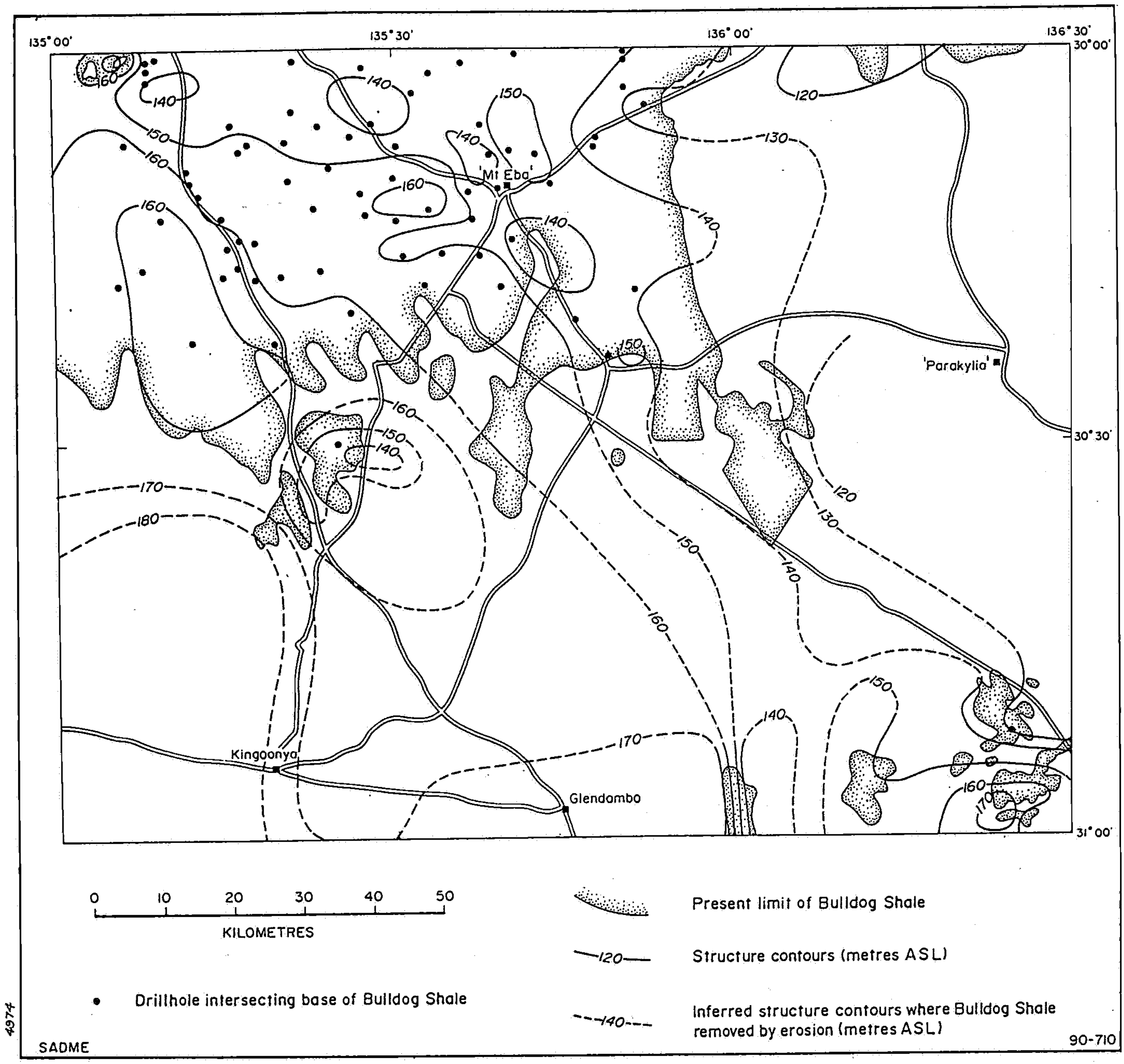
