

# MADURA-BURNABIE

## WESTERN AUSTRALIA



WESTERN AUSTRALIA  
INDEX TO GEOLOGICAL MAPS  
1:250,000 OR 4 MILE SCALE

PUBLISHED



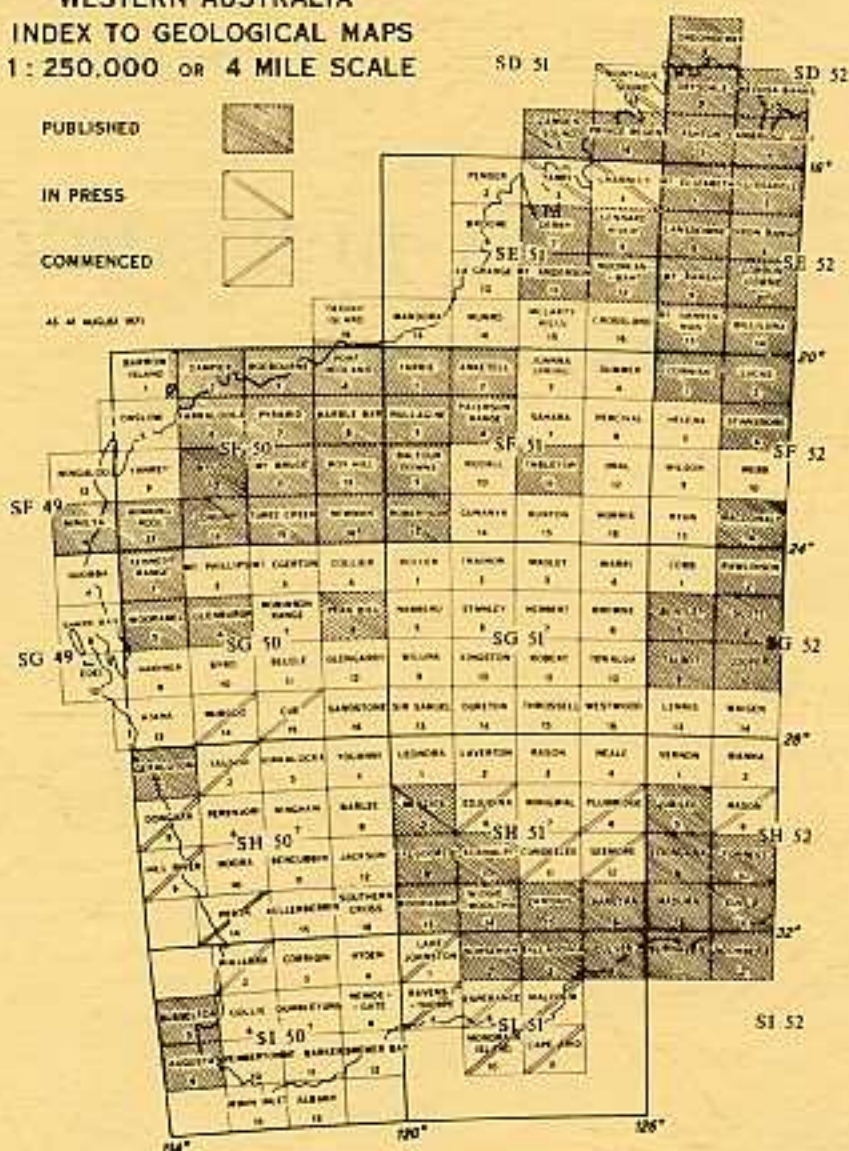
IN PRESS



COMMENCED



AS AT MARCH 1971



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA



1 : 250,000 GEOLOGICAL SERIES — EXPLANATORY NOTES

# **MADURA-BURNABBIE**

## **WESTERN AUSTRALIA**

SHEETS SH/52-13, S1/52-1 INTERNATIONAL INDEX

Compiled by D.C. Lowry

Geological Survey of Western Australia

**DEPARTMENT OF MINES, WESTERN AUSTRALIA**

**MINISTER: THE HON. A. F. GRIFFITH, M.L.C.**

**UNDER SECRETARY: I. R. BERRY**

**GEOLOGICAL SURVEY OF WESTERN AUSTRALIA**

**DIRECTOR: J. H. LORD**

Published for the Minister for National Development  
the Hon. Sir Reginald Swartz, K.B.E., E.D., M.P.,  
by the Australian Government Publishing Service.



# Explanatory Notes on the Madura-Burnabbie Geological Sheet

Compiled by D. C. Lowry

## INTRODUCTION

The Madura-Burnabbie Geological sheet is bounded by latitudes  $31^{\circ} 00' S$  and  $32^{\circ} 30' S$ , and longitudes  $126^{\circ} 00' E$  and  $127^{\circ} 30' E$ , and includes the Madura sheet and the northern half of the Burnabbie sheet (SH/52-13 and SI/52-1 on the International Grid). The sheet covers part of the Eucla Basin and lies in the south-eastern part of Western Australia.

The Trans-Australian Railway and the Eyre Highway give access to the northern and southern parts of the sheet respectively, and there are several vehicle tracks between them. The area was first settled towards the end of the 19th century when pastoral properties were developed along the Hampton Range and a transcontinental telegraph line was constructed near the coast. Much of the area is now being developed for pastoral use. Madura Station runs cattle, and Cocklebidy and Moonera Stations graze sheep. Motels are established on the Eyre Highway at Cocklebidy and Madura.

The annual rainfall is about 11 inches on the coast but decreases northwards to about 7 inches at the railway. Evaporation is estimated to be about 55 to 80 inches annually. In January the normal daily maximum temperatures range from  $75^{\circ}F$  near the coast to  $85^{\circ}F$  inland, and the normal daily minimum is about  $60^{\circ}F$ . In July the respective temperatures are  $63^{\circ}F$  and  $45^{\circ}F$  (Australia, Bureau of Census and Statistics, 1967).

The vegetation in the northern part of the sheet consists of open grassy plains with low shrubs of salt bush (*Atriplex* spp.) and blue-bush (*Kochia sedifolia*). Further south there is a belt of myall scrub (*Acacia* spp.) and south of that again near the Hampton Range, a zone of mallee-type eucalypts. On the Roe Plains south of the Hampton Range coastal dunes are covered with mallee scrub and other areas with salt bush, samphire (*Arthrocnemum* sp.) or tea-tree (*Melaleuca* sp.).

Muir (1901) and Gibson (1909) gave brief accounts of the geology of parts of the Madura-Burnabbie sheet, and Ludbrook (1958a) described a few surface samples, but there was no systematic mapping prior to the author's work in 1965 and 1966. The information on subsurface geology was obtained from the Transcontinental Railway Bores Nos. 1, 2, and 3 (Maitland, 1911; Ludbrook, 1958a), the stratigraphic well Eyre No. 1 (Shiels, 1960; Ludbrook, 1960) and geophysical surveys by Tenneco Australia Inc., (1967, 1968), Gunson and van der Linden (1956), and Quilty and Goodeve (1958). General descriptions of the geology of the Eucla Basin in Western Australia have been given by Maitland (1919a, 1919b), Fairbridge (1953), Singleton (1954), Ludbrook (1958a) and Lowry (1968a). The geomorphology of the area has been described by Jennings (1963, 1967a, b).

The Madura-Burnabbie sheet was mapped as part of a study of the western part of

the Eucla Basin by the Geological Survey of Western Australia. Fossils collected during the field work were examined by the following specialists: brachiopods and molluscs – N.H. Ludbrook; echinoids – G.M. Philip; foraminifers, bryozoans and other groups – A.E. Cockbain.

