Copy 3

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1969 / 13

BUREAU OF MINERAL RESOURCES LIBRARY 11 SEP 1992 CANBERRA, A.C.T. C3

The Geology of the Quilpie, Charleville, Toompine, Wyandra, Eulo, and Cunnamulla 1 : 250,000 Sheet Areas, Queensland

by

B.R. Senior, J.A. Ingram, B.M. Thomas, and Daniele Senior

The information contained in this report has been obtained by the Department of National Development as part of the policy of the Commonwealth Government to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology & Geophysics.

THE GEOLOGY OF THE QUILPIE, CHARLEVILLE, TOOMPINE, WYANDRA, EULO, AND CUNNAMULLA 1:250,000 SHEET AREAS, QUEENSLAND

by

B.R. Senior, J.A. Ingram, B.M. Thomas, Daniele Senior

BUREAU OF MINERAL RESOURCES
LIBRARY
1 SEP 1982
CANBERRA, A.C.T.

Records 1969/13

The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

CONTENTS

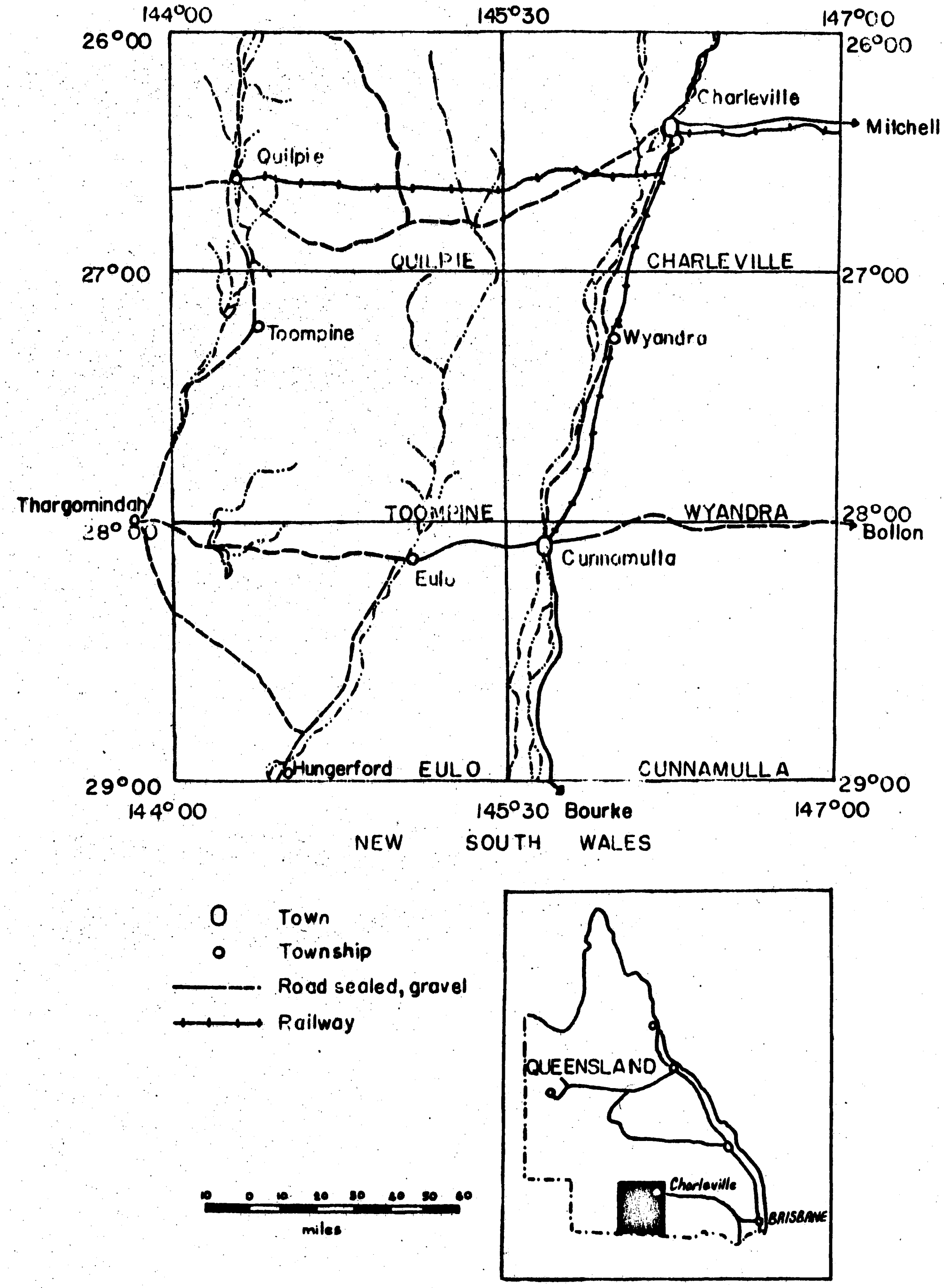
CONTENTS

CONTENTS

CONTENTS

FIG·1

LOCALITY DIAGRAM



To accompany record 1969/13

Q/A199

SUMMARY

This report describes the geology of a portion of the Eromanga basin in south central Queensland (Fig. 1).

Basement in the area consists of low grade metamorphics, intruded by granite along the Eulo and Nebine Ridges. Basalt forms the basement in part of the northwest Quilpie Sheet.

Marine, paralic and continental sediments, up to 16,000 feet thick, of Devonian to Carboniferous age, occur in the Quilpie, Cooladdi, and Westgate Troughs. These troughs are southern extensions of the Adavale Basin.

Permian continental sediments rest unconformably on the Devonian to Carboniferous Adavale Basin Group. In the mapped area they are probably restricted in distribution and are confined to the axial parts of the major troughs. Upper Permian and Triassic sediments occur in the main part of the Adavale Basin to the north, but are not known from the mapped area.

Jurassic to Cretaceous continental and marine sediments of the Eromanga Basin sequence form a cover to the whole area. A sequence from the Lower Jurassic Hutton Sandstone, to the Lower to Upper Cretaceous Winton Formation occurs in the north and northwest of the area. In the remainder of the area, which comprises the Cunnamulla Shelf, Dynevor Shelf and Eulo Ridge, the basement was elevated during Lower Jurassic time and only Hooray Sandstone and younger sediments occur.

Slight erosion forming an extensive flat plain was followed by deep chemical alteration in sediments of the Cretaceous Rolling Downs Group during late Cretaceous to early Tertiary time.

Tertiary fluviatile sediments are thin and are mainly restricted to the western third of the mapped area. These arenitic deposits were subjected to silicification in early Tertiary time. Indurated beds of silcrete formed as a result of this process.

Further erosion in Quaternary time resulted in alluviation of topographic low areas in the landscape. In some areas these deposits achieve a thickness of 200 feet.

The Adavale Basin is subject to active petroleum exploration and major but as yet non commercial supplies of gas were discovered at Gilmore, which is situated to the north of the mapped area. Three oil exploration wells were drilled in the mapped area, with targets primarily in the Adavale Basin Group. Only minor hydrocarbon shows were found and the wells were abandoned.

Five oil exploration wells were drilled on the west flank of the Nebine Ridge with targets in the Eromanga Basin sequence; another two were sited close to a water bore on Cunnamulla Sheet in which the water bore drillers' reported a show of oil There were no significant hydrocarbon indications in any of these wells.

Precious opal occurs in the Winton Formation within the zone of deep chemical alteration. Mining is in progress atthe Yowah Field near Eulo Township. All other opal areas are mined sporadically by gougers and tourists.

Fresh artesian water is available at shallow depths in the south of the area from Jurassic to Lower Cretaceous sandstones. The depth to aquifers increases from an average depth of 1700 feet on the Cunnamulla Shelf to 3000 feet or more in the north and northwest, of the area. Except for elevated areas most bores tapping these aquifers flow. Sub artesian and artesian supplies of fresh to brackish water is also available from aquifers within the Cretaceous Wallumbilla and Winton Formations.

INTRODUCTION

A reconnaissance geological survey of six 1:250,000 Sheet areas was undertaken in 1968. The area is situated in southwest Queensland (Fig. 1). This region forms the southeast part of the Eromanga Basin in Queensland; a sub-basin of the Great Artesian Basin.

Four geologists worked full time on the project, namely: B.R. Senior (Party Leader), J.A. Ingram, B.M. Thomas, and Daniele Senior. During September, Professor J. Mabbutt (University of New South Wales) visited the party and studied the geomorphology of the area. B.M.R. geologist, R.R. Vine, made two visits to the party to introduce the geology of adjacent areas to members of the field party and to get a regional view of the area. Other brief visits were made by the following:

J. Brooks	Queensland Geological Survey
M. Plane	Bureau of Mineral Resources
Dr. P. Williams	Australian National University
Prof. R.A. Binns	University of New England
Dr. J. Veevers	Macquarie University
A. Rundle	Macquarie University
P. Campbell	Macquarie University
Prof. T. Langford-Smith	University of Sydney

A Cessna 187 "Skylane" aircraft, chartered from Goss Air Taxis, was used for a few days each month for geological and geomorphological reconnaissance, and to plot the position of water bores.

Geological data was supplemented by shallow stratigraphic drilling (BMR drilling party, J. Kuenen, driller). Three stratigraphic holes were drilled which involved 890 feet of drilling, and included 60 feet of coring. In addition seventeen scout holes were drilled in previously mapped areas to the west of this survey area (Appendix 3).

Access from Brisbane is by a bitumen road which extends to Charleville. Numerous graded and formed but unsealed roads form a composite network across the area. Roads in this category may be closed temporarily after heavy rain. In the south of the survey area a beef development all-weather road, which has numerous stretches of bitumen, extends from Bollon via Cunnamulla and Eulo, to Thargomindah.

Other access is along a fine network of station tracks which vary considerably due to the differing terrain that they traverse. In the sandy plain country these tracks are easily negotiated by two wheel drive vehicles. In the dissected hill country in the north, and western half of the mapped area, 4-wheel drive vehicles are desirable.

The area has complete vertical aerial photograph coverage at a nominal scale of 1:50,000. The aerial photographs were taken in 1952 with the exception of Charleville Sheet which was flown in 1954.

Photo mosaics at approximately 1 inch to 1 mile scale have been compiled from the aerial photographs for Charleville, Toompine, Wyandra, Eulo and Cunnamulla Sheets, and at 4 miles to 1 inch scale for Quilpie Sheet. Cadastral maps are available from the Department of Public Lands, Brisbane. Planimetric maps, compiled from aerial photography, and available from the Division of National Mapping, were used as the base for the geological maps, but were amended to show all bore positions and cultural features, which post-date the photography.

Previous investigations

Prior to this survey little geological investigation had been done in the area mapped. However Whitehouse's discussions (1930, 1940, 1941, 1945, 1954) on geology in Queensland, and late geological history of Queensland are relevant to the area mapped, as are Ogilvie's (1954) discussions on the Great Artesian Basin with reference to sub-surface water supplies.

Woolnough's work (1927, 1930) on weathering surfaces is particularly relevant to the area. His discussion (1932) on subsurface structure in reference to oil production also contains valuable information for the area mapped.

Wopfner's (1960, 1964) discussions on structural development and stratigraphy in the Great Artesian Basin can be applied to the area mapped.

Geologists of the Bureau of Mineral Resources and Geological Survey of Queensland have mapped several adjacent sheets in Queensland (Gregory et al., 1967; Senior et al., 1968; Exon et al., 1967). Geologists of the New South Wales Department of Mines have mapped Yantabulla Sheet area (Fitzpatrick et al., 1962) which is adjacent to Eulo Sheet; and Engonnia Sheet area (Fitzpatrick, 1965) which is adjacent to Cunnamulla Sheet area.

Opal has been exploited in parts of the mapped area (mainly Toompine Sheet). General papers on opal mineralization have been written by a number of authors (Jackson, 1902; Woolnough, 1927; Whitehouse, 1940; Cribb, 1948; Noakes, 1949; Hiern, 1966, Connah, 1966; Ingram, 1968).

Mabbutt (1962, 1965), Jessup (1960a,b), Wopfner (1963), Langford-Smith and Dury (1965), discussed young sediments with reference to areas similar to those mapped. In addition Jennings and Mabbutt (eds 1967) discussed landforms with reference to places in central and southwestern Queensland.

Tanner (1966, 1968) discussed the Palaeozoic rocks beneath the Great Artesian Basin with reference to the areas mapped and Heikkla (1966) discussed the Palaeozoic of the Adavale Basin which is included in Quilpie and Charleville Sheet areas.

Gravity, seismic and aeromagnetic surveys by the B.M.R. and private oil exploration companies cover much of the area. These surveys are summarized in Table 1.

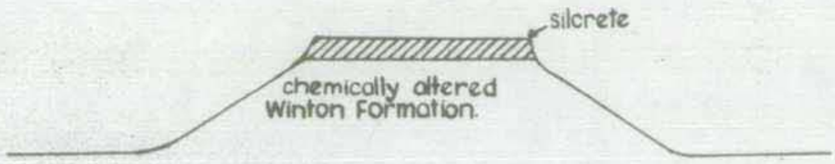
Drilling by oil exploration companies and for water has contributed much to the knowledge of the sub-surface geology.

PHYSIOGRAPHY

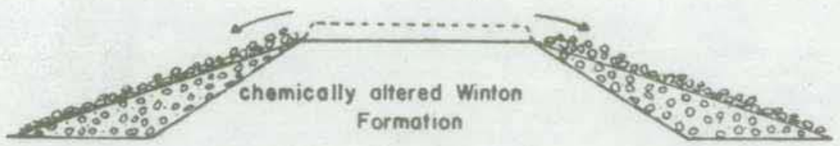
The physiography of the mapped area is described by Professor J.A. Mabbutt (University of New South Wales) in Appendix 5 of this report. This description is accompanied by a Physiographic Diagram which gives a breakdown of the area into landscape types (Fig. 15). Reference should be made to Appendix 5 for a physiographic description of the region. Only specific geomorphic features will be discussed here.

Hard cappings are a feature of the dissected plateau country of the area. The cap rock consists of weathered and secondarily iron-cemented Winton Formation sediment (i.e. weathered mantle) or the cap may be indurated Tertiary quartzose sandstone (silcrete). Removal of the hill mass by erosion is normally accomplished by simple scarp retreat but some anomalous hill forms result. Once the silcrete is broken up and transferred to the pediment slopes, the main body of the hill mass, consisting of soft kaolinitic sediments, is more easily eroded than the surrounding pediments. This results in the creation of a circular depression surrounded by a pediment capped with a silcrete breccia. Stages of erosion of a mesa with a silcrete capping are shown diagrammatically and is accompanied with an illustration (Photo 1).

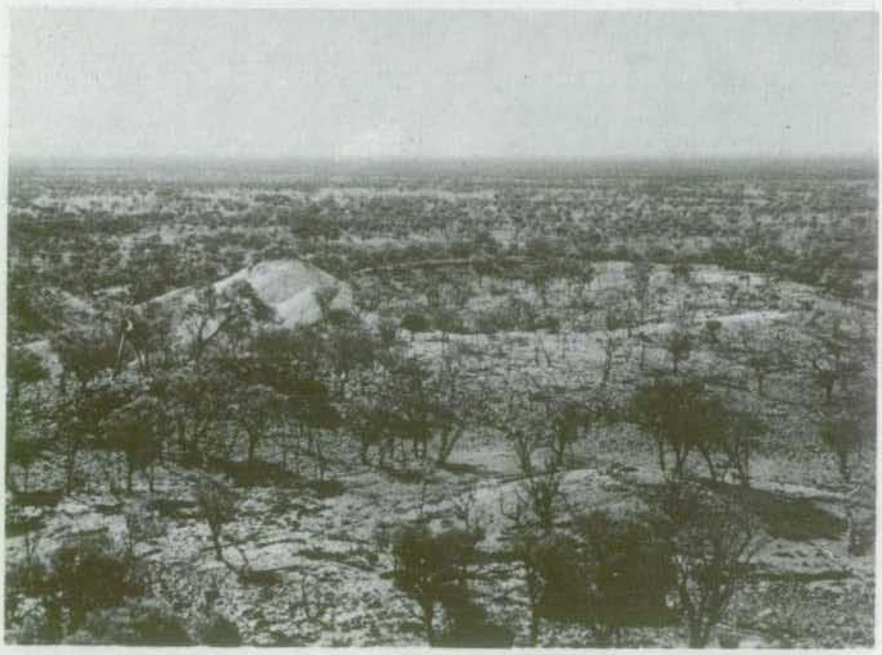
DIAGRAMMATIC STAGES OF EROSION OF A MESA WITH SILCRETE CAPPING.



I. Mesa with silcrete capping.



2. Erosion of cap and formation of pediments.



3. The soft material of the mesa has been eroded away leaving a circular depression. (Photo. I. BMR Neg. M828).

TABLE 1

SEISMIC SURVEYS

Year	Abbreviated Title	Reference
1959	Grey Range seismic survey	Smart, 1962
1961	Blackwater-Langlo seismic survey	Hier & Fjelstul, 1961
1959-1960	Quilpie-Thargomindah-Charleville seismic survey	Hier & Spivey, 1960
1961	Seismic survey, Adavale area	Hier & Spivey, 1961
1962	Detailed seismic survey, Gumbardo area	Fjelstul & Beck, 1962
1962	Reconnaissance survey, Charleville North area	Fjelstul, 1962
1963	Detail survey, Quilberry Creek Prospect	Fjelstul & Beck, 1963
1963	Bollon-Dirranbandi, seismic survey	United Geophysical Co. 1963
1965	Augathella seismic survey	Amoseas, 1965
1966	Reconnaissance and detail seismic, Lake Dartmouth area	Tallis & Fjelstul, 1966
1966	Adavale Basin detail survey	Fjelstul & Rhodes, 1966

GRAVITY SURVEYS

Year	Abbreviated Title	Reference
1960	Gravity traverse - Quilpie to Roma	Langron, 1962
1961	Gravity survey - Eromanga area	Smart, 1961
1964	Southern Queensland Reconnaissance gravity survey	Lonsdale, 1965
1964	Semi-detailed gravity survey - Adavale Basin	Darby, 1966
1966	Dartmouth Area gravity survey	Darby & Ingall, 1966

AEROMAGNETIC SURVEYS

Year	Abbreviated Title	Reference
1961	Aeromagnetic survey of Quilpie-Charleville-Thargomindah area	Rollins, Steenland & Hier, 1961

Of specific interest is the line of lakes which stretches from west of Dynevor Downs Station, to west of Boorara Station (Eulo Sheet). A feature of the lakes is the presence of numerous spits and offshore bars and small islands (Photo 2). These features have resulted from an interplay of current and wave action. Tributary streams build out sand spits into the lake and these are strongly curved at the end, suggesting a south direction of movement for the main water mass. Stranded beaches with low active sand dunes occur on the eastern margin of the lakes. These are formed as a result of aeolian action during successive lake levels. Numerous tiny claypans are a feature in this beach strand complex.