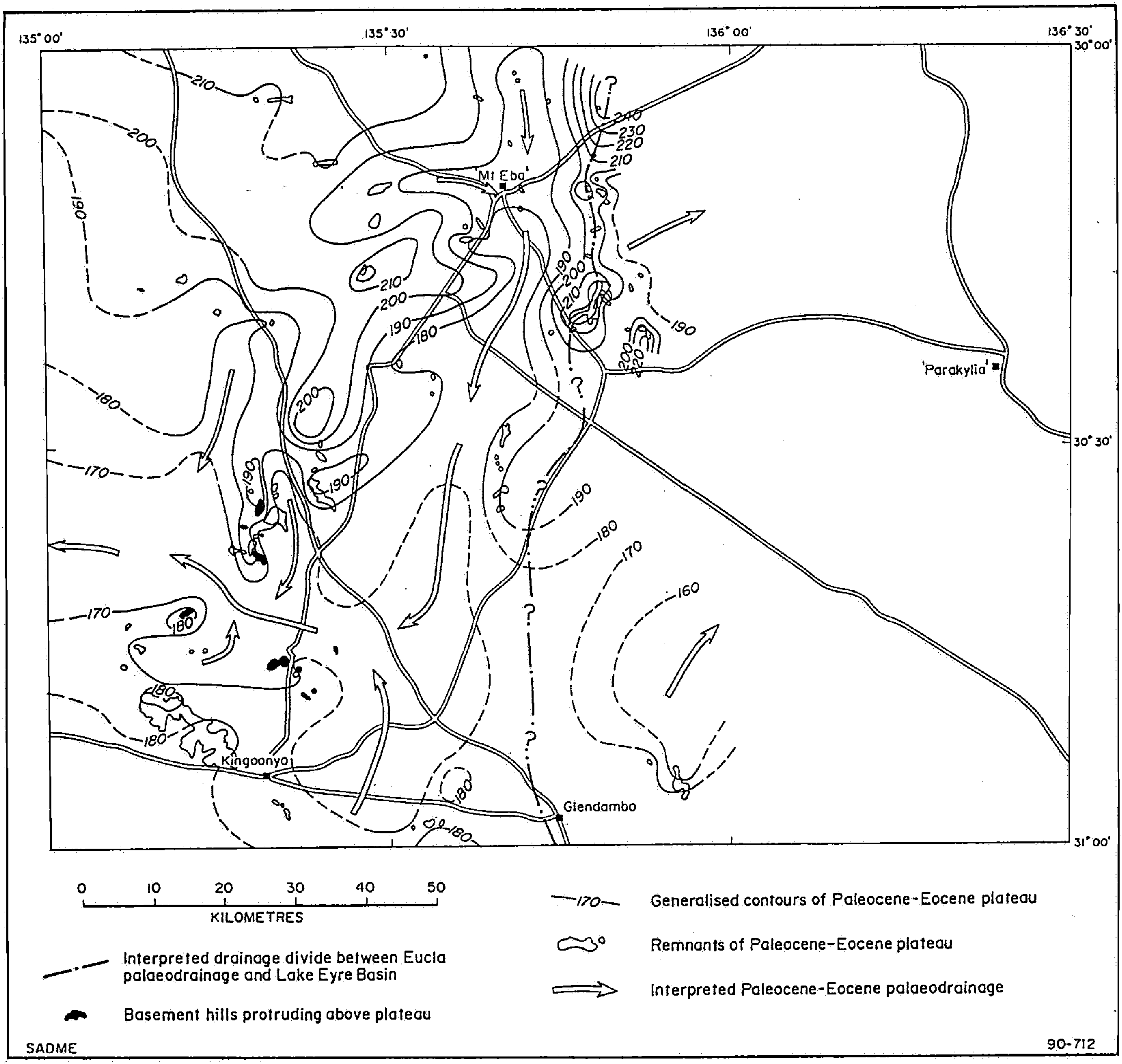