## PHYSIOGRAPHY

The land surface of the Madura-Burnabbie sheet is divided by the Hampton Range into the Bunda Plateau, which slopes gently from about 600 feet above sea level in the north to between 240 and 390 feet in the south, and the Roe Plains which slope down to the coast from an altitude of 100 feet near Madura. Coastal dunes, some reaching a height of as much as 300 feet, are developed on parts of the Roe Plains.

The flatness of the Bunda Plateau is believed to be inherited from the flatness of the Lower Miocene sea floor from which it was formed (Tate, 1879; Jennings, 1963). The plateau has subsequently been modified by the deflation of clay soils and the formation of blow-holes, caves, collapsed dolines, rock holes, and other karst features (Jennings, 1963, 1967a, 1967b; Lowry, 1968b). Karst development is not far advanced, and Jennings characterized the area as an immature karst retarded by an arid to semi-arid climate.

There are numerous small shallow caves and several large ones; the largest being Mullamullang Cave which has 15,000 feet of large passages and contains saline lakes 380 feet below the plateau surface.

The surface of the southern part of the plateau has low stony ridges separated by clay flats. The flats are formed by colluvial infillings of joint-controlled depressions that are believed to have been exposed by the removal through deflation of a cover of residual clay. Parts of the plateau show traces of former watercourses that have probably not contained streams since the Pleistocene.

The Hampton Range is a Pleistocene sea cliff and the Roe Plains were also formed by marine abrasion in the Pleistocene (Ludbrook, 1958a). There is no firm evidence to support Frost's (1958) view that the range is a fault scarp.

## STRATIGRAPHY

The Madura-Burnabbie sheet is underlain by nearly horizontal Cretaceous, Tertiary, and Quaternary sedimentary rocks resting on Precambrian crystalline rocks. Lower Miocene beds are exposed on the plateau and coast, in caves, and on the Hampton Range, but older rocks are known only from boreholes. The stratigraphic units are summarized in Table 1 and their correlation with the geological time scale is shown diagrammatically in Figure 1.

## PRECAMBRIAN

Two boreholes on the Madura-Burnabbie sheet are sufficiently deep to intersect Precambrian basement rocks. Eyre No. 1 Well (lat.  $32^{\circ} 07' S$ , long.  $127^{\circ} 04' E$ ) encountered a gneissic granite with microcline phenocrysts (Peers and Trendall, 1968) at a depth of 1,708 feet, and Transcontinental Railway No. 3 ("Loongana") Bore (lat.  $30^{\circ} 02' S$ , long.  $127^{\circ} 03' E$ ) reached mylonitic gneiss at a depth of 1,344 feet.

## CRETACEOUS

### *Loongana Sandstone*

The Loongana Sandstone (Lowry, in press), formerly the "Loongana Conglomerate" (Fairbridge, 1953), has its type section in Transcontinental Railway No. 3 Bore between 1,270 and 1,344 feet. The beds are composed of sandstone and conglomeratic sandstone. The formation does not occur in Eyre No. 1, the only other bore-