The lake water is slightly saline (6,600 conductivity units measured from a sample collected at Lake Bindegolly, Grid Ref. 203517) but is sufficiently fresh to support a varied bird fauna. The concentration of salt in the lake flocculates all the mud and thus the water is clear. By contrast muddy fresh water occurs in nearby waterholes in tributaries.

STRATIGRAPHY

Basement (Pzl) (Dmg)

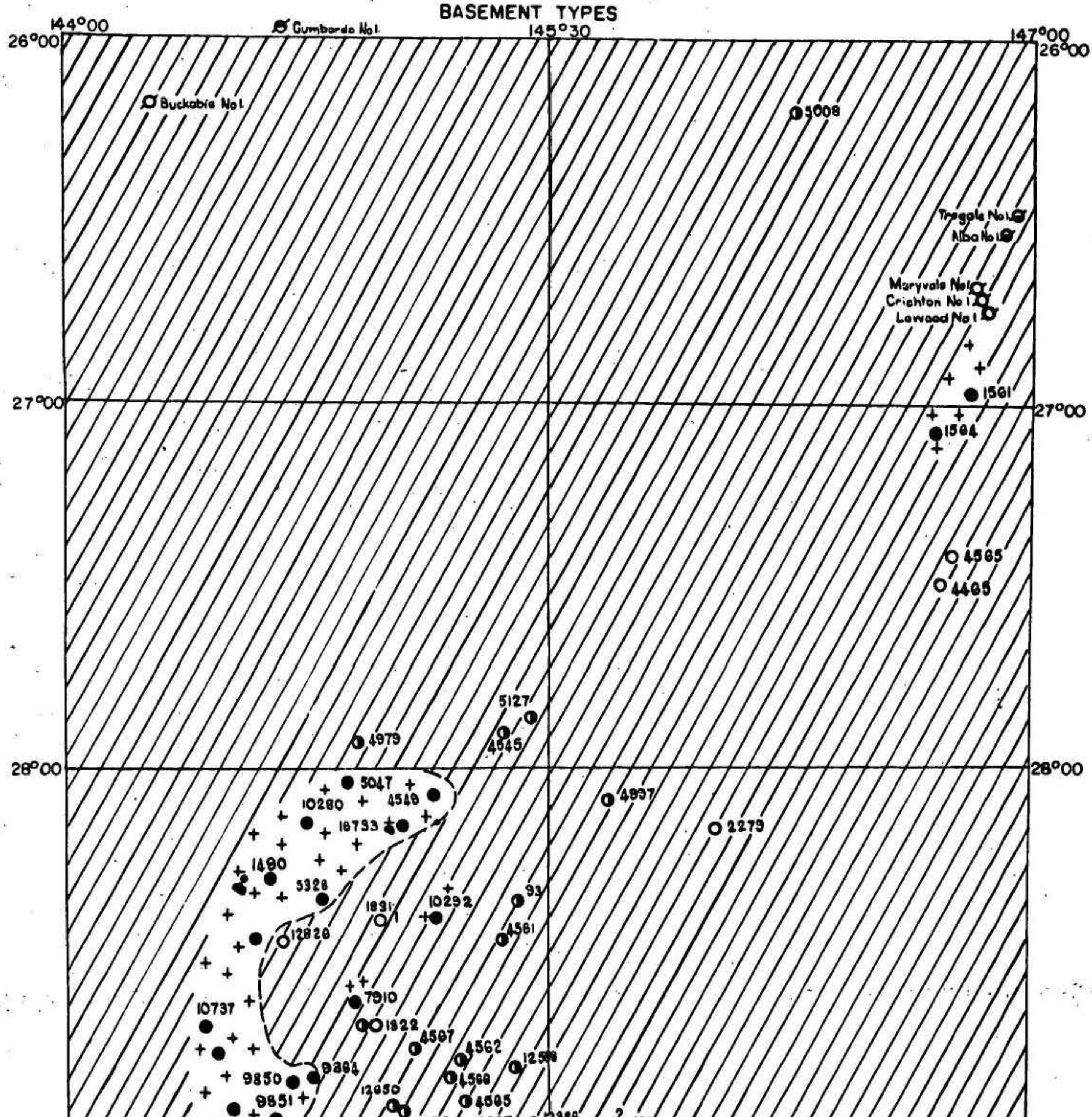
The term basement is used to denote igneous and metamorphic rocks and steeply folded sediments which underlie unmetamorphosed and mainly little-disturbed.

Small outcrops of basement rocks (Photo 3) occur along the Eulo Ridge on the Eulo and Toompine Sheet areas. The granitic outcrops on the Eulo Sheet are medium and coarse-grained, grey and pink, granite and adamellite, the granites at Hungerford and near Granite Springs homestead are biotite-rich. Pegmatite veins, some containing tourmaline, occur at the Granite Springs outcrop.

<u>Photo</u> 2: Aerial view of Lake Bindegolly, on a line of lakes known locally as the Dynevor Lakes (Eulo Sheet).

Fig.2.

BASEMENT TYPES



Dry & abandoned oil exploration well.

O7910 Water bore & registered number.

●	Granite	Basement types	+ +	Dominantly granitic basement (Mid.Devonian)
●	Basalt			
●	Slate	from	//	Dominantly low grade metamorphic rocks. (Pre Middle Devonian)
O	Schist			
●	Gneissic granite	drillers logs		Granite outcrop

To accompany record 1969/13 Q/A200

Photo 3: Granite tors near Currawinya Station.
(Eulo Sheet). BMR Neg. N.M/826.

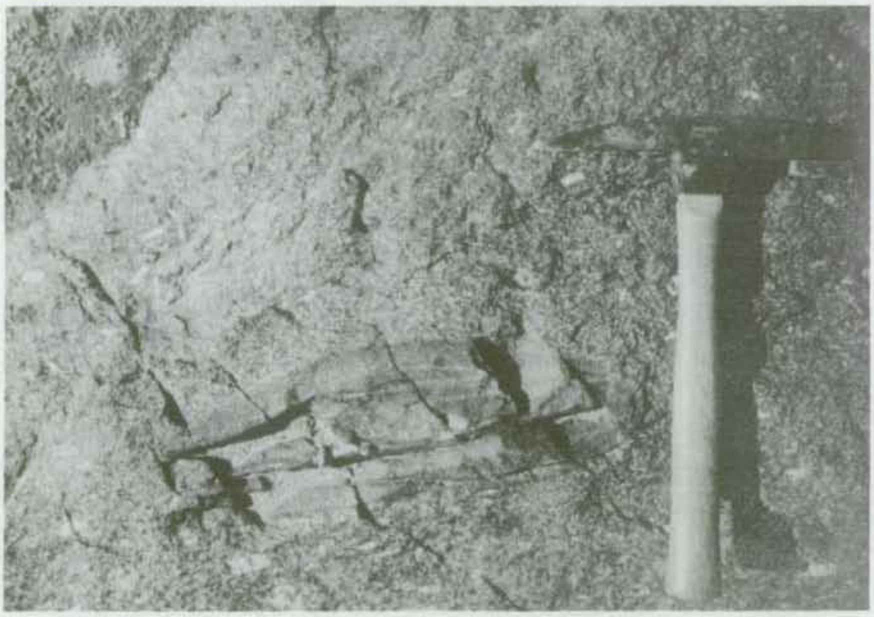


Photo 4: Xenolith in granite near Granite Springs Homestead.
(Eulo Sheet). BMR Neg.No.GA/1363.

At the same locality there are old abandoned gold workings on large quartz veins within the granite. The veins contain minor pyrite in vugs. Quartz-muscovite-schist is present along the contacts of the veins and the granite. Foliation within the granite gives rise to quartz-biotite-gneiss. Xenoliths are common in all the granites (Photo 4) and locally the granites exhibit lineation.

The granites are in places highly weathered and near Boorara homestead (Grid ref. 236432) have been affected by leaching and silicification of presumed Tertiary age. At Granite Springs there is an 8 foot thick ironstone capping where the granite is overlain by sediments.

An age determination of an outcrop sample of granite from near Eulo on the Eulo Ridge by Evernden and Richards (1962, p24) gave an age of 361 m.y. (Middle-Upper Devonian), but no indication was given of the accuracy of the determination or the freshness of the sample.

Near Hungerford, folded quartz-hornblende-schists occur with the granite, but only as loose boulders, and the relationship between the two is not seen. In the Toompine Sheet area, along the Boondoona Fault, basement rocks occur as floaters in alluvium. The rock types include feldspatholithic sandstone, quartz-veined slate and quartzite.

Elsewhere in the mapped area basement information is from water bores and oil exploration wells. Granite was encountered in water bores on the Eulo and Nebine Ridges. Over the rest of the area the basement consists dominantly of low-grade metamorphic rocks (Fig. 3). Amoseas Tregole No. 1 and Alba No. 1 encountered quartz-biotite-gneiss on the flanks of the Nebine Ridge (Campbell, 1965, 1966). Folded, slightly metamorphosed, sediments were intersected in Orion Oil Maryvale No. 1, Crichton No. 1 and Lowood No. 1 (Freeman and Stafford, 1966).

In the northwest of the area Buckabie No. 1 (Phillips-Sunray 1962) intersected phyllite, and on the Adavale Sheet area just to the north of the area mapped, Gumbardo No. 1 encountered Ordovician basalt below the Adavale Basin sediments (Phillips-Sunray, 1963).

Devonian

Rocks of Devonian age have been identified from Phillips-Sunray Buckabie No. 1, Dartmouth No. 1, and Quilberry No. 1. They occur in three large synclinal depressions, the Quilpie, Cooladdi and Westgate Troughs, and have a similar history and stratigraphic succession as the Adavale Basin which lies to the north of the mapped area. The troughs are southern extensions of this more complex basin (Fig. 9).

Sediments in the troughs belong to the Adavale Group (Phillips Petroleum, 1964) and the nomenclature is that of Tanner (1968) modified by Galloway (in press). Up to 16,000 feet of pre-Permian sediments occur in the Cooladdi Trough. The following stratigraphic divisions are made:-

ADAVALE GROUP	BUCKABIE FORMATION	
	ETONVALE FORMATION	
		Boree Salt Member
		Cooladdi Dolomite Member
	LOG CREEK FORMATION	
		Bury Limestone Member
	GUMBARDO FORMATION	

Gumbardo Formation (Dmg)

The oldest stratified rocks of the Adavale Basin are included in the Gumbardo Formation of Middle Devonian age. This formation is predominantly volcanic in its type section (Gumbardo No. 1, Adavale Sheet area) where it consists of andesitic tuff and flows resting unconformably on Ordovician basalt, and grades upward into the Middle Devonian marine shale member of the Log Creek Formation.

The Gumbardo Formation is 2442 feet thick in Gumbardo No. 1 and is Middle Devonian age by K-A dating. By extrapolation from this well this formation is likely to occur on the north central part of the Quilpie Sheet area and in all of the southern extensions of the Adavale Basin.

Log Creek Formation (Dml)

This name, defined and described by Galloway (in press) replaces the invalid "Gilmore Formation" of Tanner (1968).

Tanner (1968) and Slanis & Netzel (1967) divide the formation into a lower shale member and an upper sandstone member in the central part of the basin. Slanis and Netzel (op.cit.) regard the Bury Limestone Member, as the eastern (carbonate) facies of the shale member.

The sandstone member consists of quartzose and sublabile sandstone which is fine to very coarse-grained; locally it is conglomeratic, containing lithic grains and feldspar. The sandstone is interbedded with red-brown and pale green shale, siltstone and rare stringers of dolomitic limestone. The deposit is predominantly marine in origin, with the upper quarter grading through shallow marine to continental deposits (Slanis & Netzel, 1967).

Macrofossils include pelecypods, brachiopods, rare gastropods, and a few nautiloid fragments. They are restricted to the lower three quarters of the sandstone member. This fauna indicates a Devonian age (McKellar 1966). Palynology gives a Middle Devonian age (de Jersey, 1966).

The shale member (western facies) of the Log Creek Formation is a marine, dark grey, grey brown and black shale occasionally calcareous and micaceous with trace of fossils and pyrite. The shale member contains thin, sandstone beds.

Macrofossils include corals, pelecypods, brachiopods, bryozoan and crinoid fragments of Devonian age.

The Log Creek Formation has a thickness of 615 feet in Lissoy No. 1 (Adavale Sheet area) and 5,203 feet, with the bottom of the formation not penetrated, in Dartmouth No. 1 (Quilpie Sheet area).

Bury Limestone Member (Dmu)

The type section is between 7740 and 8685 feet in Phillips-Sunray Bury No. 1. (Adavale Sheet area). The type section is predominantly limestone, light to dark grey, or rarely tan, microcrystalline, platy, hard, locally dolomitic and fossiliferous. Interbeds of light to dark grey siltstone occur, rarely they are red-brown, moderately hard and very calcareous. Percentage of siltstone increases towards the base. In Dartmouth No. 1 calcareous shale predominates over limestone.

Etonvale Formation (Dme)

The type section of this formation occurs in Phillips-Sunray Etonvale No. 1 well (Adavale Sheet area) in the interval 6600 to 7662 feet (Galloway, in press).

At the base of the Etonvale Formation is a thin carbonate, the Cooladdi Dolomite Member and in the east, the Boree Salt Member, which Tanner (1968,p115) regards as the eastern facies of the Cooladdi Dolomite Member. The upper part of the formation consists of red-brown and grey-green shale and siltstone thinly interbedded with lesser grey-green, fine, silty, calcareous and dolomitic sandstone. This argillaceous deposit grades down into sandstone, which consists of varicoloured fine and very fine-grained calcareous sandstone with rare interbeds of dark coloured shale.

Cooladdi Dolomite Member (Dmc)

The Cooladdi Dolomite Member consists of dolomitized dense to cochinoid limestone (Tanner, 1968). It is argillaceous in part and has interbedded dolomitic sandstone in the middle and lower part. Regionally it varies to silty argillaceous grey dolomite with rare sandstone stringers and also to shaley, light coloured limestone.

The Cooladdi Dolomite Member in the main part of the Adavale Basin is the source of a prominent seismic reflection. Devonian reflectors on Quilpie and Charleville Sheet have a discontinuous distribution and are confined to the major structural troughs.

The Cooladdi Dolomite Member was only intersected in Quilberry No. 1 in the mapped area. In Quilberry No. 1 the unit consisted of 204 feet of dolomitic limestone, containing fine clastic material with dolomitized corals. It is eroded from the structurally higher Buckabie No. 1 and Dartmouth No. 1.

Boree Salt Member (Dmb)

The evidence for the presence of this member in the Quilpie and Charleville Sheet areas is conjectural. From the mapped area it is only known by a seismic high indicating the presence of a salt dome to the south of Lake Dartmouth (Tallis & Fjelstul, 1966).

The salt, as recorded from exploration wells in Adavale Sheet area, consists of colourless, brown white to grey, medium to coarsely crystalline rock salt. It contains traces of anhydrite and other evaporites and rare thin laminations and interbeds of grey and brown shale and siltstone. The maximum known thickness is 1816 feet (local doming) in Bury No. 1. The Boree Salt Member has not been dated but by stratigraphic position it is Middle Devonian.

Buckabie Formation (D-Cb)

The Buckabie Formation is a monotonous sequence of vari-coloured, primarily red siltstone, sandstone and mudstone. The formation is continental to shallow marine in origin. Minimum penetrated thickness is 121 feet in Quilberry No. 1 and maximum penetrated thickness is 5717 feet in Leopardwood No. 1 (Adavale Sheet) but may extend to 10,000 feet in structurally low areas according to seismic interpretation. This formation is devoid of plant or animal remains and is dated only by its stratigraphic position; conformable above the upper Middle Devonian Etonvale Formation, and unconformable beneath Lower Permian sandstone. An Upper Devonian age designation appears most fitting, although Lower Carboniferous could be represented (Tanner, 1968).

PERMIAN AND TRIASSIC (Pl)

Sediments of Permian age are known only from a 552 feet-thick sandstone interval found in Phillips-Sunray Dartmouth No. 1 well. This unit rests unconformably on the Etonvale Formation.

Lithologically the Permian consists of multicoloured sandstone which is medium to coarse grained and conglomeratic, and with interbeds of grey shale. The section has a basal polymictic conglomerate containing pebbles and cobbles of quartz, grey silicified shale, quartzite and pink igneous rocks.

The section is assigned to the Lower Permian, unit P1a of Evans (1965) because of a characteristic spore and pollen assemblage.

The distribution of Permian sediments in the mapped area is difficult to assess. It wedges out to the south of Dartmouth No. 1 and was not found in Quilberry No. 1. Probably the Permian thickens to the north and west of Dartmouth No. 1 and with additional local thickening in the main troughs. In the northern part of the Adavale Basin the Lower Permian is disconformably overlain by Upper Permian and in places Triassic sediments. Upper Permian or Triassic sediments are not known in the mapped area, but may exist near the axes of the Quilpie, Cooladdi and Westgate Troughs.

JURASSIC

Sediments of Jurassic age have been intersected by all of the petroleum exploration wells and by many of the deep water bores of the area. A complete sequence of Jurassic sediments occur in the Quilpie and Charleville Sheet areas, but they thin southwards, and sediments older than the Hooray Sandstone were not deposited on the Cunnamulla Shelf. The Upper Jurassic to Lower Cretaceous Hooray Sandstone is present on the Cunnamulla Shelf but in turn wedges out near the crest of the Eulo Ridge.