FIG. 12 KINGOONYA EXPLANATORY NOTES S22370

Structure contours, base of Bulldog Shale.



4974

FIG. 13 KINGOONYA EXPLANATORY NOTES S22371

Structure contours, top of Munjena Formation equivalent.

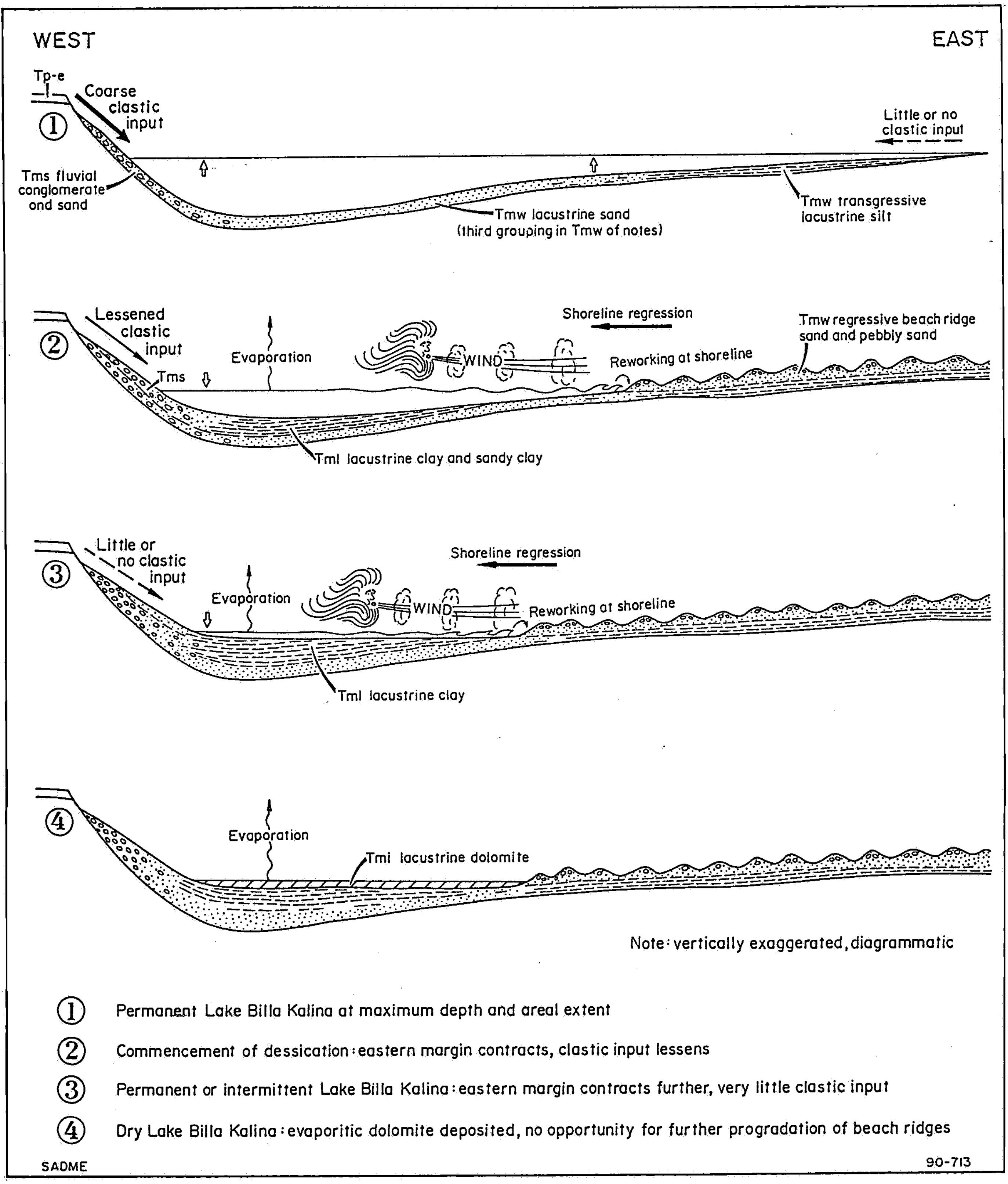


FIG. 14 KINGOONYA EXPLANATORY NOTES S22372

Interpretive palaeogeographic sections, Lake Billa Kalina.