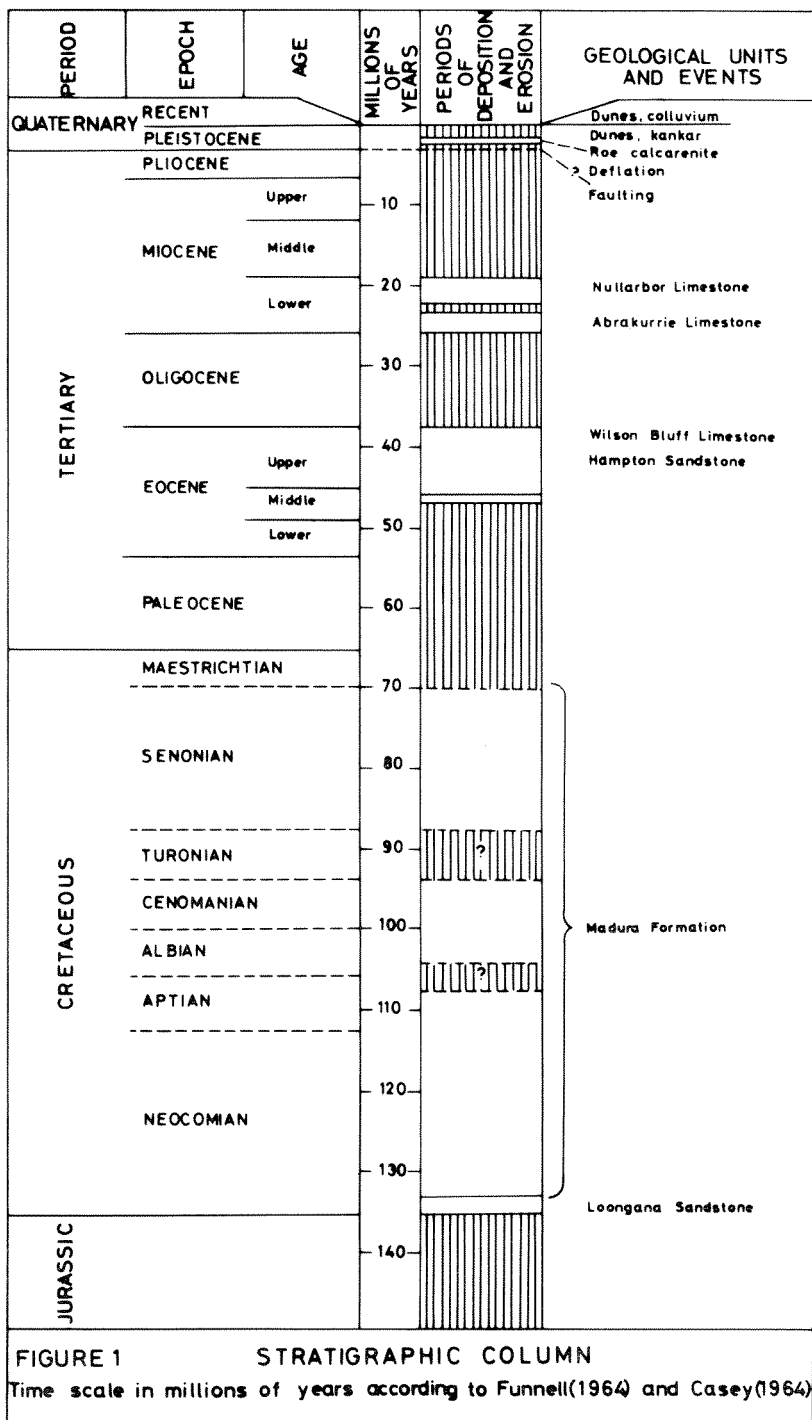


TABLE 1. MADURA-BURNABBIE 1:250,000 GEOLOGICAL SERIES STRATIGRAPHIC SUMMARY

<i>Age</i>	<i>Map Symbol</i>	<i>Name or short description</i>	<i>Maximum Thickness (feet)</i>	<i>Lithology</i>	<i>Stratigraphic relation with underlying unit</i>	<i>Remarks</i>
RECENT	Qrn	Eolian sand	100	Unconsolidated sand, weakly to moderately calcareous	Overlies Roe Calcarenite	Forms coastal dunes
RECENT	Qro	Colluvium	250	Calcareous clay with fragments of limestone and kankar	Overlies Roe Calcarenite	Forms clay flats and talus slope along Hampton Range
PLEISTOCENE	Qpo	Eolian sand	300	Siliceous sand with sheet or nodular kankar at or near the surface	Overlies Roe Calcarenite	Forms coastal dunes
PLEISTOCENE	Qpg	Lagoonal mud	210	Gypsiferous calcareous mud	Overlies Roe Calcarenite	Developed at southwestern end of Roe Plains
PLEISTOCENE	Qp1	Eolian deposits	20	Gypsiferous and calcareous clay and sand	Overlies Roe Calcarenite	Developed at southwestern end of Roe Plains
PLEISTOCENE	Qpc	Roe Calcarenite	22	Weakly cemented shelly calcarenite	Disconformable on Abrakurrie Limestone	
PLEISTOCENE- ?PLIOCENE	TQr	Residual clay and kankar	15	Clay containing sheet and nodular kankar with oolitic texture	Developed over Nullarbor Limestone	
LOWER MIOCENE	Tmn	Nullarbor Limestone	80	Foraminiferal calcarenite	Disconformable on Abrakurrie Limestone	
LOWER MIOCENE	Tmnm	Mullamullang Limestone Member	Rarely over 30	Coralline algal modules in matrix of foraminiferal calcarenite		Basal member of Nullarbor Limestone
LOWER MIOCENE	Tma	Abrakurrie Limestone	300-350	Bryozoan limestone; commonly coarse-grained, porous, and current bedded	Disconformable on Wilson Bluff Limestone	
UPPER AND MIDDLE EOCENE		Wilson Bluff Limestone	1,000	Chalky bryozoan limestone in upper part; marl in lower part	Conformable on Hampton sandstone, or disconformable on Madura Formation	
MIDDLE EOCENE		Hampton Sandstone	65 or more	Sandstone; commonly iron-stained	Disconformable on Madura Formation	Formation is markedly lenticular
UPPER AND LOWER CRETACEOUS		Madura Formation	1,172 or more	Sandstone, siltstone, shale; commonly glauconitic, carbonaceous and pyritic	Conformable on Loongana Sandstone, or unconformable on Precambrian rocks	Deposition probably in Neocomian-Aptian, Albian-Cenomanian, and Senonian
LOWER CRETACEOUS		Loongana Sandstone	74 or more	Sandstone and conglomeratic sandstone	Unconformable on Precambrian rocks	Formation is markedly lenticular
PRECAMBRIAN		Precambrian rocks		Gneissic granite and mylonitic gneiss		Forms basement of Eucla Basin

hole deep enough to have intersected it, and bores elsewhere in the basin show that the formation is lenticular and that it unconformably overlies Precambrian basement.

A core from the type section contains Upper Mesozoic spores and pollen grains but no microplankton (Ingram, 1968b). As the formation is overlain by the Lower Cretaceous Madura Formation with apparent conformity the Loongana Sandstone is probably a fluvial deposit which accumulated in hollows in the basement surface prior to the Lower Cretaceous marine transgression.

#### *Madura Formation*

The Madura Formation (Lowry, in press) formerly the "Madura Shale" (Fairbridge, 1953; McWhae and others, 1958) has its type section in the Transcontinental Railway No. 1 ("Madura") Bore (lat.  $31^{\circ} 55' S$ , long.  $127^{\circ} 00' E$ ) between 928 feet 6 inches and the bottom of the bore at 2,101 feet (Lowry, 1968a; Ingram, 1968a). Cores from the type section were described by Maitland (1904) and Ludbrook (1958a), but a better account of the lithology of the formation can be found in Ludbrook's (1960) description of cores and cuttings from the Eyre No. 1 Well between 1,180 and 1,708 feet. The formation consists of greensand and silty carbonaceous pyritic sandstone in its upper part and glauconitic pyritic sandy siltstone, carbonaceous siltstone and claystone, glauconitic sandstone, and greensand in its lower part.

The formation was also encountered in the Transcontinental Railway No. 3 Bore between 630 and 1,270 feet (Ludbrook, 1958a), and in the Transcontinental Railway Bore B between 485 feet and the bottom of the hole at 884 feet. The thickest drilled section was 1,172 feet 6 inches in Transcontinental Railway No. 1 Bore and marine seismic surveys show that the formation thickens southwards although the relief on the basement surface causes major variations in thickness. Arenaceous foraminifers (Ludbrook, 1958a, 1960) and palynomorphs (Ingram, 1968a) show that the age of the formation ranges from Lower to Upper Cretaceous. Ingram recognized three palynomorph assemblages in Transcontinental Railway No. 1 Bore and regarded them as Neocomian-Aptian, Albian-Cenomanian, and Senonian in age. Eyre No. 1 Well contained only the upper two assemblages and is therefore probably sited on a topographic high in the basement surface. Ingram (1968a) showed that although most of the formation was deposited in a marine environment, the lower part of the sequence lacks microplankton and was probably deposited in a non-marine environment.

### **TERTIARY**

#### **MIDDLE TO UPPER EOCENE**

##### *Hampton Sandstone*

The Hampton Sandstone (Lowry, 1968a), formerly the "Hampton Conglomerate" (Fairbridge, 1953) has its type section in Transcontinental Railway No. 1 Bore at Madura at a depth of between 903 feet and 928 feet 6 inches. The formation consists of lime-cemented medium to coarse-grained limonitic sandstone, conglomeratic sandstone, and minor conglomerate. It is a lenticular formation 25 feet 6 inches thick in the type section and 65 feet thick in Eyre No. 1 Well, but is missing from Transcontinental Railway Bores B and No. 3.

The formation disconformably overlies the Madura Formation. It is a marine deposit and contains characteristic Middle Eocene foraminifers in Eyre No. 1 Well (Ludbrook, 1960).

##### *Wilson Bluff Limestone*

The Wilson Bluff Limestone (Singleton, 1954; Lowry, 1968a) is a chalky bryozoan limestone that underlies the whole of the Madura-Burnabbie sheet. It is intersected



in the Eyre No. 1 Bore between about 130 and 1,115 feet and consists of pale, indurated to chalky, bryozoan calcarenite in its upper part and a soft glauconitic marl in its lower part (Ludbrook, 1960). The base of the formation occurs in the Transcontinental Railway No. 1 Bore at 903 feet, in No. 3 Bore at 630 feet, and in Bore B at 485 feet. The top of the formation cannot be accurately determined in these bores or in the Transcontinental Railway No. 2 Bore (Ludbrook, 1958a).

The thickest drilled section of about 985 feet is in Eyre No. 1 Bore and the formation thickens southwards. It rests conformably on the Hampton Sandstone, or disconformably on the Madura Formation. Benthonic and planktonic foraminifers indicate an Upper Eocene age for the upper part of the formation, and a Middle Eocene age for the lower part (Ludbrook, 1963).

## LOWER MIOCENE

### *Abrakurrie Limestone*

The Abrakurrie Limestone (Lowry, 1968a) is a porous, yellowish, bryozoan limestone ranging from fine-grained calcarenite to fine-grained calcirudite. The formation is commonly well sorted and current bedded and where the rock is fresh it is weakly cemented and retains much of its original porosity. The thickest known section is in the Mullamullang Cave where 300 feet of the formation are exposed above the water table. The formation extends as far north as Transcontinental Railway No. 3 Bore, where a core from between 67 and 130 feet contains bryozoans typical of the Abrakurrie Limestone. In the southern part of the sheet the formation is exposed on coastal cliffs, on the Hampton Range, in caves, and on the surface of the plateau.