Precipice Sandstone (Jlp)

The name "Precipice Sandstone" was first used by Whitehouse (1952) and later he (Whitehouse, 1954) stated that the type section was in the gorge of Precipice Creek. In Orion Oil Maryvale No. 1 the Precipice Sandstone consists of 31 feet of interbedded quartzose sandstone and shale. The Precipice Sandstone thickens northward with 123 feet in Amoseas Alba No. 1. The sandstone is fine-grained, sub-rounded to angular, micaceous, silty and carbonaceous. The shale is grey to black and is micaceous to carbonaceous. In Orion Oil Crichton No. 1 the formation thinned to 21 feet, with similar lithology but also had thin beds of quartz conglomerate. The upper part of the deposit in Crichton No. 1 contained coal.

In the Nebine Ridge area on eastern Charleville Sheet the Precipice Sandstone rests unconformably on metamorphosed basement schist (Timbury Hills Formation) and gneiss. These deposits might not be true equivalents of the Precipice Sandstone of the Surat Basin although they contain a similar microflora. Spores from the Precipice Sandstone in Alba No. 1 belong to Evans (1966) division J1, regarded as Lower Jurassic in age, and marked by the first appearance of abundant *Classopolis* (Burger, pers. comm.).

In Roma Sheet area this deposit is known to be a hydrocarbon bearer and much of the Roma gas comes from it. On Charleville Sheet the exploration wells found that these sandstones were water saturated.

The deposit has only been found in a small area on east Charleville Sheet on the Nebine Ridge.

On eastern Charleville Sheet the deposit was laid down under terrestrial conditions in valleys on a pre-Jurassic land surface. Its distribution pattern shows that it was confined to topographically low areas (Freeman and Stafford, 1966).

<u>Evergreen Formation</u> (Jle)

This formation name is derived from the name Evergreen Shale, (Whitehouse, 1952) and later renamed the Evergreen Formation (Exon, 1968). The Evergreen Formation was intersected in Amoseas Alba No. 1 and Tregole No. 1, and in Orion Oil Company, Maryvale No. 1, Crichton No. 1, and Lowood No. 1. These wells are located on the western flank of the sub-surface basement high known as the Nebine Ridge.

The formation consists of siltstone, mudstone and minor fine-grained labile sandstone. The Boxvale Sandstone Member which occurs on eastern Mitchell Sheet (Exon et al. 1967) was reported from the Amoseas and Orion oil exploration wells. Sandstone beds comprising the Boxvale Sandstone Member intersected in these wells are lenticular and lack continuity and it is doubtful if they are a true correlative with the Surat Basin.

Marine argillaceous beds within this formation are considered suitable source beds for hydrocarbons. The sediments were deposited in marine to brackish water, and the Evergreen sea transgressed westwards through topographically low areas to give the deposits on the western limb of the Nebine Ridge in the Eromanga Basin. The western edge of these deposits is not known, however, they may be restricted by a north south trending 'high' which extends from near Etona homestead south through Angellala to near Authoringa homestead, Charleville Sheet area.

Hutton Sandstone (Jlh)

The Hutton Sandstone is present in all of the petroleum exploration wells of the mapped area. In Phillips-Sunray Buckabie No. 1 and Quilberry No. 1 this unit rests unconformably on the Devonian-Carboniferous Buckabie Formation. In Phillips-Sunray Dartmouth No. 1 the unit rests unconformably on unnamed Lower Permian sediments. On the eastern side of the Eromanga Basin, near the Nebine Ridge, the unit rests on older Jurassic units correlated with the Evergreen Formation and Precipice Sandstone of the Surat Basin.

Lithologically the Hutton Sandstone consists of fine to medium quartzose sandstone with some coarse to pebbly beds. The fine sandstone is commonly micaceous or carbonaceous. There are minor shaly interbeds and rare thin coal seams.

The Hutton Sandstone has a constant thickness over most of the northern part of the mapped area. The maximum recorded thickness is 564 feet in Amoseas Tregole No. 1, which is located near the crest of the Nebine Ridge, and the minimum is 300 feet in Orion Oil Co., Lowood No. 1, which is situated on the western flanks of the ridge. Over the remainder of the area the deposit is approximately 500 feet thick but thins southwards to an area of non deposition on the Cunnamulla Shelf.

The age of the Hutton Sandstone has been established from palynological evidence to be Lower to Middle Jurassic (Evans, 1966). Its presence in oil exploration wells is established on lithological and wireline log evidence.

The Hutton Sandstone is predominantly a fluviatile sequence. The sandstones contain aquifers but because of suitable aquifer systems higher in the Mesozoic sequence they are seldom tapped.

Birkhead Formation (Jmb)

The Birkhead Formation occurs in the area of thick sediments to the north and west of the Cunnamulla Shelf. All oil exploration wells in Charleville and Quilpie Sheet areas, and a few deep water bores on Charleville Sheet have penetrated this formation.

The unit rests conformably on the Hutton Sandstone. It averages approximately 350 feet in thickness. Lithological information is limited but only slight variations are indicated. In Buckabie No. 1 it consists of 200 feet of interbedded siltstone and mudstone which is calcareous in part. On the western flank of the Nebine Ridge the lithology is similar and consists of partly calcareous labile sandstone with kaolin matrix, with numerous interbeds of grey calcareous siltstone. In Orion Oil Lowood No. 1 it is 352 feet thick; 294 feet in Crichton No. 1 and 330 feet in Maryvale No. 1.

The Birkhead Formation is the basal unit of the Injune Creek Group. This formation lacks marine fossils and was apparently deposited in a lacustrine environment. It varies little in thickness over the northern part of the mapped area and is continuous across the Nebine Ridge into the Surat Basin. The Birkhead Formation thins towards the Cunnamulla Shelf and was probably not deposited in that area.

The Birkhead Formation is Middle Jurassic in age. No palynological determinations have been made from this unit in the mapped area.

Adori Sandstone (Ja)

The Adori Sandstone is conformable on the Birkhead Formation. The lithology is mainly medium to coarse quartzose sandstone. In Orion Oil Lowood No. 1, Maryvale No. 1 and Crichton No. 1 it is present as a single massive sandstone unit of white fine grained quartz sandstone.

Similar lithologies were encountered in Amoseas Alba No. 1 and Tregole No. 1 with additional kaolinitic matrix in the sandstone. The unit sometimes contains argillaceous interbeds.

Thickness is uniform with variation between 352 feet thick in Orion Oil Lowood No. 1 to 294 feet in Orion Oil Crichton No. 1. The unit is 205 feet thick in Phillips-Sunray Dartmouth No. 1.

The Adori Sandstone is usually a good marker bed and a marked left deflection occurs on gamma ray logs, thus enabling it to be identified in the deep water bores of the area.

Palynological evidence is not available from samples within the mapped area. However Upper Jurassic spores were identified from Alliance Oil Co. Canaway No. 1 on Windorah Sheet area (Hodgson App. 2 in A.O.D. 1963).

Westbourne Formation (Juw)

The Westbourne Formation is conformable on the Adori Sandstone. The unit consists of interbedded quartzose to sub labile medium sandstone, siltstone and mudstone with abundant carbonaceous material and thin coal seams. The unit is 415 feet thick in Charleville town bore (No. 16987) and 355 feet thick in Phillips-Sunray Dartmouth No. 1. The unit thins southward, and is not recognizable in bores on the Cunnamulla Shelf.

The Westbourne Formation is Upper Jurassic in age and contains J5 and J6 spores. No fossil determinations have been made for this unit within the mapped area, and the Upper Jurassic age is inferred from determinations made from wells drilled to the west and east of the mapped area (Evans, App. 2 in Exon et al., 1967).

UPPER JURASSIC TO LOWER CRETACEOUS

Hooray Sandstone (J-Kh)

Woolley (1941) named this unit from Hooray Creek and the name was first published in Hill and Denmead (1960). The type section in Hooray Creek, 12 miles east-north-east of Tambo, was illustrated by Exon, (1966).

The Hooray Sandstone consists of fine to medium quartzose and sublabile sandstone with interbeds of siltstone in the upper part, and grades down into medium to coarse grained quartz sandstone. In BMR Eulo Scout No. 1 the formation consisted of very fine to very coarse quartzose sandstone which has indurated calcareous interbeds (Fig. 3). The upper most argillaceous sequence or 'transition beds' are absent in this locality.

Within the unit are numerous fresh water aquifers. Over the Eulo Ridge and Cunnamulla Shelf this unit rests unconformably on basement. In the Charleville and Quilpie Sheet areas the Hooray Sandstone rests conformably on the Westbourne Formation.

The top of the Hooray Sandstone is a consistently good reference point on gamma ray logs and is the basis for the structural contour diagram (Fig. 4). A widespread sandstone bed at the top of the unit is marked by a narrow zone of low radioactivity.

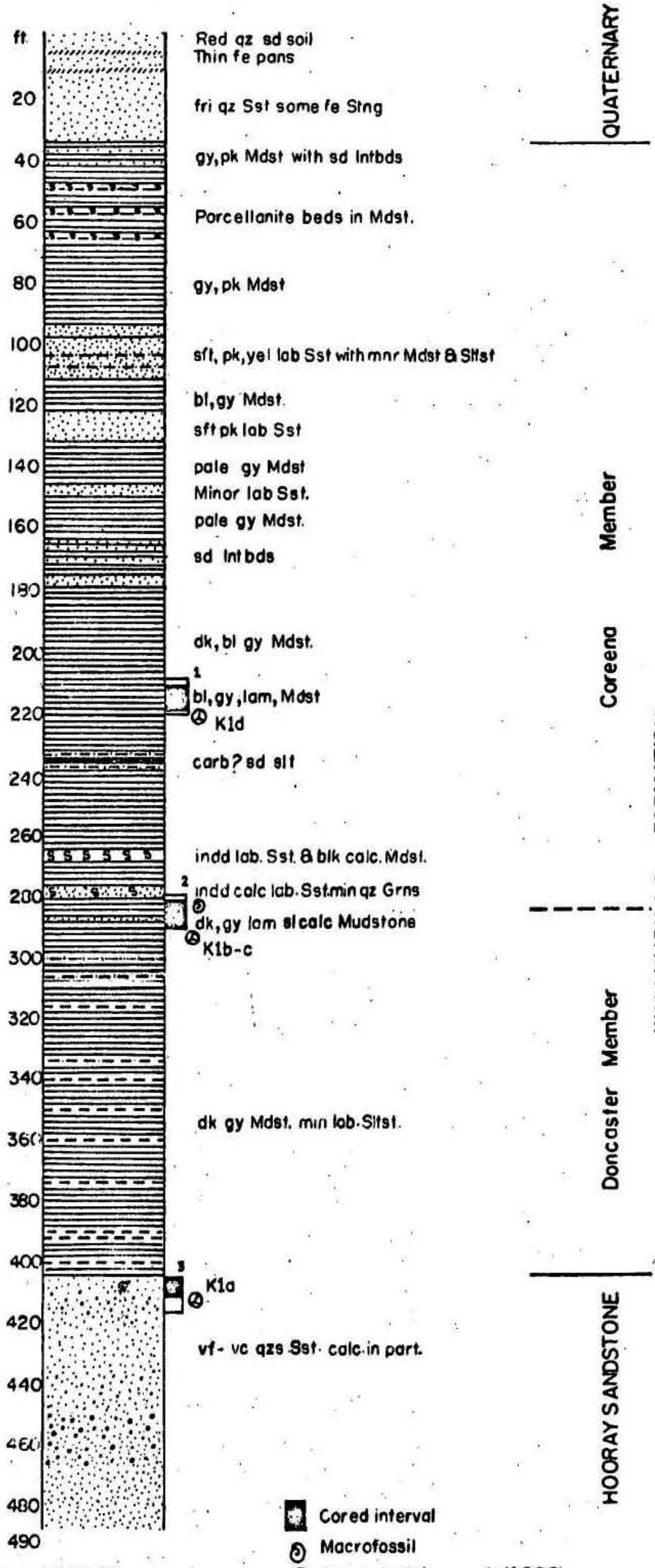
A good seismic reflector from within the Hooray Sandstone is known as the C horizon or the 'Blythesdale Reflector'.

In Quilpie and Charleville Sheet areas the deposit averages approximately 800 feet in thickness. The unit thins and wedges out towards the crest of the Eulo Ridge.

Distinctive marginal facies occur in the ridge area. (Photo 5). These marine littoral deposits are coarse grained and contain fragmentary and water worn shelly molluscan fossils.

FIG. 3.

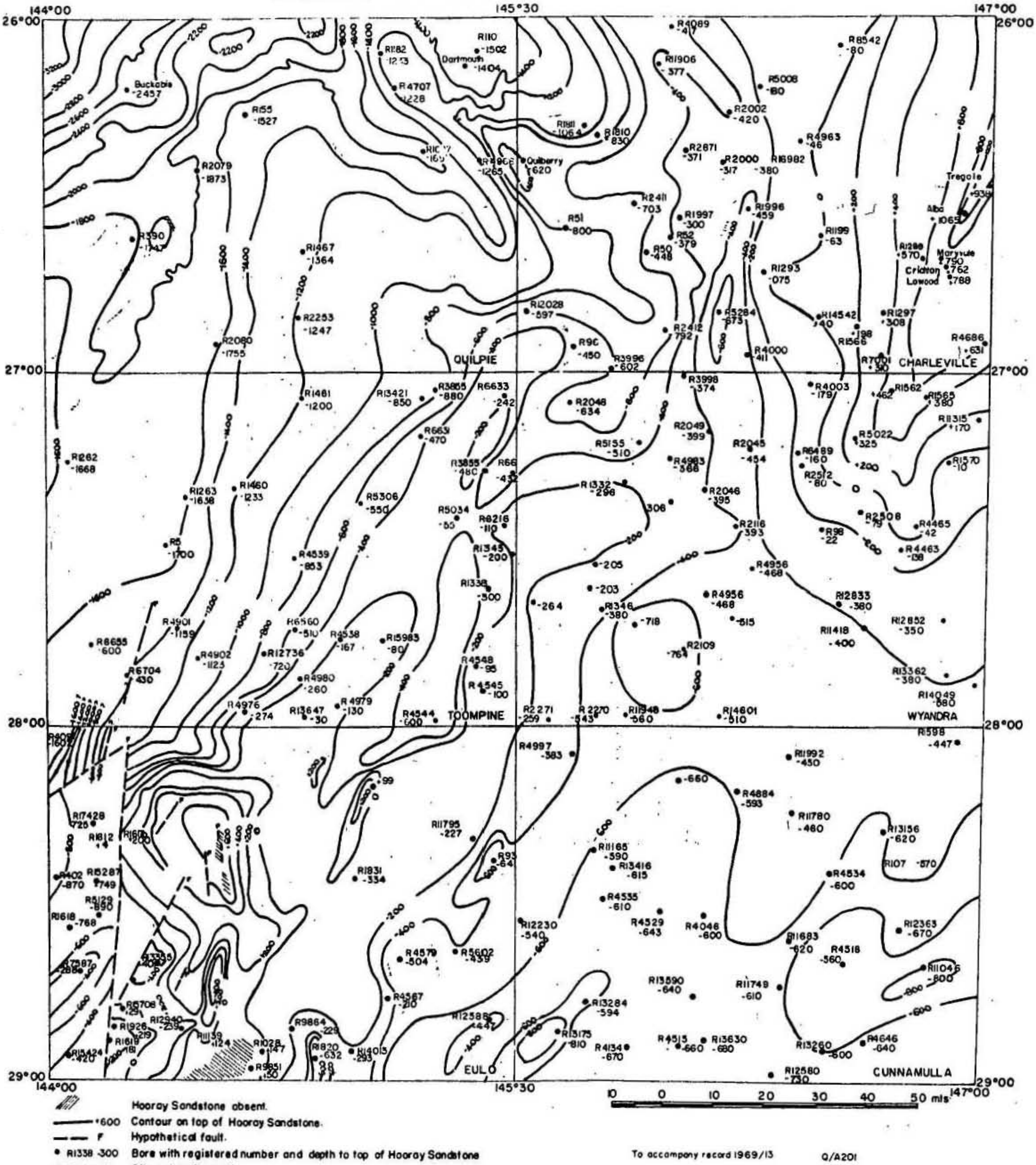
BMR EULO SCOUT NO. 1. Grid ref. 296507



To accompany record 1969/13

Q/A202

CONTOURS ON THE TOP OF THE HOORAY SANDSTONE FIG. 4.



Hooray Sandstone absent.

+600 Contour on top of Hooray Sandstone.

F Hypothetical fault.

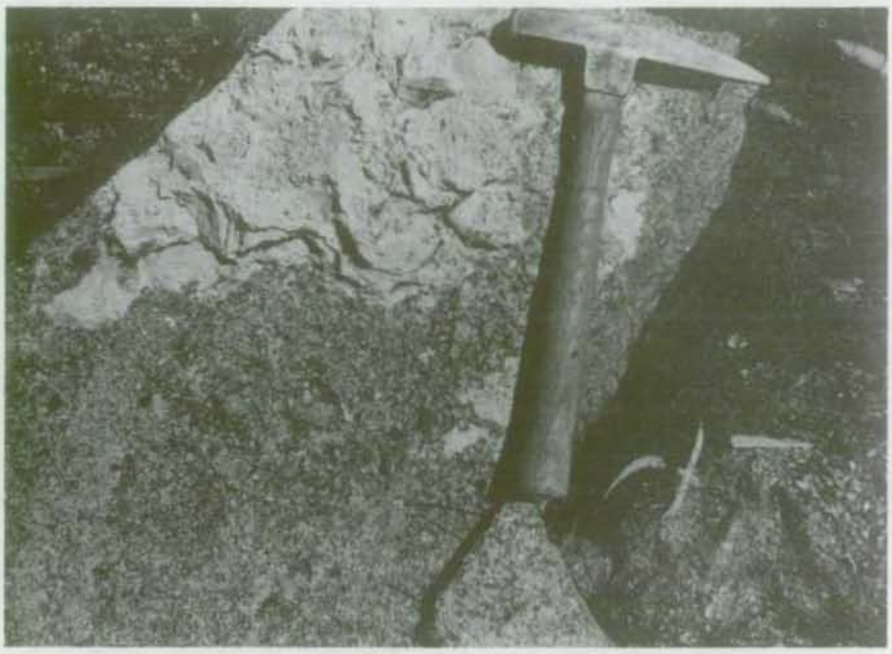
• R1338 -300 Bore with registered number and depth to top of Hooray Sandstone

• Dartmouth Oil exploration well.