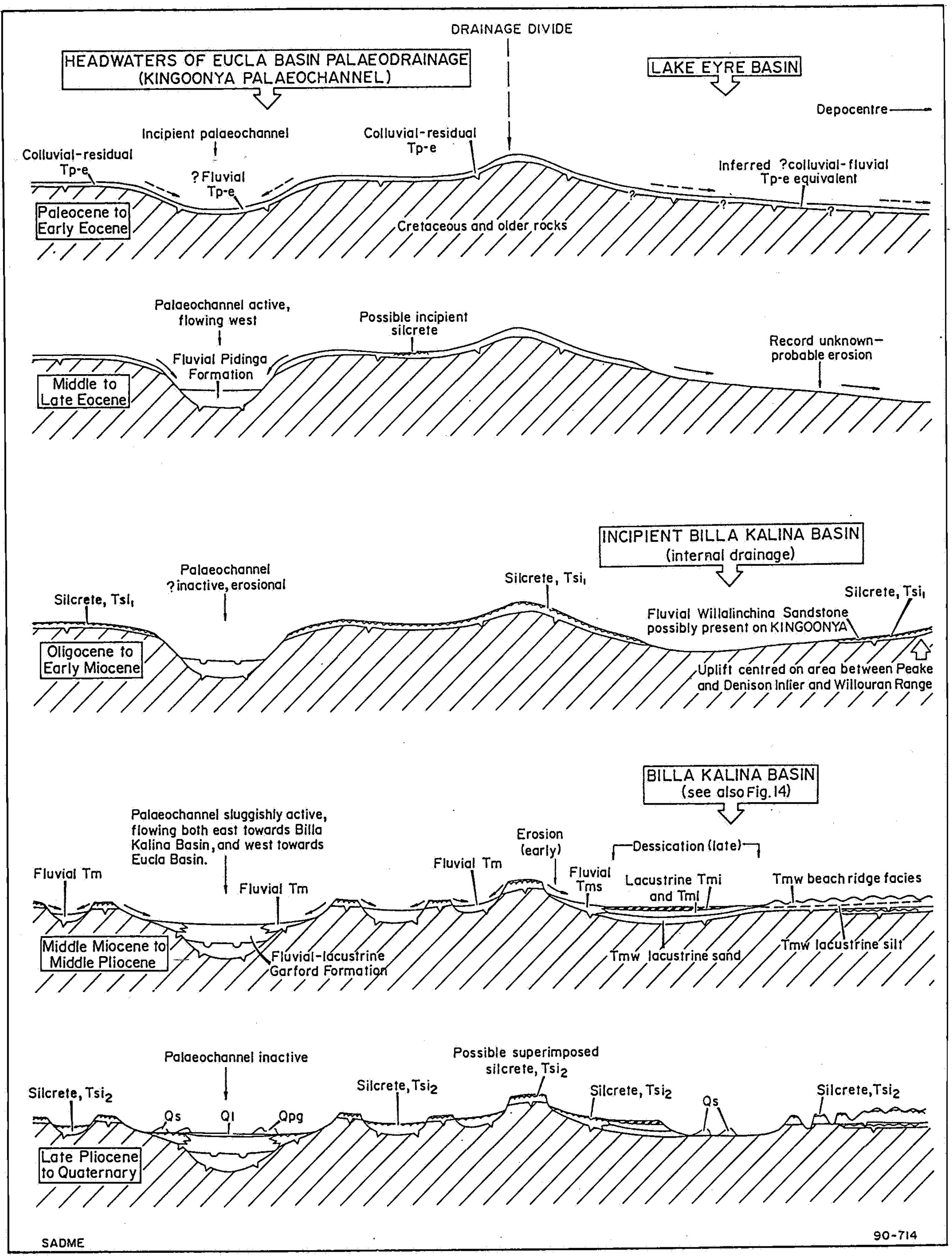
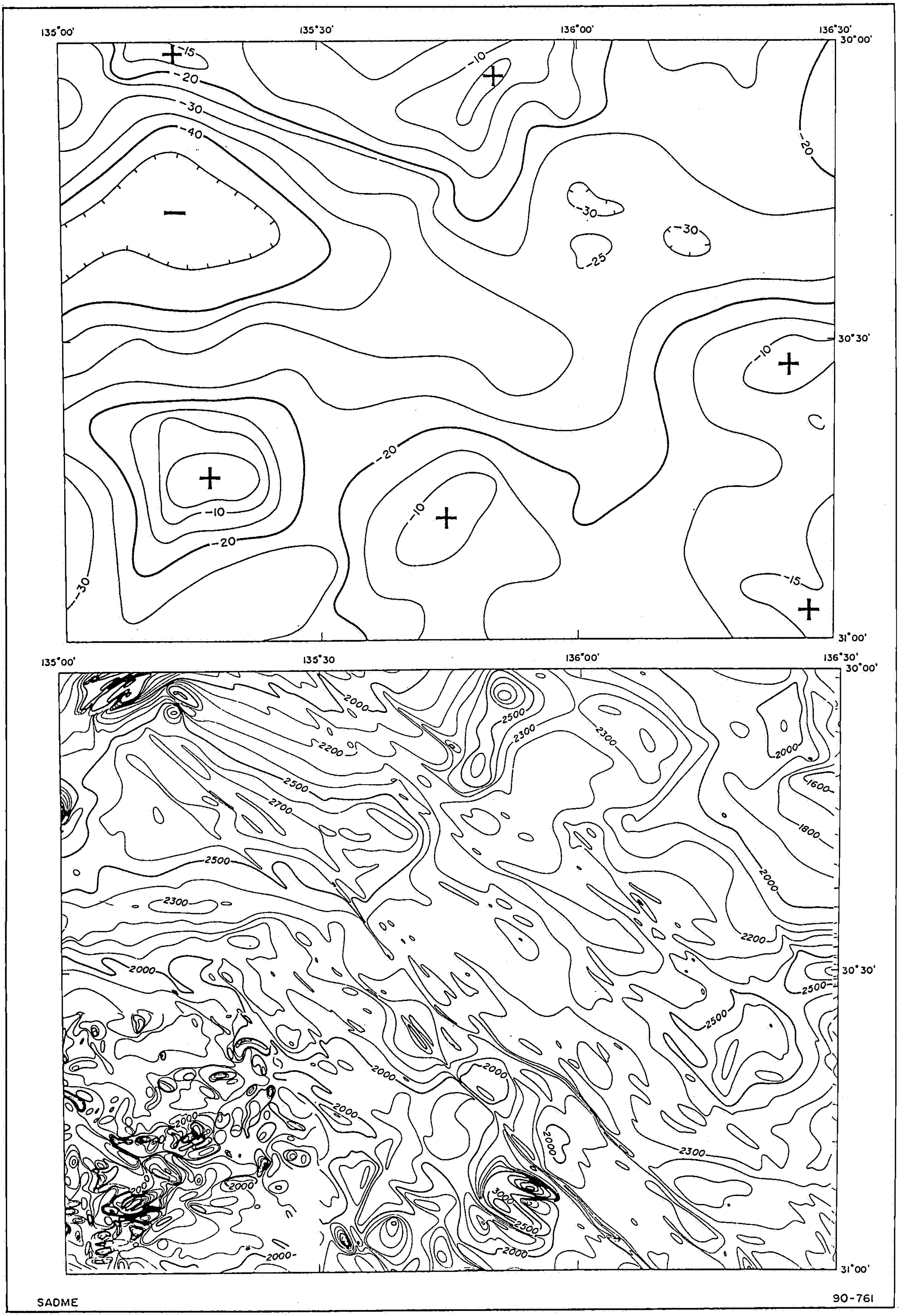