The Abrakurrie Limestone disconformably overlies the Wilson Bluff Limestone. Brachiopods and pectinids are common, and there is a rich echinoid fauna that indicates a Lower Miocene or Oligocene age (G.M. Philip, written communication, 1968). The absence of distinctive Oligocene fossils makes a Lower Miocene age probable.

### *Nullarbor Limestone*

The Nullarbor Limestone (Singleton, 1954; McWhae and others, 1958; Ludbrook, 1958b; and Lowry, 1968a) is a micritic, fine to medium-grained calcarenite with grains composed largely of fragmented and unfragmented foraminifers and calcareous algae.

The Nullarbor Limestone is the youngest of the marine Tertiary formations, and forms the surface of a large part of the Bunda Plateau. The formation is thickest (about 80 feet) in the northern part of the sheet, but thins southwards. The thinning is primarily due to the increased erosion caused by higher rainfall as the coast is approached.

The Nullarbor Limestone overlies the Abrakurrie Limestone with a slight disconformity. It contains common moulds of pelecypods and gastropods (see Ludbrook, 1967a), and occasional bryozoans and corals. The foraminifers are benthonic forms with Indo-Pacific affinities and the association in the upper part of the formation of *Marginopora vertebralis*, *Austrotrillina howchini*, and *Flosculinella bontangensis* indicates a Lower Miocene (Burdigalian) age (Ludbrook, 1963, 1967b).

In the basal part of the Nullarbor Limestone, beneath the southern part of the plateau, nodules of coralline algae are so abundant that they form an algal limestone. Lowry (1968a) named it the Mullamullang Limestone Member. The algal nodules are generally 0.2 to 1.5 inches across and are enclosed in a poorly sorted calcarenite that is similar to that in the remainder of the formation. The northernmost exposure is in Roaches Rest Cave (15 feet thick) and it thickens southwards, being 21 feet

thick at the type section in Mullamullang Cave, and up to 50 feet thick near Madura.

## TERTIARY TO QUATERNARY

A succession of late Cainozoic events can be established for the Eucla Basin, although the age of each is uncertain. Two important events were a period of major deflation of clay soils from the Bunda Plateau, and a marine incursion which eroded the Hampton Range and Roe Plains and deposited the Roe Calcarene. The deflating of clay soils is believed to have preceded the marine transgression because ancient coastal dunes on the Bunda Plateau at Madura rest directly on a hardened soil-free surface of Miocene Limestone. Ludbrook (1968a) regarded the marine shell beds at Madura (the Roe Calcarene) as Pleistocene and noted the presence of several extinct species of molluscs. Late Pleistocene shell beds associated with the Coastal Limestone in the Perth Basin contain only living species, so the Roe Calcarene is probably early or middle Pleistocene. The deflation may also have occurred in the Pleistocene because it probably corresponds to the "unstable phase of the Parakilya Cycle" which Jessup (1961) placed in the middle of the three Quaternary climatic cycles he recognized in South Australia. The thick residual clays and kankar that underwent deflation must have developed after the Miocene emergence of the plateau, and are therefore tentatively regarded as Pliocene or Pleistocene. The clay and kankar occur only in the northwest corner of the sheet where their preservation appears to be related to an old river system. The streams flowed both before and after the period of deflation, but have probably not flowed in Recent times. Coastal dunes formed around the edge of the Roe Plains after the retreat of the sea, and kankar developed near the surface of the dunes and also in thin discontinuous clay soils (unmapped) on the Bunda Plateau. The kankar is now weakly dissected and is regarded as Pleistocene. A lagoon and associated dunes developed at Damper Flat at the western end of the Roe Plains, and they are also regarded as Pleistocene because the lagoon is now largely dry and vegetated and the dunes are dissected. Colluvium is now accumulating on the plateau and at the foot of the Hampton Range. The deposits have weakly developed soils and are all regarded as Recent.

### *Residual clay and kankar*

In the northwestern part of the sheet the Nullarbor Limestone is overlain by a layer of calcareous clay which is 10 to 15 feet thick. It contains a layer of grey kankar about 6 feet thick which usually lies a few feet below the surface. The kankar forms slabs and cobbles and has a complex internal structure that is characteristically oolitic or pisolitic. The soil is believed to be dominantly residual, but the occasional presence of the land snail *Bothriembryon* sp. enclosed in the clay and kankar indicates that some reworking has occurred.

## QUATERNARY

### PLEISTOCENE

#### *Roe Calcarene*

The name Roe Calcarene is proposed for shelly calcarenite developed at or near the surface of the Roe Plains. The type section chosen is an exposure in the doline of Nurina Cave (lat. 32° 01' S, long. 127° 00' E) 8 miles south of Madura. The unit is 4 feet 6 inches thick at the type section and consists of weakly cemented, poorly bedded, medium to coarse-grained, porous, shelly, sandy calcarenite. It is overlain by 6 inches of clay soil and rests disconformably on a weathered surface of Abraham Limestone. The unit may reach a thickness of 22 feet in Transcontinental Railway No. 1 Bore (Ludbrook, 1958a), but the greater thicknesses which have been inferred to occur in Madura Cave (Jennings, 1963) and Eyre No. 1 Well (Ludbrook 1960) are believed to be incorrect.

The formation contains a rich molluscan fauna of Pleistocene age (Ludbrook,

1958a; 1958b) and it is possible that beds mapped as Roe Calcarenite have a variety of ages within the Pleistocene. Palaeontological studies and detailed mapping may eventually enable separate formations to be distinguished.

#### *Lagoonal mud and associated eolian deposits*

At the southwestern end of the Roe Plains there is an old lagoon with a surface of gypsiferous calcareous soil presumed to be underlain by saline mud. Low dunes of gypsiferous calcareous clay and sand are associated with these deposits. The lagoon was probably formed as a remnant of the sea which was cut off by advancing dunes during the late Pleistocene.

#### *Eolian Sand*

There were at least two main periods of coastal dune formation in the Pleistocene. The older dunes formed when the sea flooded the Roe Plains as far as Madura. The dunes are developed on the edge of the Hampton Tableland near Madura and reach a thickness of 55 feet at trigonometrical station NM/F/228. They were probably formerly calcareous but leaching is now so far advanced that they now consist of fine quartz sand with a 2 to 3-foot thick layer of hard kankar and remnants of eolianite developed at or near the surface.

The younger dune mass accumulated when the beach was close to its present position. The greatest development is at the western end of the Roe Plains where dunes have blown 60 miles inland and reach a height of about 300 feet. The dunes are formed of fine to medium-grained quartz sand and were probably formerly slightly calcareous. The calcium carbonate is now concentrated as a thin layer of sheet or nodular kankar at or near the surface.

#### RECENT

##### *Colluvium*

The clay flats of the Bunda Plateau are underlain by clay washed from surrounding slopes. The colluvium probably reaches about 15 feet in thickness and is composed of calcareous clay containing scattered angular fragments of kankar and limestone. In a few places weakly developed soft platy kankar occurs within the colluvium a foot or two below the surface. Colluvium is also accumulating along the foot of the Hampton Range and consists of calcareous clay with abundant rubble of kankar limestone.

##### *Eolian Sand*

A discontinuous fringe of unconsolidated sand dunes is developed along the coast. The sand is composed of medium to fine-grained quartz with a small to moderate proportion of bioclastic calcium carbonate. At the present time the sand is accumulating particularly rapidly at Twilight Cove, the beach having advanced more than 200 yards in the last 90 years. The sand has probably been transported during the Quaternary from the granitic coast southwest of the Eucla Basin.