DATUM SEA LEVEL.

To accompany record 1969/13

Q/A201



<u>Photo</u> 5: Littoral shelly deposit correlated with the Hooray Sandstone, resting nonconformably on Devonian Granite (Eulo Sheet).

BMR Neg.No. M/831

The fauna indicates a Roma age (R.W. Day pers. comm.). In BMR Eulo No. 1, core no. 3, recovered from the Hooray Sandstone, contains marine microplankton. The palynological age for this core is probably not older than K1a (Burger, Appendix 3). It appears that in the Eulo Ridge area the Hooray Sandstone is diachronous and has a Wallumbilla age.

CRETACEOUS

Rolling Downs Group

Sediments of Lower and early Upper Cretaceous age were deposited over the whole of the mapped area. The nomenclature of the Rolling Downs Group is that of Vine and Day (1965), modified by Vine et al., (1967). They proposed the following five fold divisions

e. Winton Formation
d. Mackunda Formation
c. Allaru Mudstone
b. Toolebuc Limestone
a. Wallumbilla Formation - Coreena Member
\- Doncaster Member

In the north of the mapped area, on Quilpie and Charleville Sheets, the above formations occur in normal superposition exhibiting thicknesses and rock types which are consistent over a very large area of the Eromanga Basin.

Towards the end of the deposition of the Wallumbilla Formation there was a gradual change on the Eulo Ridge, Dynevor and Cunnamulla Shelves from shallow marine to brackish and then continental conditions, which prevailed through the remainder of the Cretaceous and Tertiary. Away from the shelf areas marine and paralic conditions persisted through the deposition of the Allaru Mudstone, Toolebuc Limestone and Mackunda Formation. Under terrestrial conditions of the shelf areas Winton Formation sediments were laid down contemporaneously with the adjacent marine deposits.

The Winton Formation is remarkably consistent and is found throughout the whole area west of the Nebine Ridge, above which it has been eroded. Over the Eulo Ridge very thin deposits of Winton sandstone and mudstone lie directly on the Wallumbilla Formation with the exclusion of the intervening formations. Near Granite Springs homestead (Grid. Ref. 244488) a 50 foot thick sequence of Winton Formation sandstone rests nonconformably on Devonian granite. At this locality the Wallumbilla Formation and Hooray Sandstone pinch out in the vicinity of the granite.

The transition from a continuous Cretaceous sequence in the north is compared with the abbreviated sections from the Cunnamulla Shelf by means of gamma ray log correlation diagrams. (Plates 1 and 2). The lack of outcrop in the vicinity of the shelf margin prevents visual confirmation of the sudden disappearance of Allaru to Mackunda Formation sediments. Palynology of BMR Eulo Scout No. 1 (Appendix 2) and limited observation are consistent with this hypothesis.

a. Wallumbilla Formation (Klu)

Vine et al., (1967) describe the Wallumbilla Formation as a sequence of mudstone and siltstone, with grey concretionary limestone (locally common), minor lenticular sandstone, intraformational conglomerate and cone in cone limestone. This lithology is consistent with drillers' logs and oil completion reports for the mapped area.

Two members of the Wallumbilla Formation were recognized. The boundary between the members is gradational and the mudstones of the Doncaster Member become interbedded and eventually replaced with siltstone and fine sandstone of the overlying Coreena Member. The Doncaster Member is the approximate lithological equivalent of the Roma Series of Whitehouse (1926) and the Roma Formation used by Day (1964). Current oil company usage is to include the sediments of both members in the "Roma Formation".

Doncaster Member (Kld)

The Doncaster Member averages approximately 500 feet in thickness over all the mapped area, except in the area of the Eulo Ridge. It rests conformably on the Hooray Sandstone. A quartz sandstone which is often a useful aquifer, defines the upper extent of the Hooray Sandstone. On gamma ray logs the Doncaster Member can be differentiated from the overlying Coreena Member and underlying Hooray Sandstone with a fair degree of precision. The smooth line graph of the Doncaster Member normally deflects slightly to the right forming a characteristic 'bulge', the maximum deflection approximates the centre of the member. This characteristic was recognized in wireline logs of water bores over most of the mapped area, and it is a consistent feature of the unit throughout a wide area of the Eromanga Basin. Approximately 120 feet of Doncaster Member mudstone was identified in BMR Eulo No. 1 (Fig. 3). The microfloral assemblage from cores 1 and 2 indicate an age within the K1b to K2a range, (Burger, Appendix 2).

Coreena Member (Klc)

The Coreena Member was defined by Vine et al., (1967). It is from Coreena Station some 20 miles north-east of Barcaldine in the Longreach Sheet area. In the type area, it comprises interbedded siltstone and mudstone. The siltstone is gradational to fine grained labile sandstone.

The member is exposed in northwest and west Charleville Sheet area. The northernmost outcrops occur in rolling downs terrain. To the south they are replaced by the chemically altered equivalents. Further small areas of Coreena Member occur as elliptical patches of rolling downs in the Spring Creek Anticline and adjacent to the Boondoona Fault in Toompine Sheet area.

A fauna of macrofossils consisting mainly of pelecypods and belemites were collected from calcareous siltstone in the Spring Creek Anticline (Grid Ref. 333618). Pelecypods were also collected on Charleville Sheet near Etona homestead.

The thickness of the member, as inferred from gamma ray logs of water bores and oil exploration wells, is approximately 500 feet. The member is consistent in thickness over the mapped area except in the Eulo Ridge area where local thinning occurs. In BMR Eulo Scout No. 1, 240 feet of Coreena Member occurs, the top is eroded at this locality. The member pinches out entirely, adjacent to local granite highs on the Eulo Ridge.

BMR Wyandra No. 1 (Fig. 5) was drilled to confirm the presence of this member. In this bore 145 feet of chemically altered and 55 feet of unweathered Coreena Member sediments were drilled. Spores and pollens from core No. 1 gave a K2a age for the member (Burger, Appendix 2).

Toolebuc Limestone (Klo)

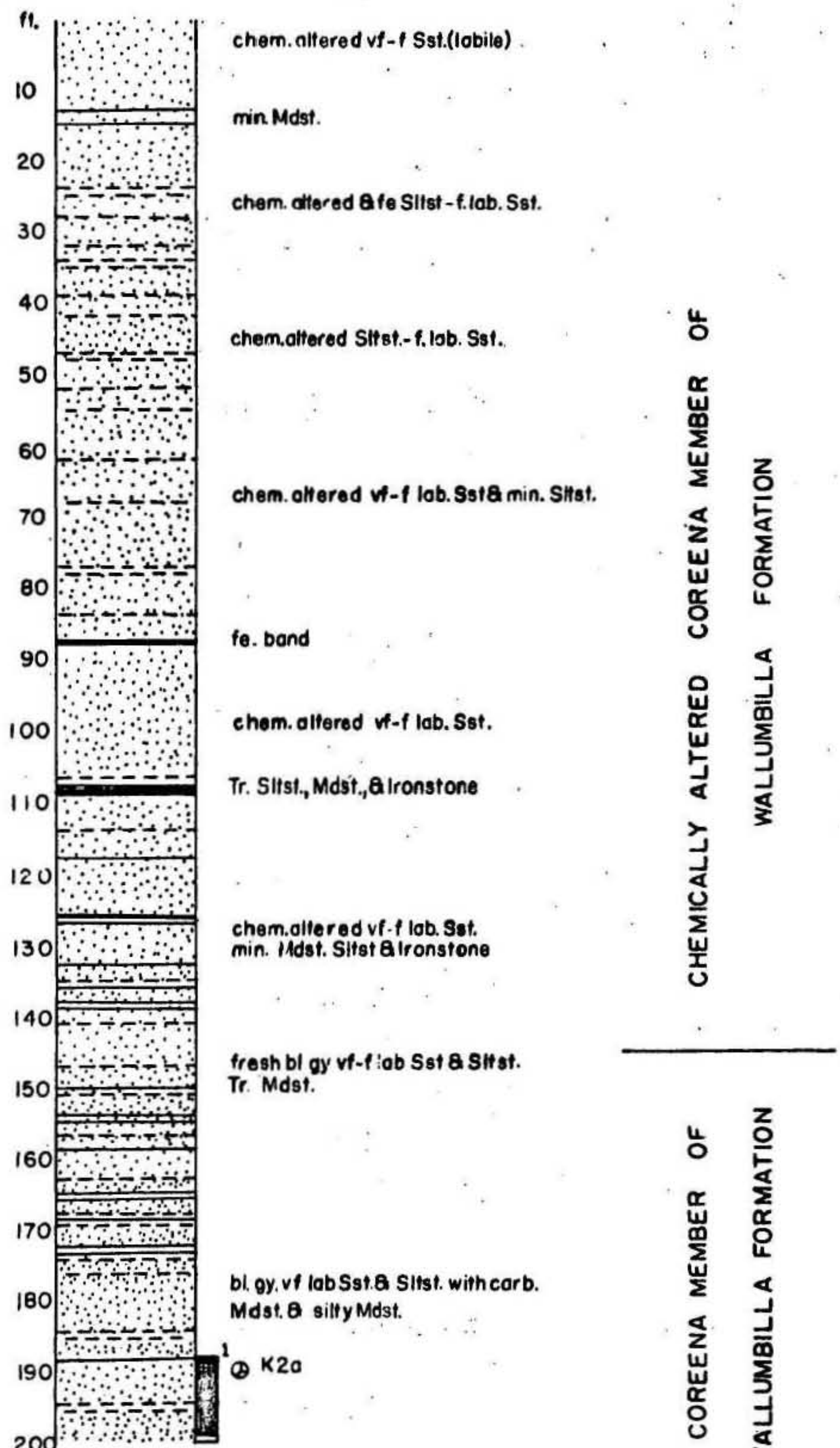
The Toolebuc Limestone (Vine et al., 1967), originally the Toolebuc Member (Vine and Day, 1965), is a platy, grey, coarsely-crystalline limestone with thin interbeds of grey calcareous shale. It is normally only a few feet in thickness, and does not outcrop in the mapped area, where it has a restricted subsurface distribution. It is not recorded on water bore drillers' logs or on the lithological logs of oil exploration wells of the mapped area. However the characteristic high radioactive peak is present on the gamma ray logs of wells on the Quilpie Sheet and part of Charleville Sheet area.

Most of the deep water bores in the mapped area have been gamma ray logged under contract to the Bureau of Mineral Resources. From a study of these logs the distribution of the Toolebuc gamma ray anomaly can be found (Fig. 6).

In Phillips-Sunray Quilberry No. 1, Dartmouth No. 1, and Buckabie No. 1, limestone was not recorded from the cuttings in the interval that corresponds to the gamma ray anomaly. It is probable that within the mapped area the Toolebuc Limestone is little more than a calcareous shale which contains a small quantity of radioactive minerals.

FIG. 5. Grid ref. 494529.

B.M.R. WYANDRA SCOUT NO. I.

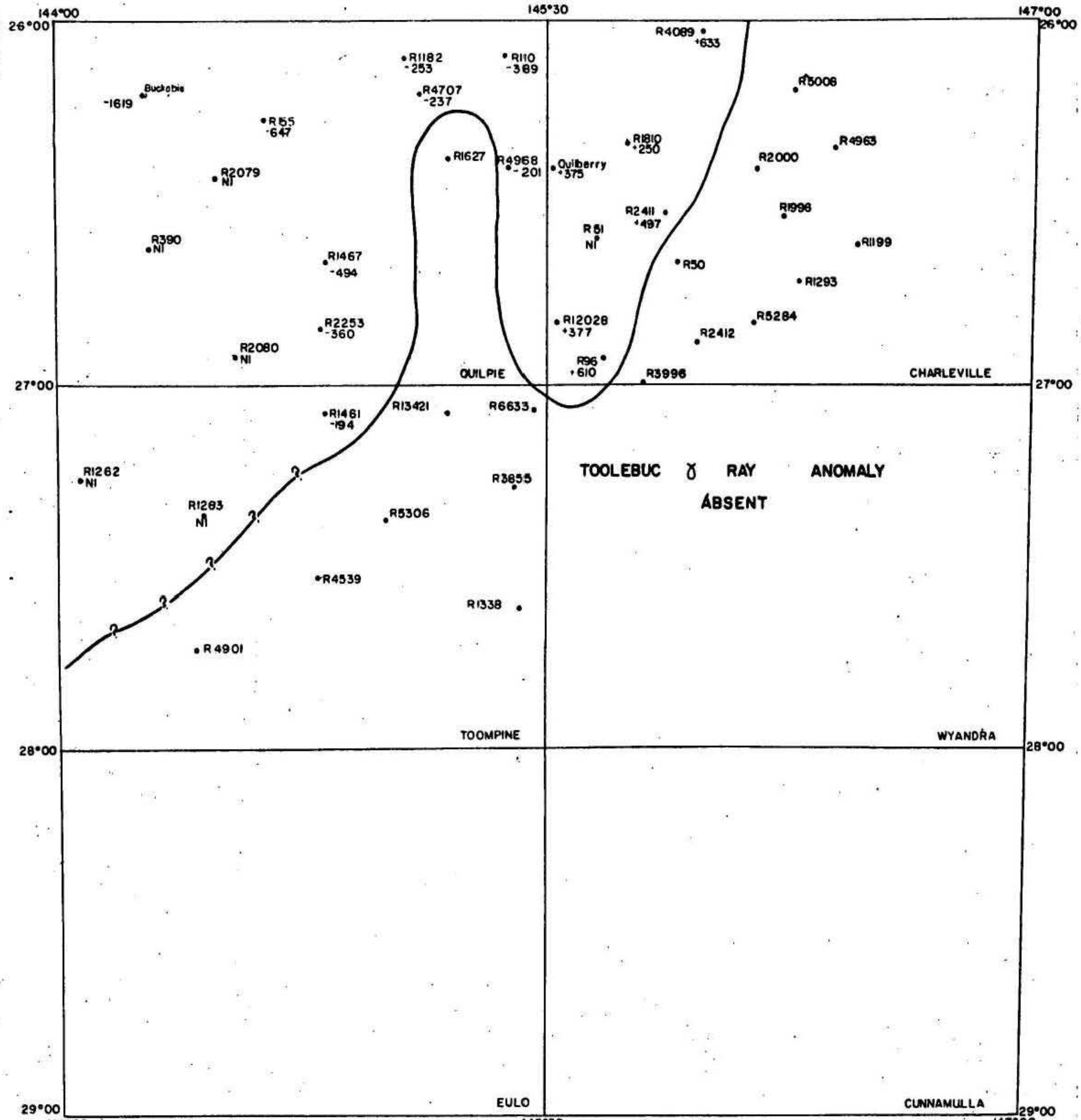


To accompany record 1969/13
Q/A203

Cored interval.
Spores and pollens
K2a Palynological age

FIG.6.

DISTRIBUTION OF THE TOOLEBUC GAMMA RAY ANOMALY



Inferred limit of the Toolebuc

±360 Depth to the top of the anomaly in feet.

NI No information

DATUM: SEA LEVEL

To accompany record 1969/13 Q/A204

In the remainder of the Eromanga Basin, especially to the northwest of the mapped area the Toolebuc Limestone can be correlated from outcrop by means of gamma ray logs over very large areas (Vine, 1966).

The Toolebuc Limestone is Albian (Lower Cretaceous) in age based on a restricted marine fauna from Julia Creek, Richmond and Boulia Sheet areas. (Vine and Day, 1965).

The correlation diagram (Plates 1 and 2) shows the progressive reduction in amplitude of the radio active peak until it can no longer be identified. The limestone is not developed in the Cunnamulla Shelf area.

Allaru Mudstone (Kla)

The Allaru Mudstone is dominantly a blue-grey mudstone which contains indurated beds of calcareous siltstone (Vine & Day, 1965). This formation crops out in central north Charleville Sheet area. Outcrops are very poor with generally only a few feet of (chemically altered) kaolinitic mudstone exposed. Three small areas of relatively unweathered outcrop were found in the extreme north of the Sheet along the east margin of the Warrego and Ward Rivers. A few samples of fossiliferous calcareous mudstone were collected from a brown soil plain at these localities.

The belt of outcrop stretches south across the central part of Charleville Sheet. The southernmost occurrence of this formation was found on the Mulga Tableland, where road cuttings provide a few good exposures. At this locality the deposit has been largely altered to kaolin during the late Cretaceous period of deep weathering. The kaolinitic mudstone is slightly siliceous and breaks along sub-conchoidal fractures.

In this area the chemically altered or unweathered parent material has little resistance to erosion and natural outcrops are rare. For the most part the Allaru Mudstone is covered with Quaternary red earth and sand deposits.

In Quilpie Sheet area subsurface studies of gamma ray logs of waterbores show that the deposit has a uniform thickness of approximately 800 feet. In Quilpie and the western third of Charleville Sheet areas the Allaru Mudstone conformably overlies the Toolebuc Limestone. On the remainder of the mapped area the Toolebuc Limestone was not deposited and the Allaru Mudstone rests conformably on the Coreena Member of the Wallumbilla Formation. The Allaru Mudstone thins towards the Cunnamulla Shelf area. This area was high while the Allaru Mudstone was being deposited and the Cunnamulla Shelf received only terrestrial deposits of the Winton Formation at this time. The distribution and thinning of the Allaru Mudstone is shown on the correlation diagram (Plates 1 & 2).

BMR Charleville Scout No. 1 recovered cores of black, pyritic, laminated mudstone which contain ammonites and fragmentary pelecypods (Fig. 7).