FIG. 15 KINGOONYA EXPLANATORY NOTES S22373

Tertiary palaeogeographic interpretation.

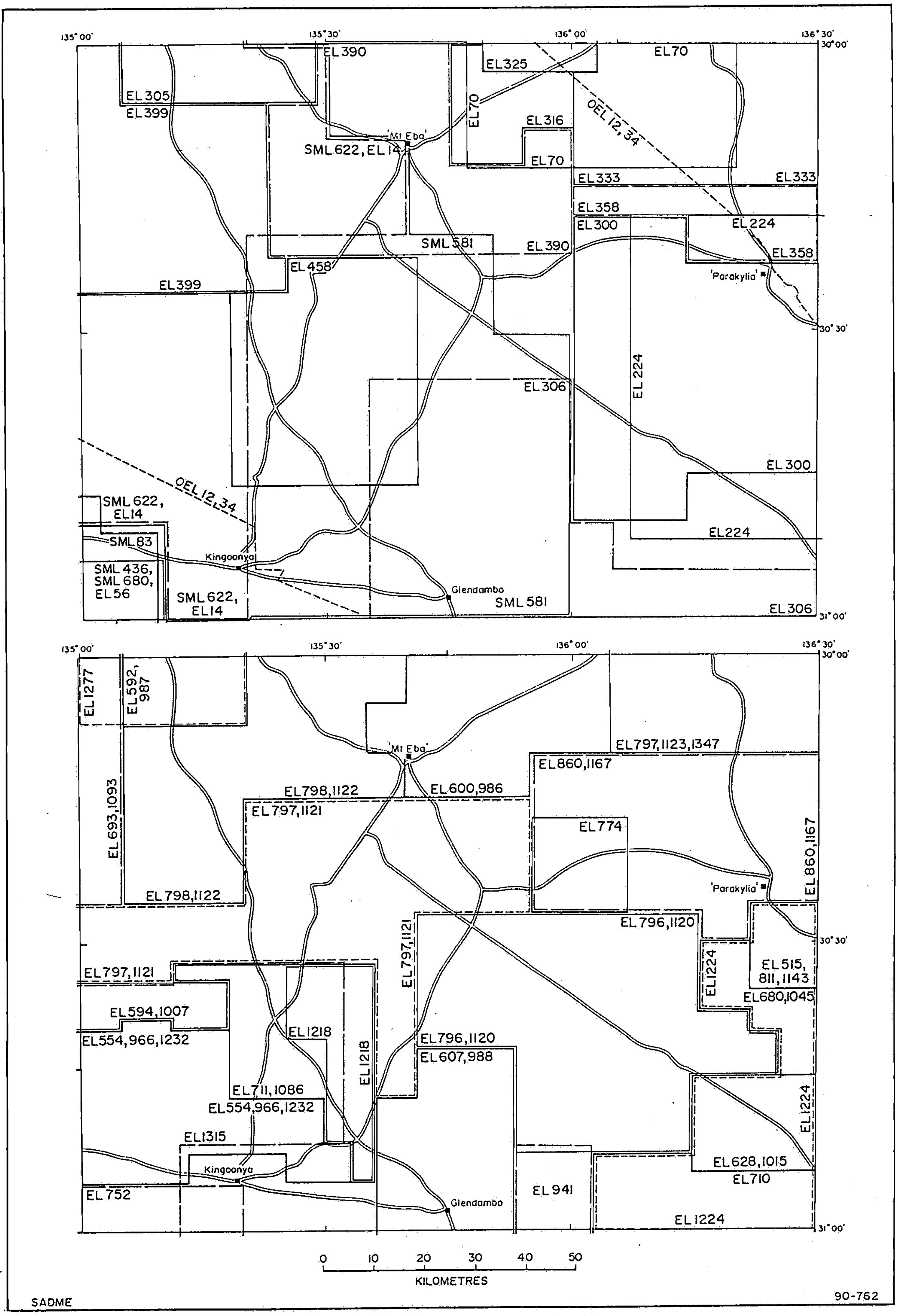


90-761