#### STRUCTURE

In the Eucla Basin, Precambrian crystalline basement rocks of unknown structure are unconformably overlain by Mesozoic and Tertiary strata which are almost horizontal. The present configuration of the basement surface (Fig. 2) is a result of the combined effects of highly irregular pre-Cretaceous topography and subsequent tectonic modification. Marine seismic surveys are interpreted as showing sediment-filled valleys with a relief of several hundred feet near the southern edge of the sheet. Epeirogenic warping of the basin has tilted the basement surface from a general level of about 750 feet below sea level at the northern edge of the sheet to about 2,000 to 3,000 feet below sea level at the southern edge.

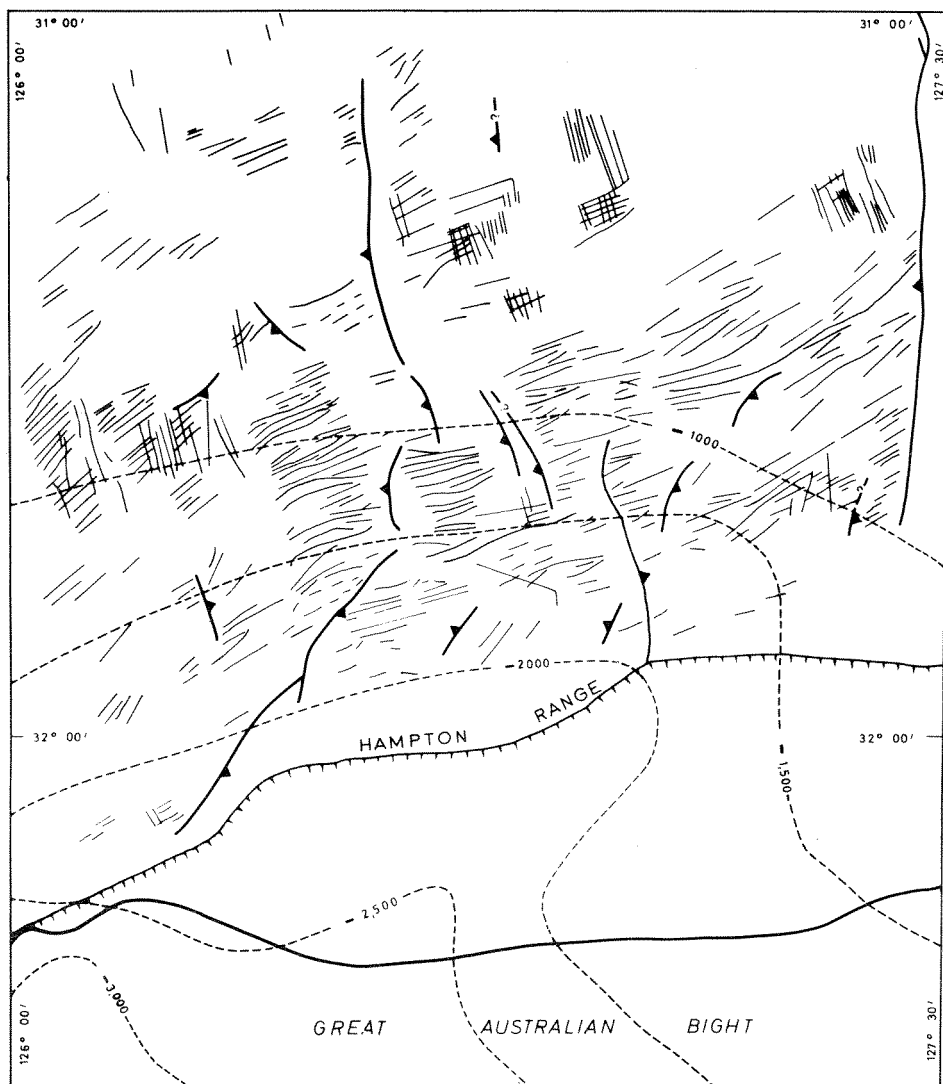


FIGURE 2

REFERENCE

- Joint
- ▲ Fault
- ?▲ Inferred fault

---2,000---  
Approximate contours  
of basement surface;  
feet below sea level

STRUCTURAL SKETCH MAP  
MADURA-BURNABBIE SHEET SH52-13  
AND PART OF SI52-1

SCALE OF MILES  
10 0 10 20 30

Low scarps 20 to 60 feet high and several miles long occur on the Madura-Burnabbie sheet, and are believed to be fault scarps formed since the Lower Miocene. The fault north of Madura grades southwards into a monoclinial fold which has a stratigraphic displacement of about 200 feet where it is exposed in section on the Hampton Range. The absence of fault scarps on the Roe Plains indicates that there has been no faulting since deposition of the Pleistocene Roe Calcarene. The movement on a fault on the Seamore sheet preceded the formation of the Pliocene-Pleistocene kankar, and it therefore seems likely that the faulting in the Eucla Basin occurred in the Miocene or Pliocene.

The elongate ridges and flats on the Bunda Plateau are joint controlled and their trends are plotted in Figure 2. The origin of the joint pattern is obscure.

## ECONOMIC GEOLOGY

### *Underground water*

Underground water is at present the most important aspect of the economic geology of the area. Pastoral development is restricted to some extent by the inadequate water supplies for stock. The hydrogeology can be discussed under four headings:

*Unconfined groundwater in Quaternary dune sands.* Small supplies of potable water can be obtained from Recent dune sands at Eyre and Twilight Cove. A spring at the foot of the cliffs at Twilight Cove (Gibson, 1909) is probably supplied from adjacent sand dunes.

*Unconfined groundwater in Tertiary limestone.* Beneath the southern part of the Bunda Plateau the water table lies within the porous Abrakurrie Limestone and its level lies only a few feet above sea level. Salinities are usually in the range 8,000 to 20,000 ppm. Beneath the northern part of the Bunda Plateau the water table lies within the less permeable Wilson Bluff Limestone and is likely to have a more variable level. Little drilling has been done but the prospects for obtaining stock water at depths of 200 to 400 feet are probably moderate. Beneath the Roe Plains the salinity of the groundwater ranges from about 20,000 to 51,000 ppm and there is no prospect of obtaining lower salinity groundwater except for limited supplies from bores or wells sited at the exits of major gorges in the Hampton Range.

*Confined groundwater in the Hampton Sandstone.* Sub-artesian water was encountered in the Transcontinental Railway No. 1 Bore and was described as saline by the driller. Water in the formation elsewhere in the basin mostly has a salinity of 20,000 ppm or more and there is little hope of obtaining stock water from this formation.

*Confined groundwater in the Loongana Sandstone and basal part of the Madura Formation.* Transcontinental Railway No. 1 Bore yielded an artesian flow (9,500 ppm) from sandstone near the base of the Madura Formation, and No. 3 Bore is reported to have yielded water with a salinity of 3,200 ppm from the Loongana Sandstone. However bores elsewhere in the basin indicate that water in these units is usually too saline for stock. Thus the depth of probable water supplies, expected high salinities, and the uncertainty of intersecting suitable permeable beds makes the formations a poor prospect for providing stock water.