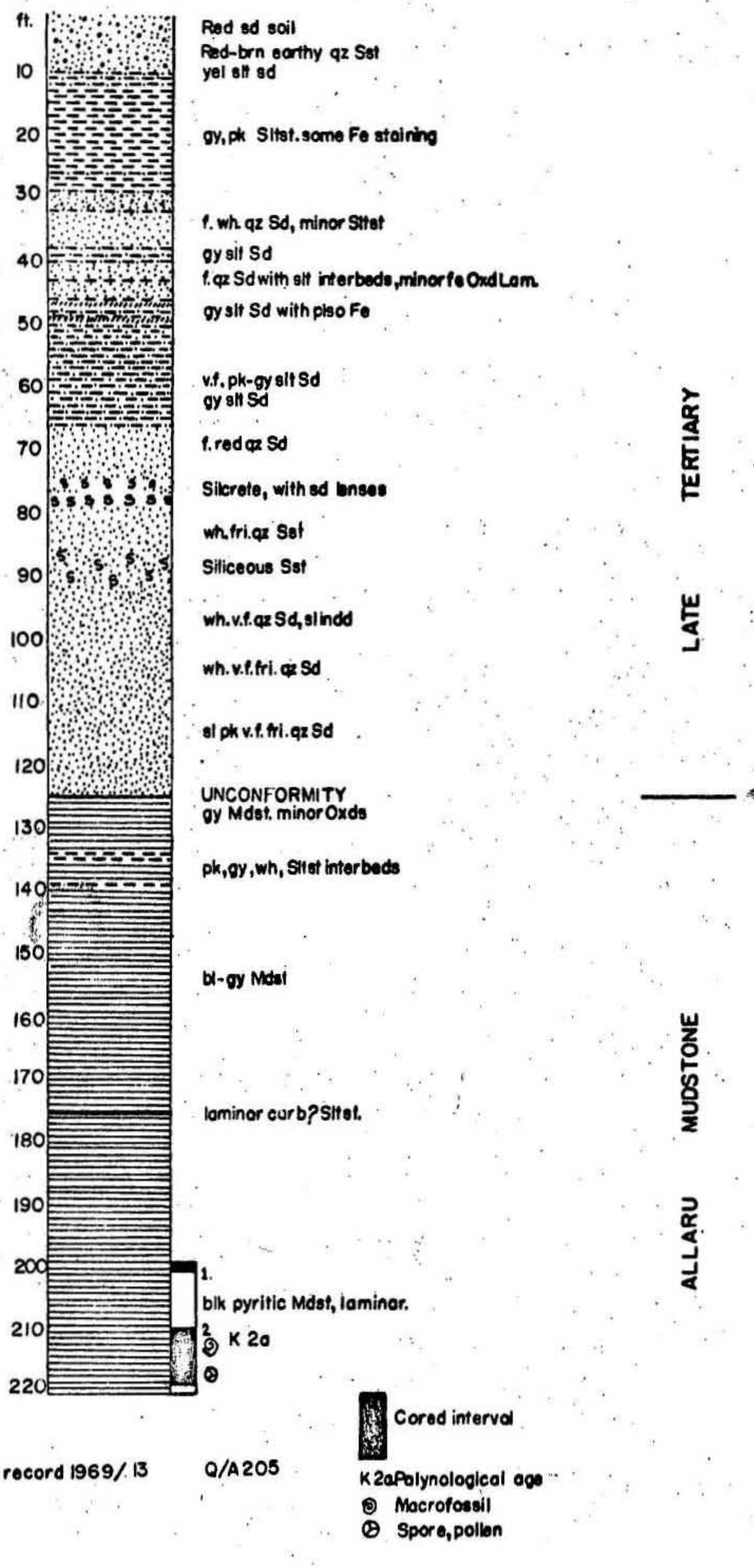
d. Mackunda Formation (Klm)

This formation was defined by Vine and Day (1965). The type area is in the headwaters of Mackunda Creek on Gnalta Station, in the Mackunda Sheet area.

In the mapped area the sub-surface distribution is restricted to Quilpie and west Charleville Sheet areas. Outcrop is restricted to a small area of flat topped hills between the Ward and Warrego Rivers. No fresh outcrops of this Formation were found in the mapped area.

FIG. 7.

BMR CHARLEVILLE SCOUT NO. 1. Grid ref. 402748.



To accompany record 1969/13

Q/A205

In Augathella Sheet area this unit consists of labile to sublabile siltstone and sandstone, thinly interbedded and interlaminated with mudstone. The sandstone is very fine and fine grained; medium grained sandstone is rare (Exon et al., 1966). In Charleville Sheet area the formation is represented by chemically altered beds in which the sediments have been kaolinized, silicified, and ferruginized (see chapter on chemical alteration) as a result nothing can be added to the above lithological description. Only the thinly bedded characteristic enabled this unit to be differentiated from the overlying more massively bedded Winton Formation.

The unit is approximately 500 feet in thickness in A.O.D. Canaway No. 1 (Windorah Sheet) (Gregory, et al., p 7). A thick sequence of labile sandstone containing Inoceramus prisms was intersected in Phillips-Sunray Buckabie No. 1. The unit thins to the west and south from the Buckabie well where it is inferred to be in the order of 200 feet in thickness. The unit is absent from the Cunnamulla Shelf.

e. Winton Formation (Kw)

The Winton Formation crops out over a large area of western Queensland (Hill and Denmead, 1960; Vine and Day, 1965; Gregory et al., 1967; Senior et al., 1968).

This formation outcrops widely on the western half of the mapped area. A structural limit to these sediments occurs in east Charleville and north Wyandra Sheet areas. In these areas the Winton Formation has been eroded along the Nebine Ridge.

The Winton Formation outcrops in two forms. Relatively unweathered calcareous labile sandstone is restricted to the core zone of structural highs such as is found along the Boondoona Fault (Toompine Sheet). More commonly only the chemically altered sediments are found. These are the selectively kaolinized, silicified and ferruginized sediments which are harder than the underlying unweathered material, and form dissected hill country.

The lithology of the unweathered parent sediment and its chemically altered derivatives are described in detail in Gregory et al., (1967) and Senior et al., (1968). Briefly the sediments consist of calcareous labile sandstone and calcareous siltstone and mudstone. Non calcareous argillaceous beds and minor coal do not outcrop but are evident on water bore drilling logs and in shallow scout hole drilling.

In the north of the area the Winton Formation conformably overlies the Mackunda Formation. Winton deposits thin to the south, but are continuous on to the western part of the Cunnamulla Shelf and on the Eulo Ridge. In the ridge area the Winton Formation overlies the Wallumbilla Formation. On local granite highs, in the ridge area, the Winton Formation rests disconformably on the granite.

The unit is approximately 1100 feet thick in Phillips-Sunray Buckabie No. 1. It thins to the south where it is approximately 300 feet thick in the Eulo Ridge area. Near Granite Springs homestead (Grid Ref. 244488) (Eulo Sheet) the Winton Formation is only 50 feet thick. No variations in lithology were found from the thick sequence in the north to the thin sequence in the south.

Fragmentary plant material consisting of impressions of stems and sometimes leaves occurs wherever the Winton Formation is found. Numerous specimens of Phyllopteris lanceolata Walkom, were collected in the Quilberry Anticline (Quilpie and Charleville Sheets). The fossil leaves indicate a Lower Cretaceous age (White, 1969).

Spores recovered from a core sample in BMR Connemara No. 1 (Connemara Sheet) indicate an early Upper Cretaceous age (Gregory et al., 1967). The upper age limit for the Winton Formation is not known.

The Winton Formation is a fresh water sequence. The sediments are coal bearing and indicate an interplay of fluviatile and paludal conditions.

TERTIARY

Glendower Formation (Tg)

Summary

(1) The Glendower Formation is a fluviatile sequence of quartzose arenaceous sediments containing minor argillaceous interbeds which unconformably overlies chemically altered sediments of the Winton Formation.

(2) Some Glendower Formation sandstone was intensively silicified to form beds of silcrete in early Tertiary time. Silcrete is highly resistant to erosion and forms cappings of scarp-bounded hills.

(3) This unit is restricted to the western part of the mapped area on Quilpie, Toompine and Eulo Sheets, and the western half of Charleville Sheet. Similar sediments of local extent in east Charleville and Cunnamulla Sheet areas are probably not part of the Glendower river system but represent smaller river systems possibly of similar age. Correlates of the Glendower Formation which are geographically removed are designated with the symbol (T) on the maps.

The Glendower Formation has been mapped across a large area in southern Queensland (Gregory et al., 1967, Senior et al., 1968) but there is considerable doubt that the spatial distribution is correlatable with the type locality as defined by Whitehouse (1954).

(4) On Eulo Sheet silicification was so intense that the entire remaining deposit consists of silcrete.

Nomenclature

The term, Glendower Series was introduced by Whitehouse, (1940) and later renamed Glendower Formation (Whitehouse, 1954) to cover a sequence of arenaceous sediments which occur in the valley of the Flinders River near Hughenden. Subsequent mapping has shown that the Glendower Formation contains the deposits of an extensive river system. Lithologically identical sediments occur over a wide area of south west Queensland and because no boundary was observed between the Glendower Formation and adjacent widespread sediments they were all collectively mapped as the same formation (Gregory et al., 1967; Senior et al., 1968). Very similar sediments in South Australia were called the Mount Howie Sandstone of Upper Cretaceous age (Wopfner, 1963). Clearly a detailed survey on a regional scale is needed to define the limits of this unit.

Topography

The unit crops out in areas of flat topped hills. Usually the surface is littered with several feet of cobbles and boulders of silcrete commonly called 'gibbers'. Where erosion has penetrated the silcrete the unit forms scarps or steep sided hills.

Lithology

Quartzose sandstone, sandy conglomerate and minor siliceous siltstone are the dominant rock types. Normally the bulk of the deposit is silicified. The lower face of most escarpments are obscured by very coarse, iron-cemented breccia which often contains large boulders of silcrete. Variable amounts of reworked chemically-altered Winton Formation clasts are common within the sandstone.

Thickness

The upper surface of the Glendower Formation,as seen in outcrop,is an erosion surface so the original thickness is unknown. Variations from a few inches to 25 feet occur locally and represent channel filling on the eroded Winton Formation surface (Photo 6). More normally the beds are a constant thickness over a distance of several miles.

Structure

Fold movements took place after the Glendower Formation was deposited and selectively silicified. Howaver, because the unit is only sparsely represented within the mapped area, due to non-deposition and erosion, there is a lack of indurated silcrete beds which, in adjacent areas, delineate shallowly-dipping fold limbs. As a result fewer structures were mapped than in areas to the west where the unit is widespread (Senior et al., 1968), but it is not certain whether this is due to lack of evidence or fewer structures.

Silicification

The Glendower Formation sediments are quartzose, and are very susceptible to silicification to produce a distinct rock type called silcrete. Silcrete has been described in detail from areas to the west of this survey (Gregory et al., 1967; Senior et al., 1968). Multiple beds and lenticular beds of silcrete which are not genetically related to a duricrust are described by Senior et al.,(1968).

Widespread silcrete is restricted to the western third of the mapped area, but sporadic islands of boulders, and a few intact silcrete beds occur throughout the area. Silcrete is identical to deposits further west and only specific examples of unusual features will be given here. The reader is referred to the above works for a full synthesis of silicrete in southwestern Queensland.

Some very well preserved silicrete beds were observed on Eulo Sheet. Beds up to 20 feet thick occur showing strong columnar structure, in which there is sub-horizontal fracturing (Photo 7). Wide vertical fractures are commonly infilled with rubble which is sometimes re-cemented with silica or iron oxides (Photo 8). The columnar structure is reflected at the surface by a polygonal pavement surface (Photo 9). Most commonly, silcrete surfaces are covered by a mantle of silcrete cobbles and boulders.

The process of silicification might have been continuous over a long period of time and fragmentary silcrete material has become locally resilicified to form a secondary composite mass. Photo 10 shows a homogeneous silcrete formed from such a conglomerate of silcrete clasts.

Siliceous groundwater only formed silcrete in quartzose host sediments. On eastern Toompine Sheet a channel sand which lies unconformably on a truncated weathered mantle is completely silicified to silcrete. The underlying weathered mantle is relatively free of quartz (Photo 6).

The silicification process had a similar effect on a granite which is surrounded and partly buried by Tertiary sediments. The zone of silicification extends from the upper part of the Tertiary sandstone across the acid weathered granite (Photo 11).

CAINOZOIC ARENITES (Cz)

Consolidated to slightly indurated quartzose sandstone and quartzose pebble conglomerate crop out along parts of Angellala Creek (Charleville Sheet area). Iron cementation of the conglomerate beds occurs towards the top of the outcrop. Miniature earth pillars occur (Photo 12).

Photo 6: Channel sandstone infilling an eroded hollow in the weathered mantle. The sandstone is strongly silicified forming silcrete. The head of the figure demarks the unconformity (Toompine Sheet). BMR Neg. No.M/826.

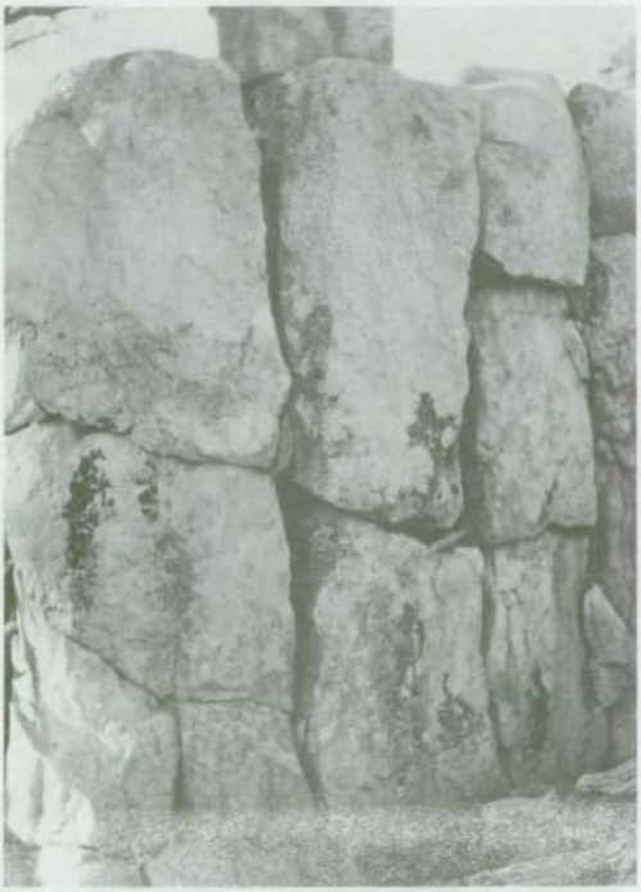


Photo 7: Strong columnar jointing and sub-horizontal jointing in silcrete (Eulo Sheet). BMR Neg. No.M/831.

<u>Photo</u> 8: Silcrete in a Quarry on Quilpie Sheet, showing a 'pipe' infilled with re-cemented silcrete breccia.

BMR Neg.No.M/828

<u>Photo</u> 9: Pavement surface formed by terminating polygonal silcrete columns (Quilpie Sheet).

BMR Neg.No.M/831

The thickest section observed is 45 feet. This outcrop (Grid Ref. 485702) is close to the base level of Angellala Creek and if the low sand covered hills in the vicinity are part of the deposit it has a true thickness of approximately 200 feet.

These sediments contain iron stained indurated beds, with quartz pebbles and cobbles, and clasts of redeposited Coreena Member and silcrete pebbles.

Similar unconsolidated sandstone occurs below the sand-plain as indicated in BMR Charleville No. 1. Although there is only limited outcrop occurrence and evidence from the one drill hole, it appears that this deposit is widespread. Also preliminary drilling on Dirranbandi Sheet indicated 270 feet of unconsolidated sediments.

The physical relationship between the Cainozoic sediments and Tertiary deposits is not understood. The Cainozoic deposits are not indurated and are restricted to topographic lows in the present day landscape. In contrast the Glendower Formation and similar sediments are found as hill cappings and must have been subject to epeirogenic movement. For these reasons the Cainozoic deposits are probably younger than the Glendower Formation.

QUATERNARY

Alluvial and Lacustrine Deposits (Qa)

Superficial alluvium covers much of the mapped area, however in the vicinity of the major water courses, particularly the Warrego River, the alluvium is thick and covers a large area. Little is known about the thickness of the deposits but 380 feet in Wyandra Town Bore, Registered Number 4983, is close to the inferred maximum for the mapped area.

Lacustrine sediments are extensive in the Lake Dartmouth and Dynevor Lakes area. Similarly, alluvial deposits occur in the many thousands of clay pans scattered throughout the mapped area.

Lacustrine and spring deposits occur near the Boondoona Fault (Toompine Sheet area) (Photo 13). These deposits contain a Pleistocene fauna consisting chiefly of diprotodont and reptile remains (see Appendix 5).

All the alluvial deposits are fine-grained and contain swelling clays which pose engineering problems on the roads that cross them. The alluvium contains crystals of gypsum which are often concentrated a few inches below the alluvial surface. Sand deposits occur in point bars in the wide alluvial channels of the Warrego River.

Red Quartzose Sand (Qs)

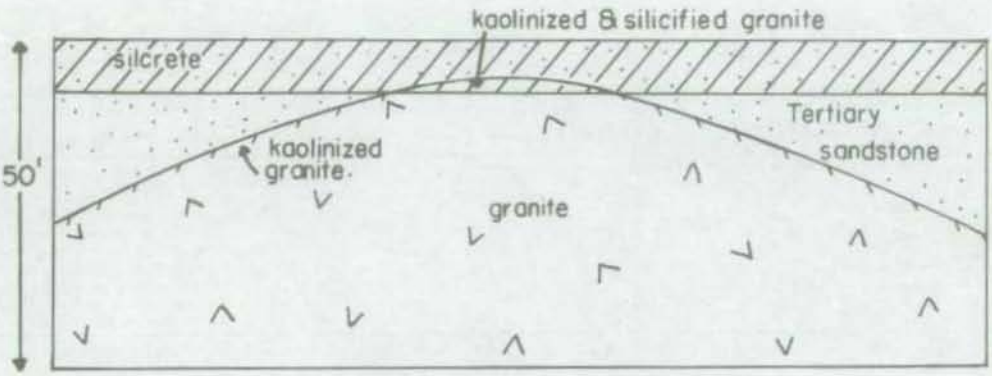
Large areas, especially in southern Charleville, Wyandra and Cunnamulla Sheets, are covered by red quartzose sand deposits. Indications from drillers' and gamma ray logs are that these deposits are generally less than 50 feet thick. However in the vicinity of Angellala Creek (Charleville Sheet) sand deposits cover a loosely indurated arenaceous sequence up to 200 feet thick. Sand cover on the margins of the Ward River (Charleville Sheet) overlies similar deposits approximately 120 feet thick as indicated by drilling BMR Charleville Scout No.1. Much of the Quaternary sand cover of the area might be the upper reworked portion of Late Tertiary fluviatile deposits.