FIG. 16 KINGOONYA EXPLANATORY NOTES

S22374

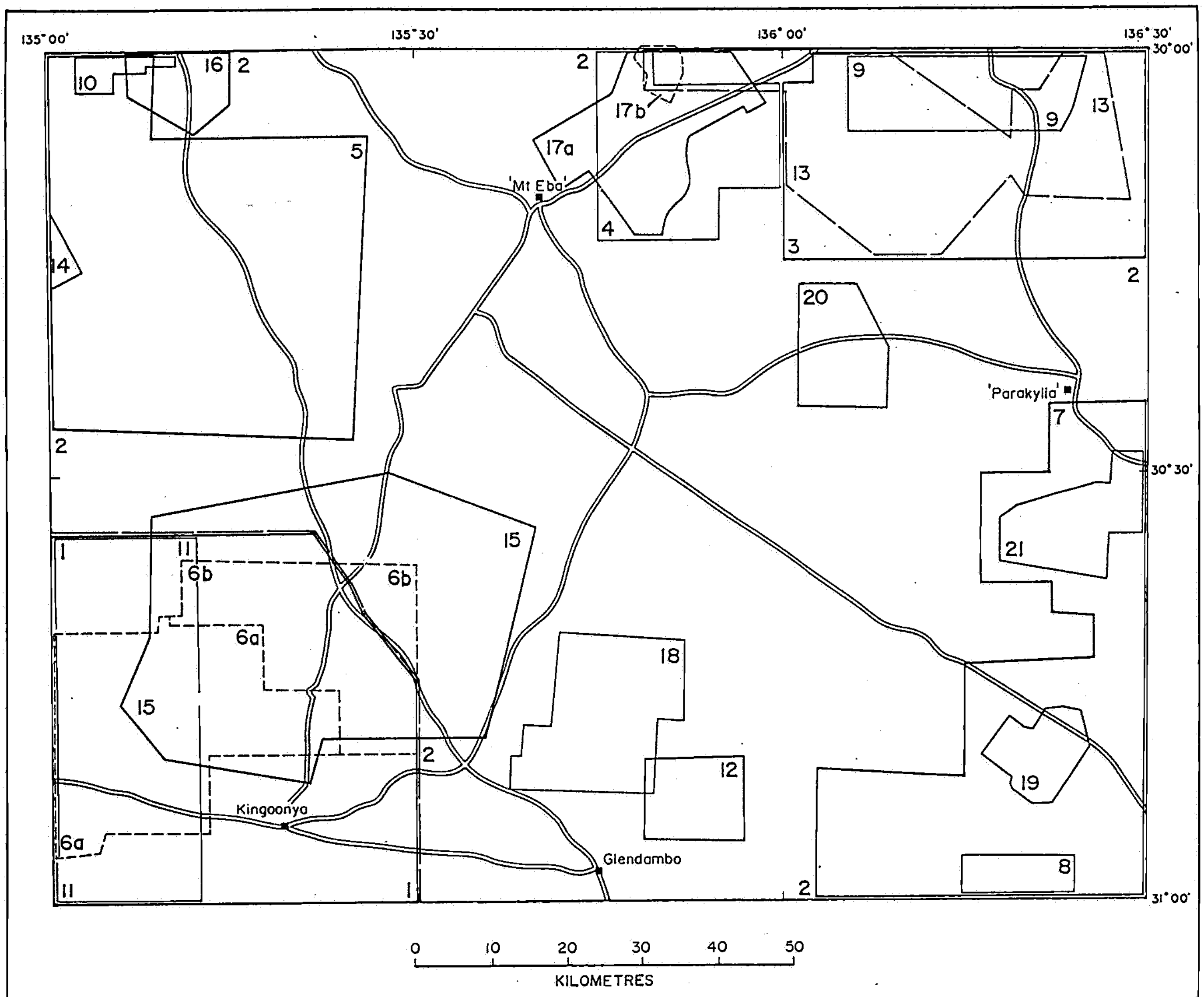
Bouguer gravity contours (above) and aeromagnetic contours (below), KINGOONYA area.