### *Petroleum*

The prospects of finding accumulations of petroleum in the Madura-Burnabbie Sheet area are poor. Although the marine mudstone in the Madura Formation is a possible source rock, seven stratigraphic wells (including some in South Australia) and numerous water bores have been sunk in various parts of the Eucla Basin without any traces of petroleum having been reported. The Loongana Sandstone, rare sandstones in the Madura Formation, and the Hampton Sandstone, are known to be



permeable and could act as suitable reservoir rocks, while the mudstone in the Madura Formation and perhaps the marl of the lower part of the Wilson Bluff Limestone are potential cap rocks. However no structural traps are known and it is likely that any permeable beds are flushed by the flow of confined groundwater from the northern part of the Eucla Basin.

### *Limestone*

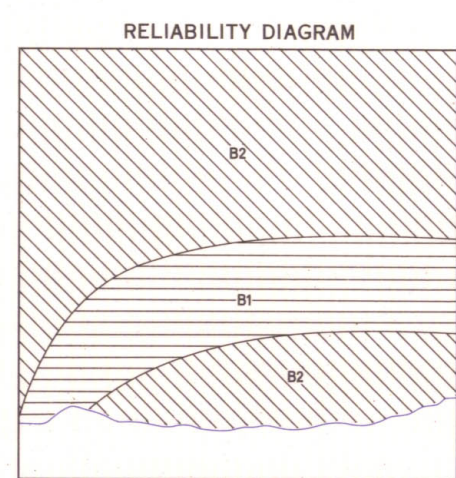
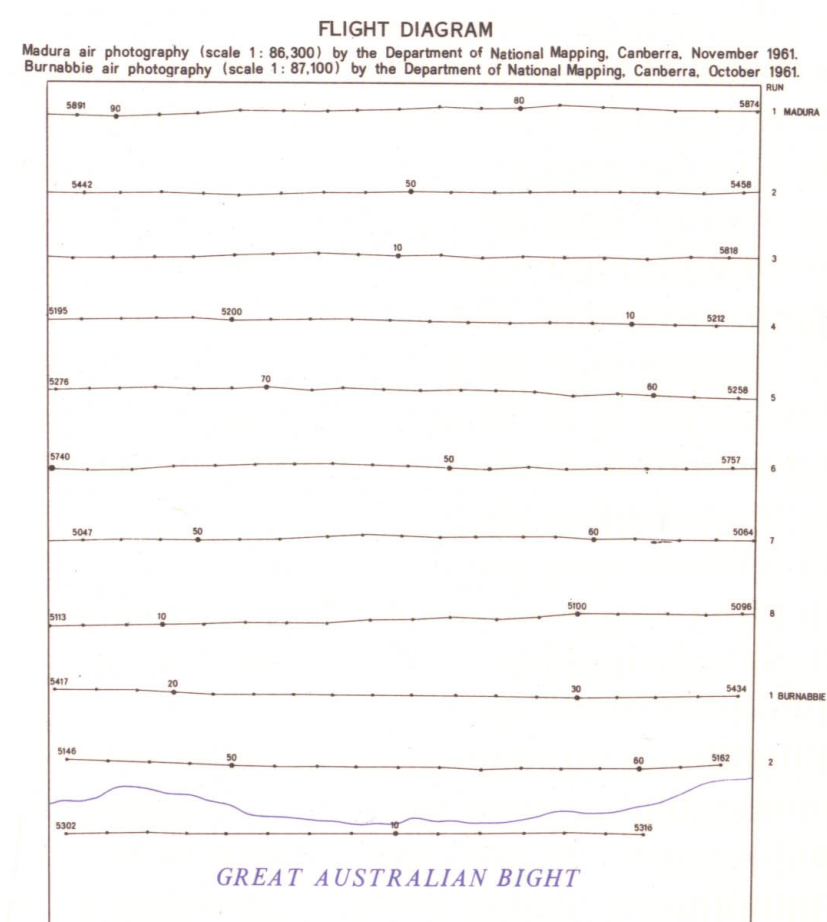
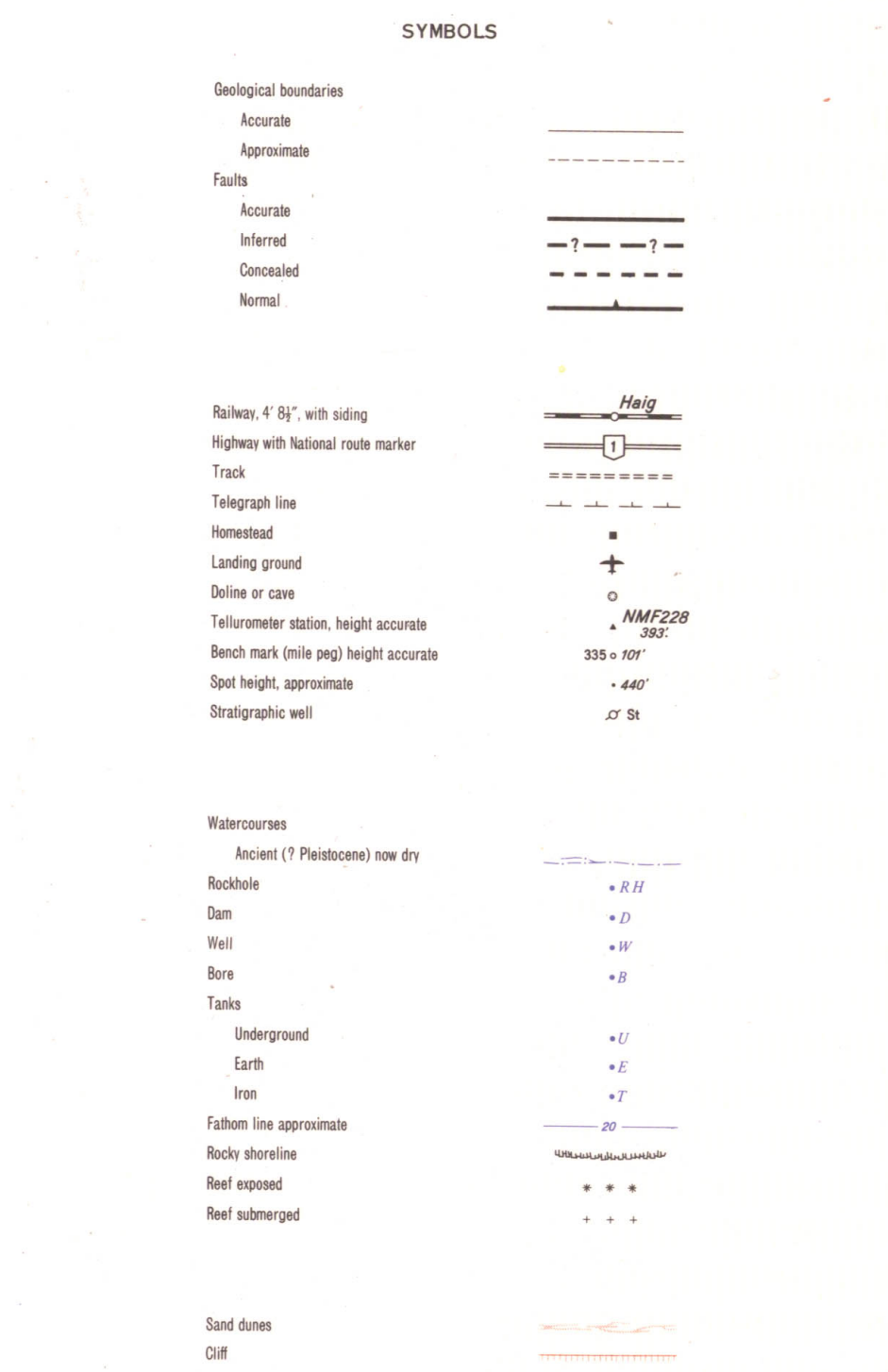
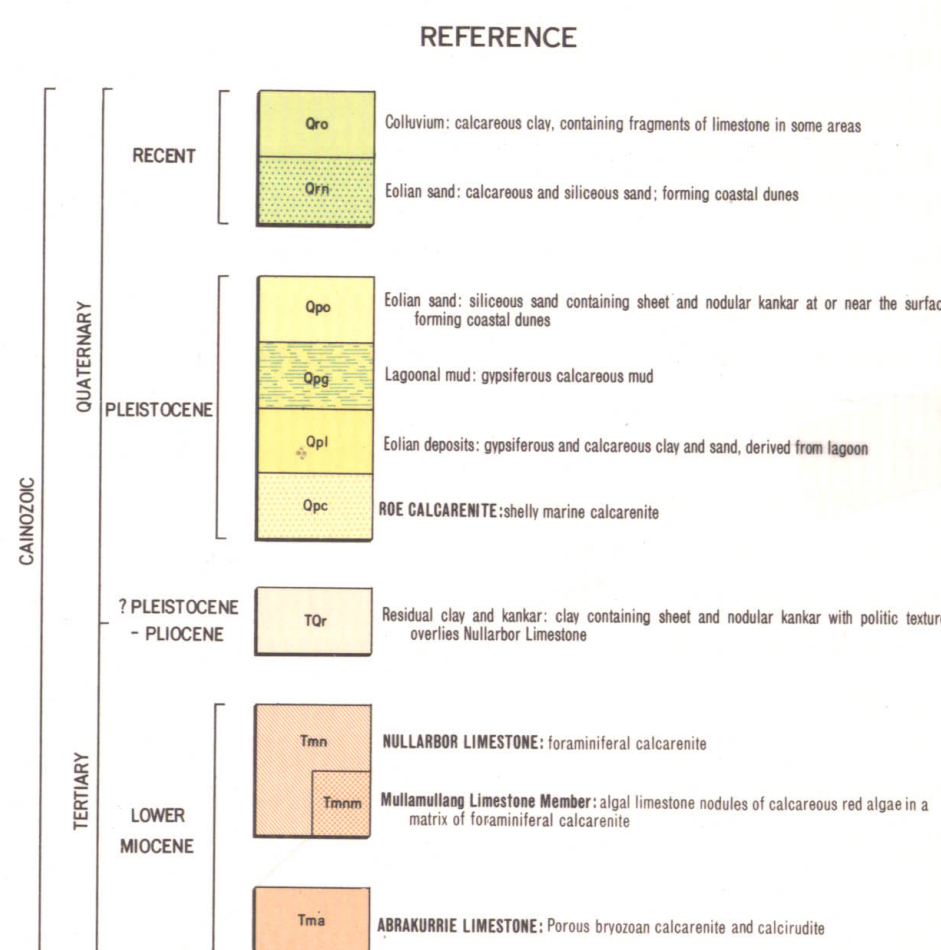
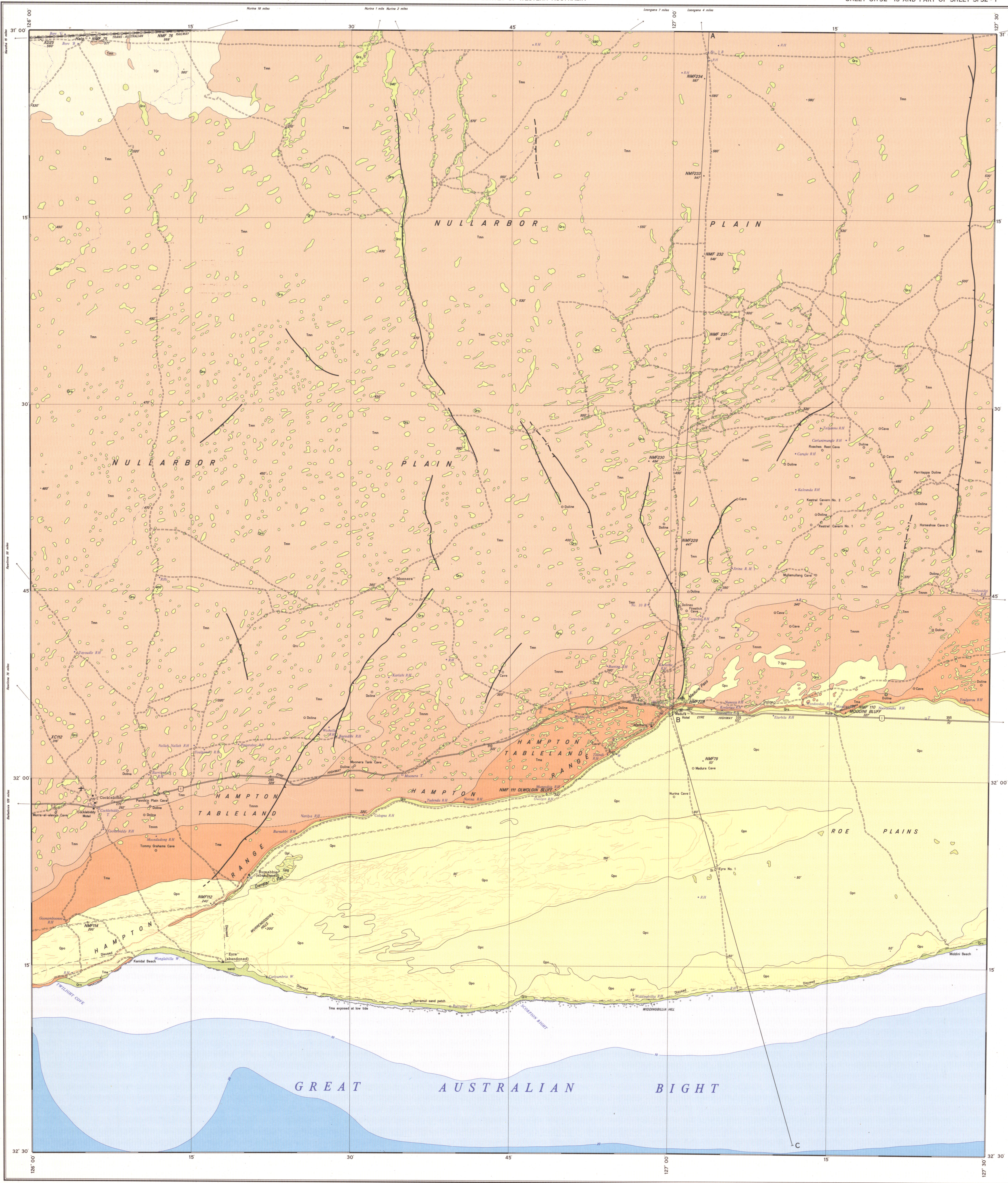
Tertiary limestone in the centre of the Eucla Basin contains about 97 per cent calcium carbonate and 1 or 2 per cent magnesium carbonate. Despite its purity it is remote from industry and is unlikely to be exploited in the near future. Hardened *Abrakurrie Limestone* from near the surface of the plateau has been quarried and crushed for road metal.