Sandy Red earth (Qr)

Red earths are extensively developed throughout the area with the exception of Cunnamulla and Wyandra Sheets. Red sandy soils which occur on the lowlying plains of Wyandra Sheet area lack a distinct photo pattern and their higher sand content make them indistinguishable from Qs.

Photo 10: Re-silicified silcrete breccia with gradation to an outer zone of amorphous silcrete (Quilpie Sheet). BMR Neg. No. M/828

Relationship of silcrete to the granite. Currawinya area   Grid ref 236433



White silicified granite overlying normal granite near "Currawinya", Eulo Sheet.

(Photo II)

BM.R Neg. No. 826.

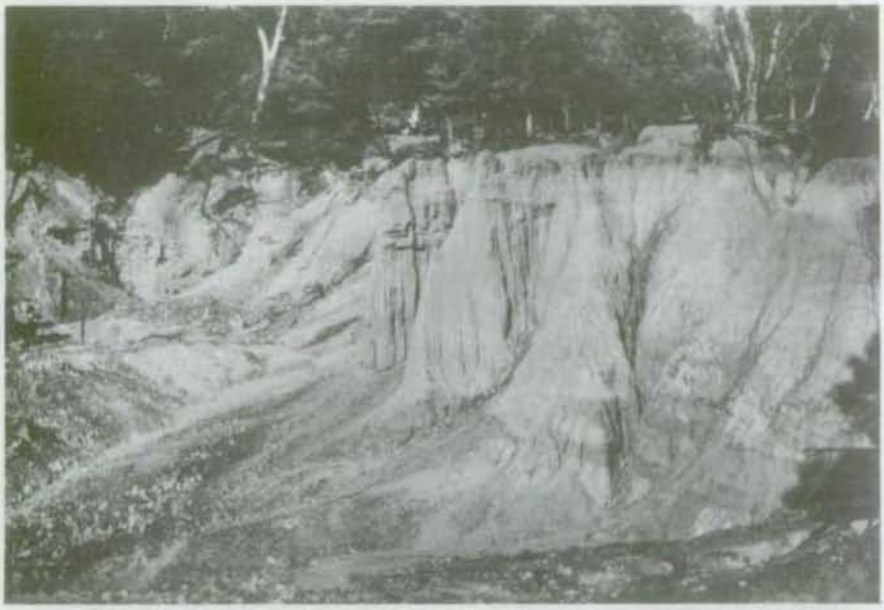


Photo 12: Cainozoic sandstone and conglomerate exposed on the margins of Angellala Creek (Charleville Sheet).

BMR Neg.No.GA/1380

Photo 13: Pleistocene lake beds at Boondoona Creek (Toompine Sheet) which contain vertebrate fossils (Toompine Sheet).

BMR Neg.No.829

The red earth varies in thickness from a few inches to 12 feet, and in colour from a brick-red to dark red-brown. It has a friable texture and consists of silt size and fine sand size quartz grains. Rock fragments constitute a small percentage and the clay content is variable, but usually less than 30%.

Locally the soils are reworked giving sandy areas. Magnetic haematite pellets commonly accumulate in small washouts and depressions on the Qr surface.

These soils flank structures and cover table-topped hills in the absence of Tertiary deposits. They thicken downslope on hill surfaces. Locally these soils are stony and grade into areas of silcrete cobbles and boulders. The downslope gradation into sandplain and alluvium makes the boundary of this unit difficult to interpret; in such cases it becomes an arbitrary boundary.

Characteristic of the soils on the table-topped hills and slopes is a banded tree pattern, an example of which was illustrated in Senior et al., (1968).

Silcrete gravel (Qc)

Mantles of rounded boulder to pebble sized silcrete clasts occur throughout the mapped area. Mapped deposits are small in area, but thin surface cover of this material, although not significant for mapping purposes, occurs on all units across the mapped area. The silcrete clasts are very hard and survive on the land surface, possibly indicating the former widespread occurrence of the silcrete.

The size of the clasts varies from boulder to pebble size; however some residuals are several feet in diameter.

In Quilpie Sheet area piles of silcrete clasts have caused small reversals in the topography. In places where they accumulated in greater concentrations, they protect the underlying softer Winton Formation sediments. As erosion proceeds low rubble mounds have formed which are 20 feet high on a stripped Winton surface.

CHEMICAL ALTERATION, SILICIFICATION AND THE FORMATION OF A WEATHERED MANTLE

Summary

1. During the late Cretaceous or early Tertiary the Cretaceous sediments were kaolinized, silicified and ferruginized to a depth of approximately 300 feet.

2. The chemically altered beds consist largely of kaolinized sandstone and mudstone with numerous iron-enriched interbeds. Iron staining and mottling is common. Silicified kaolinitic mudstone (porcellanite) and sandstone beds occur throughout the full thickness of the chemically altered beds.

3. The contact between the chemically altered and relatively unweathered parent material is seldom observed but in drill holes it appears gradational. In Eulo Sheet area iron-enrichment is concentrated in concretions near the base of the chemically altered beds.

4. The upper surface of the chemically altered beds is an erosion surface and the original thickness of alteration is not known. Tertiary and Quaternary deposits lie unconformably on these beds.

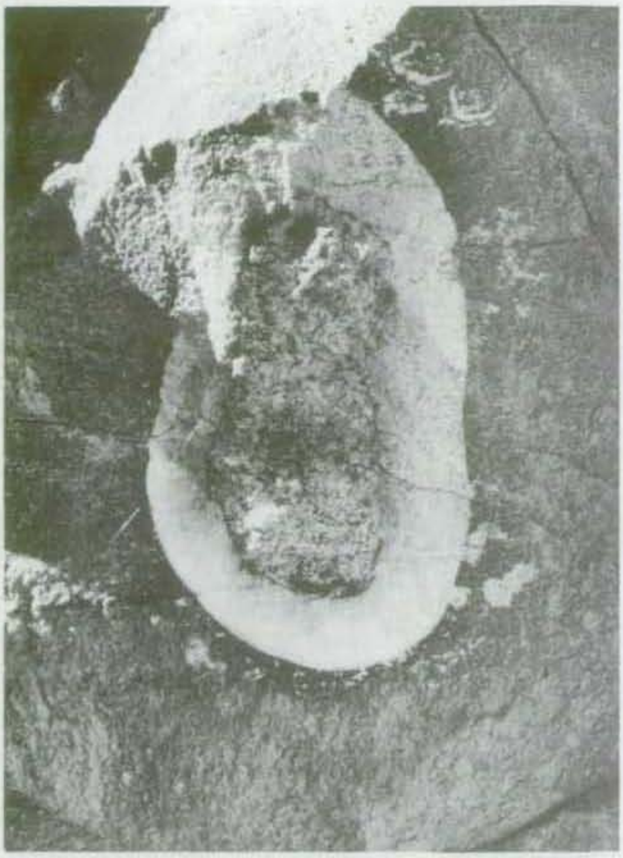


Photo 14: Uniformly iron stained red coloured sandstone bed in the Winton Formation, containing a secondary 'pod'. The inner zone of the 'pod' has a bleached sponge like texture surrounded by a uniformly bleached zone. There is strong demarkation between the outer bleached zone due to iron enrichment (Toompine Sheet).
BMR Neg.No.GA/1364

Photo 15: Concretions enriched with iron oxides which occur near the gradational contact between the chemically altered Winton Formation and unaltered sediments (Eulo Sheet). BMR Neg.No.M/835

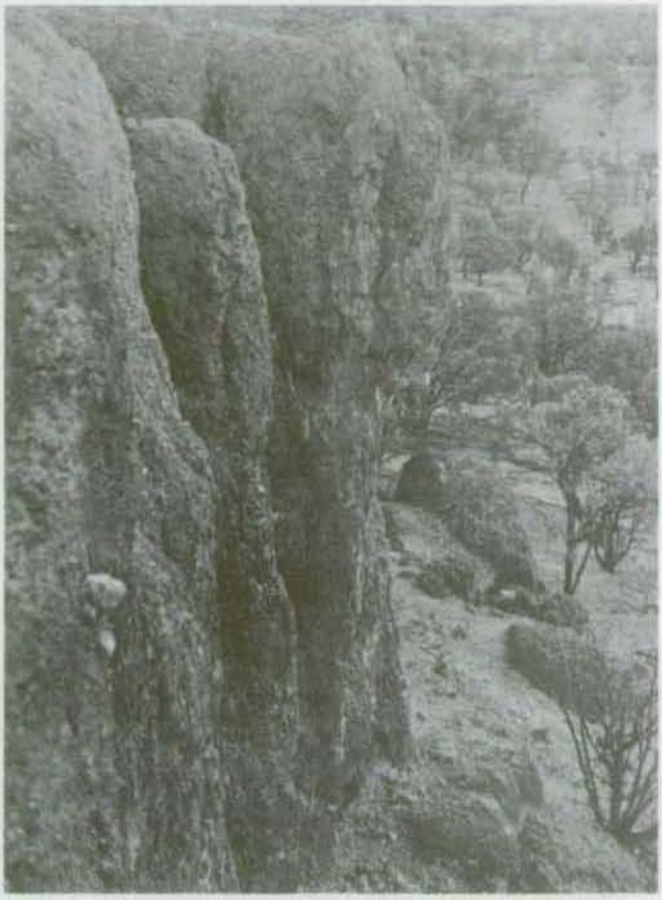


Photo 16: Scarp of weathered mantle material overlying a bench of chemically altered Winton Formation (Quilpie Sheet). BMR Neg.No. 828

Photo 17: Weathered mantle with thin silcrete gravel cover and containing a large isolated silcrete boulder. (Toompine Sheet). BMR Neg.No.M826

5. In areas where Tertiary sedimentation was thin, or the deposits were eroded at an early stage, a weathered mantle formed in the top of the chemically altered beds. The weathered mantle forms a steep-sided resistant capping to hills and plateaus of the area. This mantle possibly developed by a soil-forming process in which a soil was formed with minimal profile development.

A. Chemical Alteration of the Cretaceous Sediments

Chemically altered sediments of southwest Queensland have been described by Gregory et al., (1967) and Senior et al., (1968). The deposits do not exhibit profile development like those of laterites and the term chemically altered was introduced in Gregory et al., (1967) to describe them. The physical process of alteration and the morphology of these sediments is described in detail in the above references.

Lithologically the chemically altered sediments consist of kaolinitic sandstone and mudstone. These beds are predominantly white in colour but are often varicoloured due to iron staining. Sub-conchoidal fracture surfaces are common in thick beds of chemically altered mudstone. Iron staining may be uniform or irregular giving mottled beds. Secondary leaching in iron stained beds has formed some rather unusual mottled patterns, an example is illustrated on Photo 14.

Iron enrichment takes place in selective beds throughout the entire thickness of the chemically altered sequence. In Eulo Sheet the formation of an 'ironstone' bed in granite immediately below the contact of the overlying chemically altered sediments suggests that iron moved down through the sequence. This is in direct contrast to laterite development where concentration of iron is at the top of the profile. Former calcareous beds in the sediments appear to have been replaced by iron and in many places iron enrichment occurs in concretions which are situated close to the gradational contact between the chemically altered and fresh sediments (Photo 15).

Silica enrichment in the chemically altered beds are most noticeable where they form siliceous mudstones or porcellanite. These beds are quite strongly indurated, but are highly fractured and crumble readily on exposure. Arenitic beds in the Winton Formation are sometimes cemented by opaline silica, and are not fractured as closely as the siliceous argillaceous beds.

In the mapped area, sediments of the Rolling Downs Group were deeply weathered during a period of intense leaching which took place in Upper Cretaceous or early Tertiary time. The chemically altered beds are more resistant to erosion than the fresh sediments and thus form steep-sided mesas and plateaus.

Movement of silica-laden groundwater through fissures and cracks in the chemically altered beds resulted in local deposition of opal. Precious opal is restricted to the chemically altered beds. The mode of formation is discussed under 'Precious Opal' in the chapter on Economic Geology.

B. The weathered mantle

The term "weathered mantle" is used here to describe the hard brecciated zone which commonly overlies chemically altered sediments. (Photo 16) The mantle varies from a few feet in thickness up to 50 feet. Tertiary deposits were silicified to form silcrete (see chapter on Glendower Formation) possibly contemporaneously with the formation of the mantle. The weathered mantle occurs in areas in which there was little or no Tertiary deposition. The chemically altered sediments have apparently been brecciated *in situ* by soil forming and weathering processes although fluvial and colluvial deposits may be included. The brecciated fragments are cemented by clay minerals and iron oxides. The weathered mantle forms steep scarps which grade down into the less steep slopes of the chemically altered sediments.

DIAGRAMMATIC RELATIONSHIP OF SILCRETE AND WEATHERED MANTLE

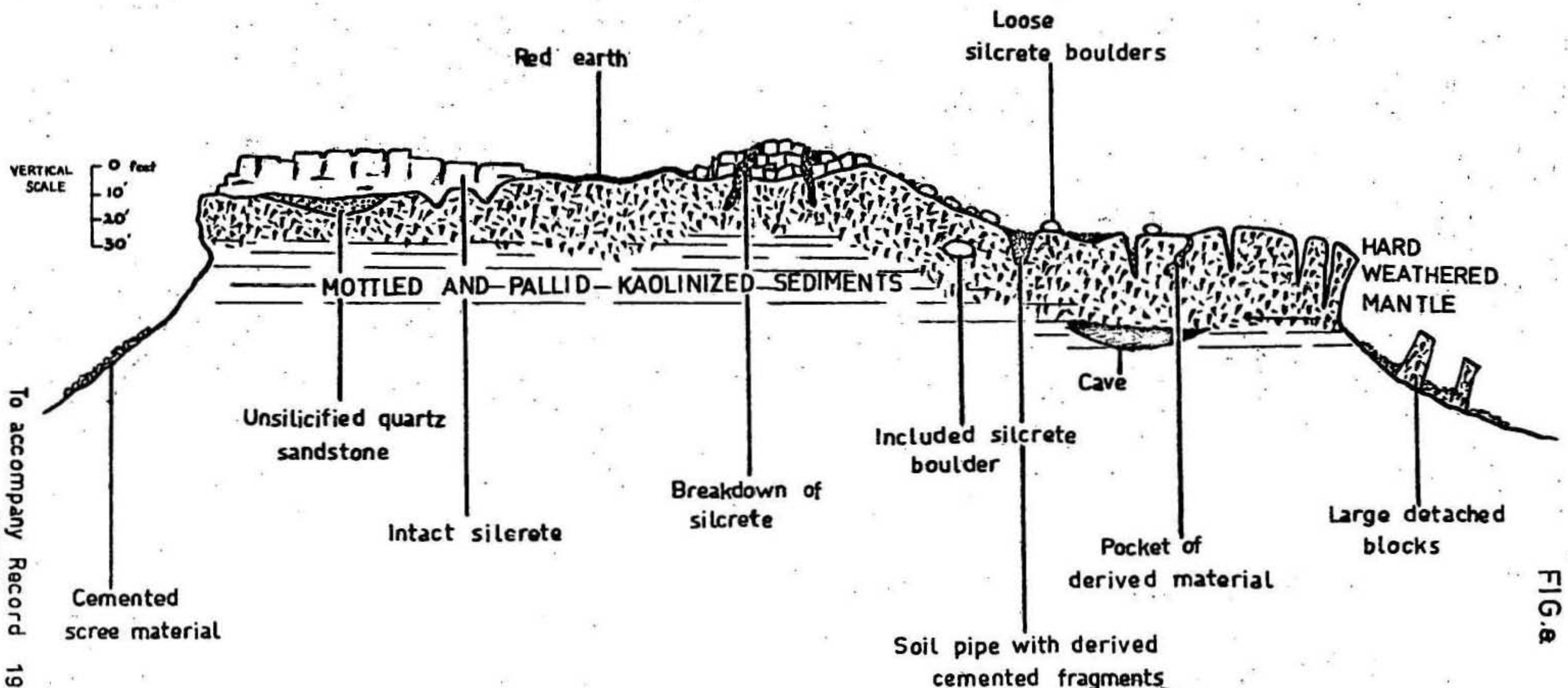


FIG.8

To accompany Record 1969/13
Q/A206

Figure 8 illustrates some of the complex inter-relationships of the weathered mantle and the silcrete. Beneath an intact silcrete the brecciated zone is thin or absent. It reaches its thickest development where silcrete is absent or only represented by loose boulders. Where loose Tertiary material such as silcrete fragments and quartz grains was available this was commonly recemented into the weathered mantle in soil pipes, irregularities on the surface, and in apparently disconnected pockets and also as large isolated boulders (Photo 17). Some of the derived parts of the mantle are pisolitic and other portions are partially silicified.

Silicification to form silcrete is not necessarily a surface feature (Senior et al., 1968) although widespread near-surface silicification was probably the dominant silcrete forming process. Moreover silicification occurred more than once during the Tertiary as is obvious from resilicified fluvial deposits containing silcrete clasts and also from resilicified silcrete breccia. If, as Woolnough (1927) states, silicification was related to a land surface with very sluggish drainage, then there must have been distinct breaks in silicification during which a higher energy environment prevailed and the silcrete was broken up, transported and deposited, in part, as conglomeratic fluvial deposits. Although silcrete at present occurs over a large part of the southern Eromanga Basin it is not everywhere in situ and large areas apparently represent masses "let down" in the landscape.