4974

FIG. 17 KINGOONYA EXPLANATORY NOTES

Exploration Tenements, granted 1959-1979 (above) and 1980-1989 (below).



Aeromagnetic Surveys

Area	Line spacing(km) and orientation	Elevation (m)	Flown by	For	Date	Reference
1	1.6 E-W	150	Adastra Hunting	SADM	1957	Whitten(1960)
2	3.2 E-W	150	BMR	SADM	1966	Young & Gerdes(1966)
3	0.5 E-W	100	Geometrics	Samedan	1977	Env. 3002, 3067
4	0.8 N-S 0.8 E-W	100	Austral	Carpentaria	1977-78	Env. 3034
5	0.5 E-W	100	Geometrics	Samedan	1978	Env. 3293
6a	0.4 N-S	90	Geoex	Amoco	1980	Env. 3726,3822,4033
6b	0.4 E-W	90	Aerodata	Amoco	1981	Env. 3726,3822,4033
7	0.3 N-S	80	Austirex	BHP	1984	Env. 5547
8	0.4 ?	125	Austirex	Afmeco	1982	Env. 3992
9	0.25 NNE-SSW	70	Aerodata McPhar	Stockdale	1982	Env. 4272
10	0.3 N-S	120	Geoterrex	CRA	1985	Env. 5431
11	0.3 N-S	80	Geoterrex	CRA	1986	Env. 6532

Regional or Semi-regional Gravity Surveys (*includes ground magnetics)

Area	Line spacing(km)	Surveyed by	For	Date	Reference
Entire mapsheet	6.4 x 6.4 grid	SADM	SADM	1969	Gerdes (1972)
12*	2.0	Solo	Dampier	1978	Env. 3030
13	1.0 x 1.0 grid	Geoterrex	Kennecott and Samedan	1978	Env. 3002, 3067
14*	1.0	Solo	Samedan	1980	Env. 3293
15	fences and tracks	Solo, Amoco	Amoco	1980	Env. 3726,3822,4033
16*	0.7-2.0	Solo	Esso	1981	Env. 3772
17a*	1.0-2.0	Solo	Esso	1979-1980	Env. 3784
17b	0.5-4.0	Solo	Esso	1981	Env. 3784
18*	2.0	Solo	Esso	1980	Env. 3786
19*	1.0-2.0	Geoterrex	Esso	1981	Env. 3878
20	0.7 x 0.7 grid	Solo	Shell	1981	Env. 4113
21*	0.8-2.0	Geoterrex, Solo	Esso	1981-82	Env. 3942,4249

4974

SADME

90-763

FIG. 18 KINGOONYA EXPLANATORY NOTES

S22376

Aeromagnetic and Gravity Surveys.