### **BIBLIOGRAPHY**

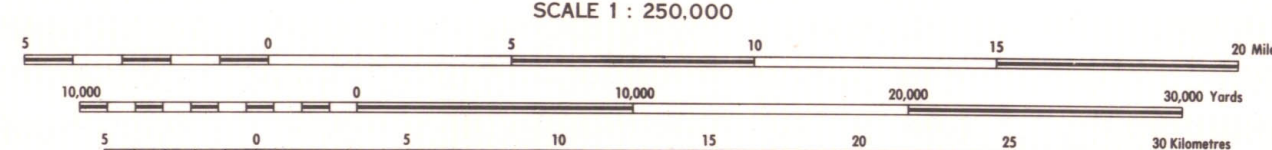
- Australia, Bureau of Census and Statistics, 1967, Official year book of the Commonwealth of Australia, No. 53, Canberra, Government Printer.
- Casey, R., 1964, The Cretaceous Period, p. 193-202 in *The Phanerozoic time-scale*: Geol. Soc. London Quart. Jour., v. 120S.
- Fairbridge, R.W., 1953, *Australian Stratigraphy*: Perth, Univ. West. Australia Text Books Board.
- Frost, M.J., 1958, Jointing associated with the Hampton Fault near Madura, W.A.: Royal Soc. West. Australia, Jour. v. 41, p. 23-26.
- Funnell, B.N., 1964, The Tertiary Period, p. 179-192 in *The Phanerozoic time-scale*: Geol. Soc. London Quart. Jour., v. 120S.
- Gibson, C.G., 1909, Country lying along the route of the proposed transcontinental railway in Western Australia: West. Australia Geol. Survey Bull. 37, 27pp.
- Gunson, S., and van der Linden, J., 1956, Regional gravity traverses across the Eucla Basin 1954-55: Australia Bur. Mineral Resources Rec. 1956/145, (unpublished).
- Ingram, B.S., 1968a, Stratigraphical palynology of Cretaceous rocks from bores in the Eucla Basin, Western Australia: West. Australia Geol. Survey Ann. Rept. 1967, p. 64-67.
- 1968b, Palynology of a sandstone core, Loongana Bore: West. Australia Geol. Survey Palaeont. Rept. 19/1968 (unpublished).
- Jennings, J.N., 1963, Some geomorphological problems of the Nullarbor Plain: Royal Soc. South Australia Trans., v. 87, p. 41-62.
- 1967a, Some karst areas in Australia, p. 256-292 in Jennings, J.N., and Mabbutt, J.A., eds., *Landform studies from Australia and New Guinea*: Australian Natl. Univ. Press, 434p.
- 1967b, The surface and underground geomorphology, p. 13-31 in Dunkley, J.R., and Wigley, T.M., eds., *Caves of the Nullarbor*: Sydney, Speleol. Research Council, 61pp.
- Jessup, R.W., 1961, A Tertiary-Quaternary pedological chronology for the southeastern portion of the Australian arid zone: Jour. Soil Sci., v. 12, p. 208-213.
- Lowry, D.C., 1968a, Tertiary stratigraphic units in the Eucla Basin in Western Australia: West. Australia Geol. Survey Ann. Rept. 1967, p. 36-40.
- 1968b, The origin of blow-holes and the development of domes by exsudation in caves of the Nullarbor Plain: West. Australia Geol. Survey Ann. Rept. 1967, p. 40-44.
- in press, Explanatory notes on the Culver 1:250,000 geological sheet SI/51-4 Western Australia: Canberra, Australia Bur. Mineral Resources.
- Ludbrook, N.H., 1958a, The stratigraphic sequence in the western portion of the Eucla Basin: Royal Soc. West. Australia Jour., v. 41, p. 108-114.
- 1958b, The Eucla Basin in South Australia: Geol. Soc. Australia Jour., v. 5, pt. 2, p. 127-135.
- 1960, Exoil Pty. Ltd. Eyre No. 1 and Gambanga No. 1 Wells subsurface stratigraphy and micro-palaeontological study: South Australia Dept. Mines, Palaeont. Rept. 11/60 (unpublished).
- 1963, Correlation of the Tertiary rocks of South Australia: Royal Soc. South Australia Trans., v. 87, p. 5-15.
- 1967a, Tertiary molluscs and brachiopods of the western part of the Eucla Basin: South Australia Dept. Mines Rept., D.M. 323/66.

- \_\_\_\_\_ 1967b, Correlation of the Tertiary rocks of the Australasian region *in* Hatai, K., ed., Tertiary correlations and climatic changes in the Pacific: Sendai, Japan, Sasaki Ltd., 102p.
- Maitland, A.G., 1904, Artesian water, Eucla Division: West. Australia Geol. Survey Ann. Prog. Rept. 1903, p. 33.
- \_\_\_\_\_ 1911, Results of boring for water on the Eucla Plateau: West. Australia Geol. Survey Ann. Rept. 1910, p. 13-14.
- \_\_\_\_\_ 1919a, A summary of the geology of Western Australia: West. Australia Geol. Survey Mem. 1, Chap. 1, p. 1-55.
- \_\_\_\_\_ 1919b, Petroleum prospects in the Nullarbor Plains, Eucla Division: West. Australia Geol. Survey Ann. Rept. 1918, p. 7-11.
- McWhae, J.R.H., Playford, P.E., Lindner, A.W., Glenister, B.F., and Balme, B.E., 1958, The stratigraphy of Western Australia: Geol. Soc. Australia Jour., v. 4, pt. 2, 161pp.
- Muir, J., 1901, Report on preliminary examination of country between Kalgoorlie and Eucla: West. Australia Parl. Paper No. 42, 14pp.
- Peers, R., and Trendall, A.F., 1968, Precambrian rocks encountered during drilling of the main Phanerozoic sedimentary basins of Western Australia: West. Australia Geol. Survey Ann. Rept. 1967, p. 69-77.
- Quilty, J.H., and Goodeve, P.E., 1958, Reconnaissance airborne magnetic survey of the Eucla Basin, southern Australia: Australia Bur. Mineral Resources Rec. 1958/87, (unpublished).
- Shiels, O.J., 1960, Geological report on the stratigraphic well Eyre No. 1: Exoil Pty. Ltd. P.S.S.A. Rept. (unpublished).
- Singleton, O.P., 1954, The Tertiary stratigraphy of Western Australia, a review: Pan-Indian Ocean Sci. Cong., Perth, 1954, Proc., Sect. C, p. 59-65.
- Tate, R., 1879, The natural history of the country around the head of the Great Australian Bight: Royal Soc. South Australia Trans., v. 2, p. 94-128.
- Tenneco Australia Inc., 1967, Final report marine seismic survey offshore Eucla Basin South and Western Australia: Tenneco Australia Ltd. P.S.S.A. Rept. (unpublished).
- \_\_\_\_\_ 1968, Final report marine seismic survey offshore Eucla Basin South and Western Australia: Tenneco Australia Inc., P.S.S.A. Rept. (unpublished).





HON. A. E. GREFFEL, M.L.C.  
MINISTER FOR MINES  
J. H. LLOYD, DIRECTOR, GEOLOGICAL SURVEY



TRANSVERSE MERCATOR PROJECTION  
ZONE 5 AUSTRALIA SERIES

INDEX TO ADJOINING SHEETS

SHEET	FORMATION	FORMATION
SH 51-12	LOONGANA	FORREST
SH 52-9	SH 52-10	
SH 51-16	MADURA	EUCAL
SH 52-13	SH 52-14	
CULVER	BURNABIE	NOONAN
SH 51-4	SH 52-1	SH 52-2
GREAT AUSTRALIAN BIGHT		



MADURA - BURNABIE  
SHEET SH 52-13 AND PART OF SHEET SI 52-1

FIRST EDITION 1969

DIAGRAMMATIC SECTION

SCALE 1: 5

SECTION A-B-C