Woolnough (1927) states that "throughout Australia in or about Miocene time there existed a peneplain of almost ideal maturity of development" and "the duricrust residuals are all portions of one and the same peneplain surface". Wopfner and Twidale (1967) have described as part of their "duricrust profile" in South Australia a "fragmented zone". Both the terms "duricrust" and "fragmented zone" have not been used here because it is believed that this brecciation does not necessarily form as part of a profile related to silicification and deep chemical alteration, but simply as the result of soil processes which were, in part, contemporaneous with the formation of silcrete, but were also probably operative throughout most of the Tertiary. It is suggested that the brecciated mantle, except where associated with an intact silcrete sheet, is not representative of one siliceous weathering phase during the Tertiary but is the result of weathering over a long period during which there were periods of silicification and periods of break-up of the siliceous products. There is no reason why the soil-forming process should not have continued as the land surface was lowered by erosion.

Mabbutt (Appendix 3, Senior et al., 1968) argues against silcrete having been "let down" bodily in the landscape on a large scale. Two of his arguments were (a) that the fragmented zone which normally underlies the silcrete still survives; and (b) the "pipes" with hardened fillings of silcrete nodules and clasts which could only have penetrated a few metres beneath the silcrete surface, still survive. These arguments presume that the "fragmented zone" and the soil pipes only formed immediately beneath the silcrete surface. But if, as suggested here, brecciation continued with landscape lowering, there is no reason why this weathering should not have included piping and other surface cracking to be later filled with detritus.

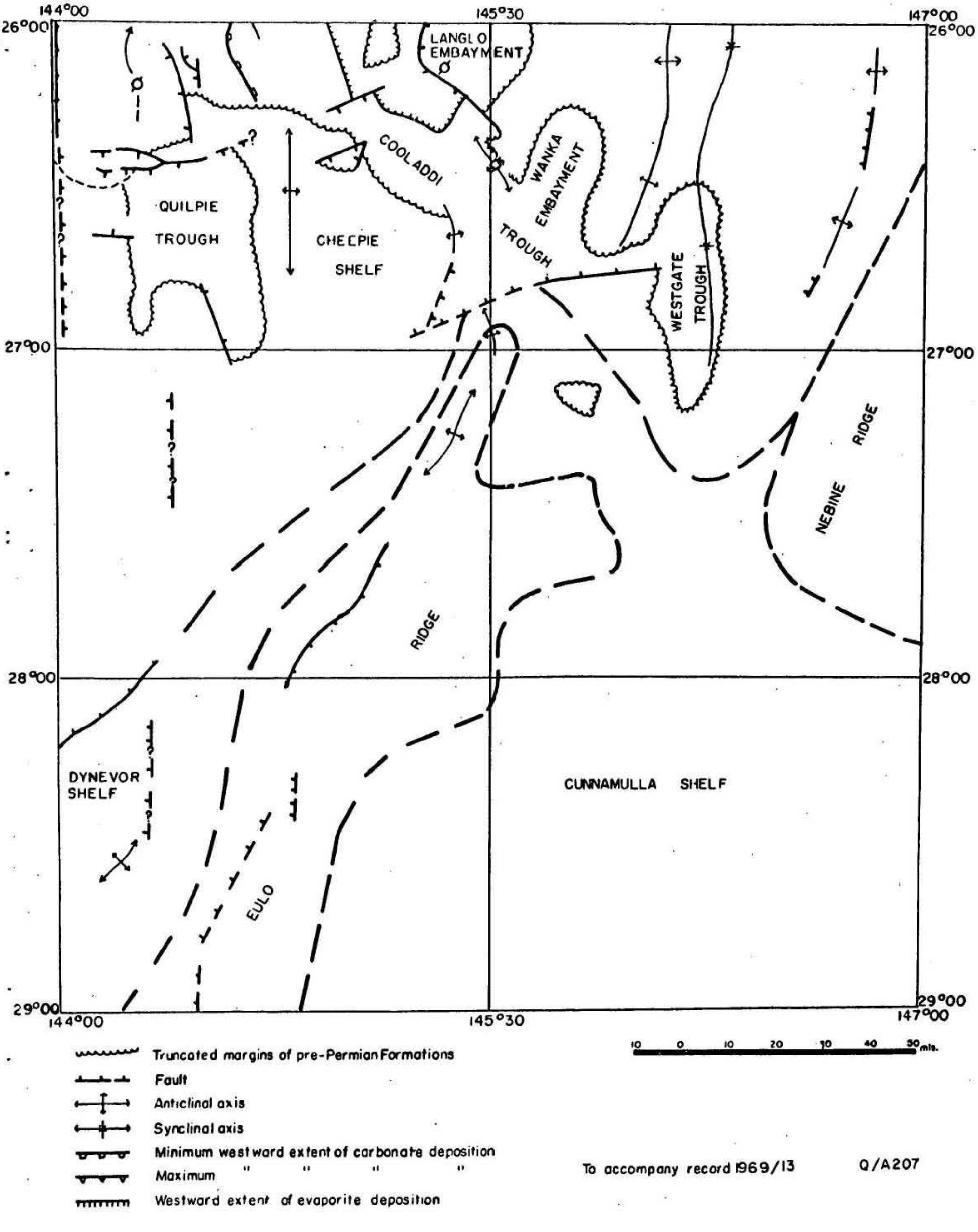
STRUCTURE

Introduction

Pre-Jurassic sediments are confined to structural remnants of the Adavale Basin sequence, and they are found only in the northwest part of the mapped area. Three main elongate troughs containing Devonian to Carboniferous sediments are the Quilpie, Cooladdi and Westgate Troughs. Threse troughs contain up to 16,000 feet of pre-Permian sediments. The Devonian to Carboniferous sequence is regarded as a remnant of the western shelf of the Tasman Geosyncline (Tanner, 1966). The troughs trend in a northerly direction and have steep-sided or fault-bounded margins.

FIG. 9.

STRUCTURAL INTERPRETATION MAP



To accompany record 1969/13

Q/A207

Jurassic to Cretaceous sediments unconformably overlie the Adavale Basin sequence in the north, and overlie metamorphic and granitic basement in the remainder of the mapped area. These sediments belong to the Eromanga Basin sequence. The Eromanga Basin sediments are flat-lying but are disturbed in places by shallow symmetric folds, or monoclines caused by subsurface faulting.

The mapped area lies in the eastern part of the Eromanga Basin and includes the basement Nebine Ridge (Whitehouse 1945) which defines the eastern structural margin with the Surat Basin. In the northwest of the area the Canaway Ridge separates the Adavale Basin remnants (Devonian-Carboniferous) from the Cooper Basin (Permian-Triassic). The major structural elements are illustrated diagrammatically in Figure 9.

Major Structural Elements

The Nebine Ridge

This gentle ridge in the metamorphic basement extends from the Nogoa Anticline in Springsure Sheet area, south to Wyandra Sheet area. In the mapped area it extends across southeast Charleville Sheet area and terminates in eastern Wyandra Sheet area. It is not continuous south into N.S.W. as reported by Whitehouse (1954). In the Wyandra Sheet area the ridge plunges gently to the south and merges with a wide flat platform here named the Cunnamulla Shelf. In Charleville and northern Wyandra Sheet areas the Nebine Ridge forms a structural division between the Eromanga Basin and the Surat Basin.

The Nebine Ridge was probably elevated in Devonian time and during this period it was intruded by granite. It was subsequently eroded and became a low lying area in early Jurassic time. It had little effect on Jurassic to Cretaceous deposition and in fact a slight increase in thickness of Lower Jurassic formations occurs near the crest of the ridge. Earth movements in late Cretaceous or early Tertiary time formed the present structural divide between the Eromanga and Surat Basins. These movements resulted in uplift and erosion of post-Wallumbilla sediments from the ridge area.

The Cunnamulla Shelf

The Cunnamulla Shelf is a new name which includes the east part of the Eulo Shelf and the southern part of the Nebine Ridge as defined by Whitehouse (1945). This shelf consists of a wide flat platform covered by near horizontal sediments which extends across Cunnamulla, southern Wyandra, and eastern Eulo Sheet areas. This shelf was an elevated area until the Upper Jurassic, and was probably a source for sediments for the Eromanga and Surat Basins. In Upper Jurassic to Lower Cretaceous time, the Hooray Sandstone was deposited across the shelf, and at this time the shelf ceased to form a divide between the Eromanga and Surat Basins.

A platform of similar elevation to the Cunnamulla Shelf lying to the west of the Nebine Ridge is called the Dynevor Shelf.

The Eulo Ridge

A second basement ridge, the Eulo Ridge formerly included as part of the Eulo Shelf of Whitehouse (1945), is represented at the surface by five granitic outcrops. The ridge was probably elevated during Jurassic to Cretaceous sedimentation as indicated by the pinching out of the Hooray Sandstone and the thinning of the Cretaceous units. Facies variations occur in Cretaceous sediments near the crest of the ridge with littoral deposits occurring. The present granite outcrops were islands for the initial part of the Cretaceous marine transgression, and some areas probably were never covered by the Cretaceous sea. Several strong lineaments, interpreted as faults, occur on the southern part of the ridge. The Eulo Ridge plunges shallowly northward and is reflected at the surface by an en echelon series of drape folds and faults, including the Boondoona Fault, and the Spring Creek and Tumblebury Anticlines.

Drilling for groundwater south of the Granite Springs basement outcrop indicates that quite a large area of granite is covered with less than 100 feet of Cainozoic sediments.

<u>Surface Structures</u>

Surface investigations are hindered by the extremely poor outcrops which are a consistent feature across all of the mapped area. As a result it is impossible to determine dip values and therefore calculate the symmetry of structural highs. The 10 anticlines mapped appear symmetrical with extremely shallow ($<5^{\circ}$) dipping limbs. Seismic evidence shows increasing dip with depth for many structures. The largest apparently symmetrical structures are the Winbin, Quilberry and Spring Creek Anticlines.

The <u>Boondoona Fault</u> is an inferred north-northeast trending fault on southern Toompine Sheet. There is no obvious corresponding lineament. Uplift has exposed fresh rocks of the Wallumbilla and Winton Formations. Fossiliferous mudstone of the Doncaster Member of the Wallumbilla Formation and interbedded sandstone, mudstone and cone-in-cone limestone of the Coreena Member outcrop adjacent to the fault. Peripheral to this is outcrop of the Winton Formation consisting dominantly of sandstone. The fault is downthrown to the east and a dip of 25° to the east was recorded adjacent to the fault. Floaters of basement rocks (quartz-veined quartzite and slate) occur in the alluvium along Boondoona Creek and presumably basement occurs beneath the alluvium on the west side of the fault. There is however no outcrop of Hooray Sandstone, although it is present at shallow depth in nearby waterbores. The Hooray Sandstone must pinch out against a depositional basement high which has been further uplifted along the Boondoona Fault during late Cretaceous or early Tertiary times. Abundant springs which occur along Boondoona Creek are probably due to leakage of artesian water along the fault.

The <u>Yalamurra Anticline</u> (Quilpie Sheet area) is an example of a surface fold which has resulted from fault movements at depth. The structure is elongate (11 miles long by 1.5 miles wide) north-trending fold. It is partly eroded, having an elliptical core zone of chemically altered Winton Formation surrounded by cuestas of the same material. Erosion along the structural axis has not been sufficient to expose relatively unweathered material. Similar folds with axial lengths greater than their widths are found in southwest Queensland and were also noted to be the surface expression of faults (Senior et al., 1968). Seismic evidence for the Yalamurra Anticline indicates 10,000 feet displacement on the Pre-Mesozoic horizon, diminishing to 500 feet on the Hooray Sandstone reflector.

GEOLOGICAL HISTORY

The basement rocks, which vary in age from Ordovician possibly to lower Devonian, were steeply folded and suffered low grade metamorphism in an orogeny probably of late Silurian to early Devonian age. The granites of the Eulo and Nebine Ridges were probably intruded late in this orogeny.

Devonian sediments were deposited on the western shelf of the Tasman geosyncline (Tanner, 1968). Unstable conditions early in the Middle Devonian gave rise to the volcanic sediments of the Gumbardo Formation. This was followed by more stable marine conditions (Log Creek Formation). Uplift and erosion was then followed by shallow marine carbonate conditions (Cooladdi Dolomite Member of Etonvale Formation) while in the east of the area the Boree Salt Member was deposited in an evaporite basin. Shallow marine conditions continuing through the deposition of the Etonvale Formation gave way to continental conditions of low-lying arid fluvial flood plains and saline lakes during deposition of the Buckabie Formation (Tanner,1968).

Epeirogenic movements in late Carboniferous times resulted in downwarping of the Devonian sediments in the Quilpie, Cooladdi and Westgate troughs and erosion of the Devonian, and bevelling of the basement rocks in the intervening areas. Mobilization of the Boree Salte during this phase of tectonism produced salt domes and diapiric ridges (Tanner,1968).

Continental conditions existed throughout the Permian and Triassic. Paludal conditions were dominant during the Permian and fluviatile and lacustrine conditions were probably dominant during the Triassic. Epeirogenic movement after the Triassic removed the Permo-Triassic sediments, at least in part, from the structurally high areas, leaving them mainly as remnants in the structurally low areas.

Renewed uplift occurred along the Eulo Ridge with basinal development to the east and west of the Ridge. Lower Jurassic fluviatile and lacustrine sediments were deposited in the basinal areas. The Ridge itself and the surrounding Dynevor and Cunnamulla Shelf areas were transgressed in the Upper Jurassic by the fluviatile Hooray Sandstone. The sandstone did not form a complete blanket as some basement residuals along the Ridge were not covered.

A marine transgression occurred in the Lower Cretaceous during which the Wallumbilla Formation was deposited. Towards the end of the deposition of the Wallumbilla Formation there was a gradual change on the Eulo Ridge and surrounding shelf areas from shallow marine to brackish and then to continental conditions which persisted through the rest of the Cretaceous and Tertiary. Some basement residuals on the Ridge remained as islands throughout the marine Cretaceous but were covered by the continental Winton Formation. On the Bulloo Sheet area (Ingram, in prep.) there is evidence that on the Dynevor Shelf there was a short-lived brackish water incursion after deposition of the Wallumbilla Formation. Away from the shelf areas, marine or paralic conditions persisted through deposition of the Allaru Mudstone, Toolebuc Limestone and Mackunda Formations.

Folding over the Nebine Ridge took place sometime after deposition of the Wallumbilla Formation.

After deposition of the Cretaceous there was peneplanation, possibly with deep chemical alteration and then deposition of the fluviatile Tertiary sediments. Further silicification and leaching occurred during the Tertiary. Deposition of thick alluvial deposits occurred in the structurally low areas during the Tertiary and Quaternary.

Renewed uplift related to block faulting along old lines such as the Eulo, Canaway and Nebine Ridges occurred in Tertiary times.

ECONOMIC GEOLOGY

Groundwater

Within the mapped area there are approximately 1300 water bores which are registered with Queensland Irrigation and Water Supply, Brisbane. Numbers of water bores per sheet area are as follows: Quilpie 152, Charleville 148, Toompine 162, Wyandra 200, Eulo 350, and Cunnamulla 290. In addition there are a number of sub-artesian bores and wells which are not registered (approximately 30) and these are not included in the above totals.

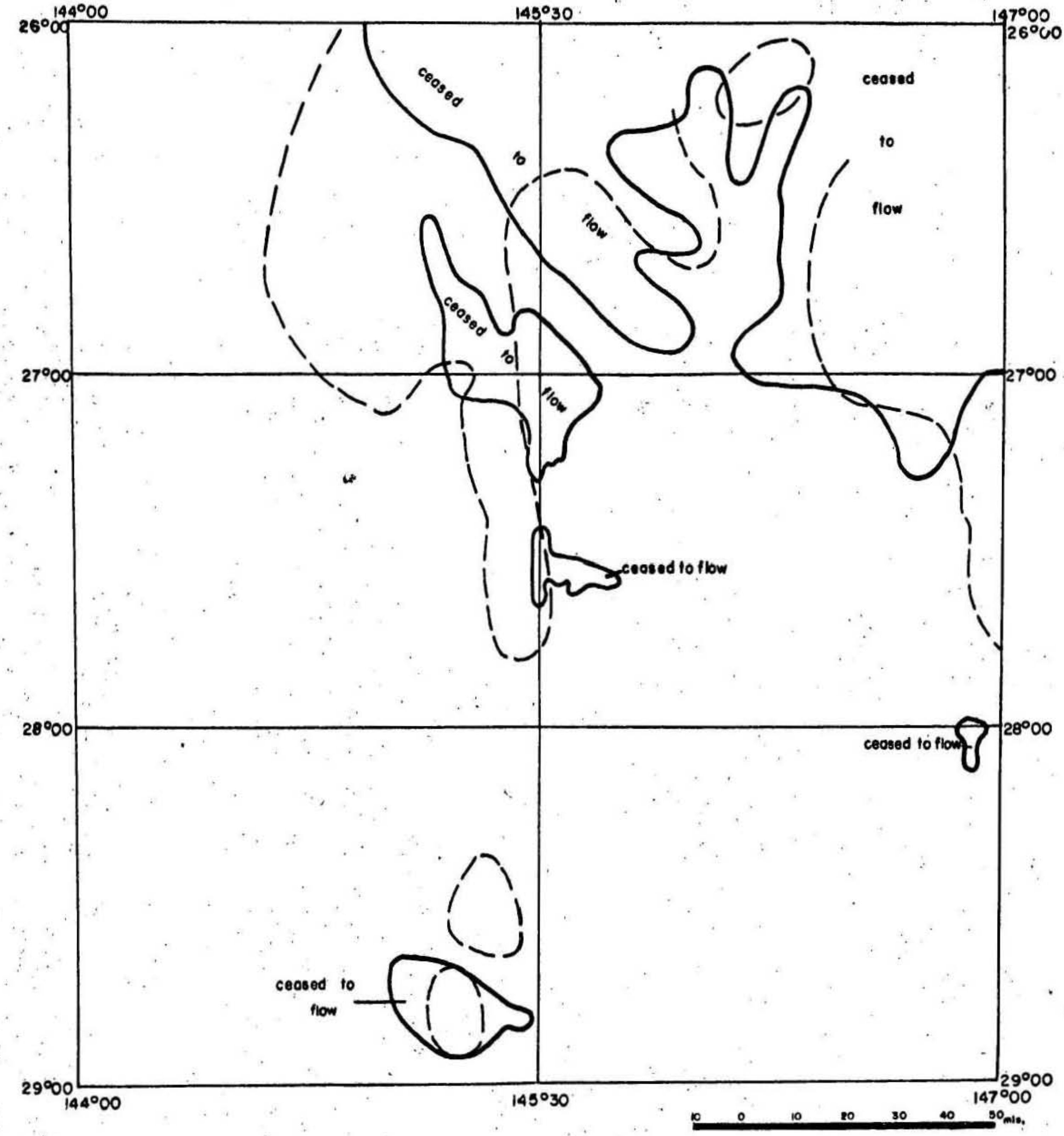
The first flowing bore in Queensland (Reg. No. 4514) is located on Cunnamulla Sheet area and was completed in 1887.

Whitehouse and Ogilvie (1954) give a comprehensive account of the artesian water supplies in Queensland. The mapped area, which has a large number of artesian bores, is discussed in detail.

The best aquifers in the area are those in the Hutton, Adori and Hooray Sandstones. Aquifers in the Coreena Member of the Wallumbilla Formation are utilized in some areas. All these aquifer systems are capable of giving flowing water except in the more elevated areas.

FIG. 10.

DISTRIBUTION OF HOORAY SANDSTONE AQUIFERS SHOWING AREAS WHICH HAVE BECOME NON-FLOWING.



Artesian bores within this limit tapping Hooray Sandstone aquifers have ceased to flow. (1968)

Limit of artesian bores ceased to flow according to Ogilvie (1954)

To accompany record 1969/13 Q/A208

The most utilized aquifers are those in the Hooray Sandstone. In general the potentiometric surface of these aquifers is below the land surface in elevated areas. The potentiometric surface is above the land surface in the south excepting for small areas in the divide between the Warrego River and Paroo River. Areas where Hooray Sandstone aquifers have ceased to flow through loss of pressure are shown in Figure 10.

Groundwater is used mainly for stock water. One very important group of bores Nos. 334, 335, 5007, and 16982 in Charleville Town, 390 in Quilpie Town, and 338 and 4997 in Cunnamulla Town provide inhabitants with domestic supply and water for industrial use. In addition the majority of homesteads are situated close to artesian bores.

The depth to the pre-Hooray aquifers presents severe economic limitations to their use. The pressure in these aquifers is higher and they are used in areas where Hooray Sandstone aquifers have ceased flowing. Charleville town bores Nos. 335 and 334 were completed in the Hooray Sandstone. A continuous fall in pressure from the Hooray Sandstone aquifers prompted the drilling of bore 16982 to 3660 feet to tap Adori Sandstone and Hutton Sandstone aquifers. This bore had an initial flow in 1967 of 750,000 G.P.D.

Depths to Hooray Sandstone aquifers decrease from north to south in the mapped area. They are close to the ground surface in the Eulo Ridge area and give rise to numerous clear water springs and mud springs.

In the Eulo Ridge area the Hooray Sandstone pinches out in the vicinity of the basement 'highs'. Under these conditions the Hooray Sandstone contains fewer aquifers, and these give small flows (Photo 19). Local thickening occurs between the basement highs where the Hooray Sandstone has infilled depressions on the basement surface. Bores sited in these localities often produce high pressure supplies of hot artesian water (Photo 18).

On the Cunnamulla Shelf, aquifers in the Hooray Sandstone lie at depths averaging 2000 feet below ground surface. In central Quilpie Sheet area, depths in the order of 3000 feet are required to intersect this aquifer system.

The Winton Formation contains numerous aquifers which give sub-artesian supplies of variable quality and quantity. These aquifers are used in Quilpie Sheet area mainly because costs of drilling to the deeper aquifer systems is prohibitive.

In a small area on Greenmulla property, to the south-east of Quilpie Township, are a group of 4 artesian bores which flow from a Winton Formation aquifer. Depths to the aquifer vary from 445 feet in the east to 752 feet in the west. A small flow from 1475 feet in Quilpie town bore might be a continuation of this aquifer. Bores tapping Winton aquifers are confined to low lying land on the Bulloo Plains and there is an elevation change of 200 feet from the Bulloo Plains to the hills to the east. The regional dip is very shallow to the west and the tilted aquifers are thus favourably intersected on the low plains. The water is only suitable for stock and has a high conductivity range of 7,000 to 8,500 micromhos/cm.

During the field work conductivity measurements were made on water samples obtained from 191 bores. Three portable "Dionic" conductivity meters were used. The results show that the aquifer systems have consistent ranges in conductivity. The results, arranged in aquifer systems by sheet areas are shown for comparison in Table 2.

Artesian Leakage

Natural leakages occur on Eulo and Toompine Sheet areas in the form of fresh water springs or mud springs (Photo 20). Whitehouse (1954) stated that mound or mud springs are found along lines of faults, most commonly where cover sediment above the aquifer is thin. Their relationship to shallow ridges of bedrock

Photo 18: Werewilke Homestead bore (depth 1248 feet) which has a high pressure artesian supply of hot water from a channel sand in the Hooray Sandstone. (Eulo Sheet). BMR Neg.No.M/831

Photo 19: Tunga bore (depth 213 feet) which is typical of bores of very small flows derived from a pinch out of Hooray Sandstone against basement highs in the Eulo Ridge area (Eulo Sheet).
BMR Neg.No.GA/1372

Photo 20: Active mound spring near Eulo township. Note flooded ground formed by artesian leakage. (Eulo Sheet). BMR Neg.No.M/829

Photo 21: Less active mound spring which is elevating silcrete detritus suspended on an outer crust of hard mud. (Eulo Sheet). BMR Neg.No.GA/1371

suggested to him that many such springs developed by water arising along tensional cracks as the beds have been slightly arched over these sub-surface blocks. He suggested that hot alkaline water under pressure puddled the clays in the aquaclude and that the developing springs burst out suddenly and quickly established a mound. During this survey evidence suggests that the present growth of mount springs is a slow process.

Cretaceous material in the form of concretions and pieces of indurated calcareous sediments are sometimes transported to the surface with the flowing mud. Silcrete blocks and boulders of granite are not transported to the surface as reported by Whitehouse (1954), but are detrital boulders on a hard crust of dried mud which is elevated by upwelling from below (Photo 21). The maximum height of the mounds is 20 feet, and may be limited to this height because of the present day hydrostatic head of the artesian water.

Where the Hooray Sandstone is close to the surface, springs of clear water without mounds (Photo 22) occur. Where the aquifers are close to the surface, but overlain by Cretaceous mudstone, any fracture, joint or fault allows seepage and brings up mud derived from the Cretaceous mudstones. Mound spring and clear water spring areas are popular sites for water bores. Bores in the vicinity of such springs have depths ranging between 20 feet and 350 feet without reaching basement.

Before the area was tapped by bores there was considerable leakage by springs. Carbonate coatings and deposits of tufa in many areas on Eulo Sheet attest to this former activity.

Several abandoned wells approximately 20 feet deep provided sufficient supply of artesian water to supply bore drains. Double Well (Reg. No. 7915) (Grid Ref. 238469) is 15 feet deep and is still flowing.

TABLE 2

LIST OF WATER BORES GIVING FIELD CONDUCTIVITY MEASUREMENTS ANI AQUIFERS

QUILPIE SHEET

Aquifer	Q.I.W.S. Bore No.	Conductivity in Micromhos /cm at 25°C	Range	Grid Ref.
Hooray Sandstone	155	550 (540)		250736
" "	390	704		212694
" "	1627	1,320 (1237)		313724
" "	2080	682	Total range 550 to 1320	241657
Winton Formation	12691	9,350		227682
" "	13302	7,700		224682
" "	6113	5,720		200667
" "	12018	3,850		291718
" "	12173	1,760		310690
" "	12174	5,720		306689
" "	12249	3,740		314654
" "	13815	3,520		319674
" "	14481	7,920		304685
" "	14522	2,400	Total range 1760 to 9350	242746

WYANDRA SHEET

Aquifer	Q.I.W.S. Bore No.	Conductivity in Micromhos /cm at 25°C	Range	Grid Ref.
Hooray Sandstone (Top Sand)	10557	1,100		492645
" "	4692	1,200		502644
" "	16306	1,760		421611
" "	2506	1,034		456615
" "	8246	990		476603
" "	12833	1,045		465563
" "	12852	1,100		493564
" "	2123	1,045		415534
" "	2117	1,030		393584
" "	14601	1,023 (1070)		414531
" "	11315	957		506632
" "	16420	790	Total range 1030 to 1760	361535

Note: Figures in brackets denote measurements determined at the Government Chemical Laboratory, Brisbane.

WYANDRA SHEET (Cont'd)

Aquifer	Q.I.W.S. Bore No.	Conductivity in Micromhos /cm at 25°C	Range	Grid Ref.
Hooray Sandstone	13362	1,100		494545
" "	3998	748 (925)		403648
" "	3997	198		414646
" "	1570	517 (633)		495618
" "	100	770		440630
" "	2047	671		373615
" "	1332	550 (712)		383612
" "	12976	935		393624
" "	4983	671 (792)		398619
" "	2041	700 (792)		399604
" "	2046	682 (920)		409611
" "	11594	935		455610
" "	2507	715		456615
" "	2508	726		465602
" "	4463	880		478587
" "	2051	495		478577
" "	4956	660		427582
" "	2119	473		409574
" "	2120	660		390573
" "	5002	418		352572
" "	31	594		428557
" "	11418	726		470557
" "	1464	649		477549
" "	14049	858		504541
" "	11948	880		384532
" "	2274	418 (545)		358529
" "	2118	627	Range 418 to 1100	387584
Adori Sandstone	1562	572		475643
" "	1564	572	Average 572	478641

WYANDRA SHEET (Cont'd)

Aquifer	Q.I.W.S. Bore No.	Conductivity in Micromhos /cm at 25°C	Range	Grid Ref.
Wallumbilla Formation	13476	6,270		498543
" "	13473	4,510		493536
" "	13475	5,720		501535
" "	15039	4,950		488527
" "	14314	2,640		493529
" "	14070	737	Total range 737 to 6270	352529

EULO SHEET

Hooray Sandstone	1618	704 (640)		191460
" "	16530	714		244463
" "	11139	748		236422
" "	1616	792		234460
" "	7587	935		196444
" "	9782	1,320		269439
" "	7906	262		276433
" "	12956	990		276412
" "	408	628		188475
" "	403	726		193523
" "	1487	740		253498
" "	1488	740		265496
" "	2431	638 (780)		239517
" "	2547	770		279497
" "	4546	154 (870)		302502
" "	4560	693		304472
" "	5006	748		252515
" "	5330	715		279512
" "	5408	605		488295
" "	5409	605		301488
" "	6269	888 (693)		324487
" "	6574	671		283502
" "	6689	1,650		213501
" "	6711	1,210		259497
" "	6712	825		244503

EULO SHEET (Cont'd)

Aquifer	Q.I.W.S. Bore No.	Conductivity in Micromhos /cm at 25°C	Range	Grid Ref.
Hooray Sandstone	7375	374		249507
" "	11908	638		278511
" "	12749	605	Total range 154 to 1650	288492

CUNNAMULLA SHEET

Aquifer	Q.I.W.S. Bore No.	Conductivity in Micromhos /cm at 25°C	Range	Grid Ref.
Hooray Sandstone (Top Sand)	11955	891		366458
" "	4577	1,430		364446
" "	4514	770		405448
" "	11057	748		369501
" "	12568	1,100		379491
" "	11935	924		371476
" "	11165	814		372486
" "	11019	957		365452
" "	12832	715		441446
" "	11749	902		436440
" "	10641	836		434405
" "	13260	770		451408
" "	6963	682	Total range 715 to 1430	397468
Hooray Sandstone	1806	440		369510
" "	2265	506		379517
" "	4535	572 (722)		376470
" "	12230	594		349463
" "	4557	704		369437
" "	13284	616 (1480)		376435
" "	11957	594		379434
" "	13175	506 (722)		365424
" "	4530	550		392442
" "	4525	605		418413
" "	11835	561		418462
" "	4049	528		424473
" "	4883	605		428495

CUNNAMULLA SHEET (Cont'd)

Aquifer	Q.I.W.S. Bore No.	Conductivity in Micromhos /cm at 25°C	Range	Grid Ref.
Hooray Sandstone	12114	814		427399
" "	3992	561		485493
" "	3993	770		475487
" "	16709	880		464483
" "	4526	550		472476
" "	107	495		480480
" "	4519	605		459457
" "	4518	715 (990)		458446
" "	12705	704		425437
" "	13493	781		428414
" "	4523	869		446417
" "	4521	880		443409
" "	4641	770	Total range 440 to 880	492424
Wallumbilla Formation	15625	1510		427526
" "	5428	2,860		490474
" "	12667	1,980		456520
" "	13423	2,750		496505
" "	13413	6,600		452426
" "	11080	1,870		483411
" "	10978	726	Total range 726 to 6600	484402

CHARLEVILLE SHEET

Aquifer	Q.I.W.S. Bore No.	Conductivity in Micromhos /cm at 25°C	Range	Grid Ref.
Hooray Sandstone	50	990		391690
" "	52	1,650		399695
" "	1199	1,430		447705
" "	1200	1,100		453721
" "	1810	1,650		374730
" "	1996	1,430		426705
" "	1997	1,430		402701
" "	2002	1,430(1534)		399737
" "	2532	2,090		507733
" "	2533	1,760		504738
" "	2868	1,430		403755

CHARLEVILLE SHEET (Cont'd)

Aquifer	Q.I.W.S. Bore No.	Conductivity in Micromhos /cm at 25°C	Range	Grid Ref.
Hooray Sandstone	2870	1,650		402759
" "	2871	1,980		404725
" "	4693	1,540		489668
" "	4696	1,980		502653
" "	4699	1,540		497670
" "	4697	1,320		494663
" "	5284	1,320 (1534)		416669
" "	8393	1,210		449717
" "	10889	1,540		494686
" "	12615	1,045		437747
" "	13767	1,540		423754
" "	14295	1,540		443708
" "	14660	1,320	Total range 990 to 2090	453698
Adori and Hutton Sandstones	51	495		364698
" "	96	539		365658
" "	2867	374		454754
" "	5008	440	Total range 374 to 539	430746
Coreena Member	2537	3,960		496756
" "	5387	11,000		385724
" "	6940	1,870		446700
" "	7001	1,320		473654
" "	12533	13,200		483753
" "	16122	3,795	Total range 1320 to 13200	436676
Quaternary Aquifers	7124	3,080		424724
" "	12176	1,210		428724
" "	13720	264		433731
" "	13766	506	Total range 264 to 3080	433737

TOOMPINE SHEET

Aquifer	Q.I.W.S. Bore No.	Conductivity in Micromhos /cm at 25°C	Range	Grid Ref.
Hooray Sandstone	1345	517 (514)		345586
" "	1338	550		337574
" "	3854	1,320		318642
" "	4542	550		340553
" "	4543	572		326554
" "	4979	891 (630)		285533
" "	5034	627 (610)		326598
" "	4976	880		253530
" "	2420	645		242561
" "	3	902		225587
" "	15983	990		301555
" "	326	1,320		224621
" "	4902	627		236549
" "	13716	891	Range 517 to 1320	340531

<u>Photo</u> 22: Artesian spring formed by tension fractures developed in the cover sediments along the Boondoona Fault (Toompine Sheet).
BMR Neg.No.M/826

<u>Photo</u> 23: Mullock heaps and buildings at Nil Desperandum opal mine, Yowah. (Toompine Sheet).
BMR Neg.No.M/829

Hydrocarbons

A summary of results from exploration wells drilled in the mapped area can be found in Appendix 1 of this Record.

Thick sediments occur in the Quilpie Cooladdi and Westgate Troughs which are southern extensions of the Adavale Basin. Phillips Australian Petroleum Co., and Sunray D.X. Mid Continent Oil Co., have drilled 3 deep wells in the mapped area but the low porosity and permeability found in the pre-Mesozoic sediments was not encouraging. In the entire Adavale Basin 20 exploratory and field development wells have been drilled. Of this total 16 were exploratory new field wildcats, 2 were outposts and 2 were field development wells. Major, but as yet non-commercial supplies of gas were encountered at Gilmore (Adavale Sheet) from sandstone beds in the Log Creek Formation.

Interest in the Eromanga Basin sequence has been concentrated on drilling structural traps and stratigraphic wedge-outs on the western flank of the Nebine Ridge. All sandstones in the Mesozoic sequence were found to be fully water flushed.

Preliminary seismic surveys have covered a large part of Quilpie Sheet area and the western third of Charleville Sheet. These were followed by detailed work in the vicinity of the well sites. The surveys are listed in previous investigations.

Sediments on the Cunnamulla Shelf area are regarded as poor hydrocarbon prospects. The sedimentary sequence is quite thin in this area (less than 2,000 feet). All the sandstones are water flushed and some aquifers have natural outlets along the tension faults in the Eulo Ridge. If the Mesozoic sequence contained hydrocarbons shows would be expected in the areas of artesian leakage.

Precious Opal

Precious opal from the Paroo and Cunnamulla Mineral Fields has been mined in Toompine and Eulo Sheet areas. All the mines except the Yowah (Grid Ref. 253530) are abandoned or are only rarely worked. There are less than one dozen permanent miners working their claims at Yowah. The period of peak production from the fields was between 1890 and 1914. Between the wars there was negligible production but since the last world war there has been an increase in production (Croll, 1950).

A good supply of water from an artesian bore is available at the Yowah mines and there is good access to the mines from Eulo with 45 miles of graded and formed earth road and 10 miles of graded track.

The mines are popular at present with tourists, and coach tours visit the mines where the tourists pick over the mullock heaps. The Duck Creek mines are also fairly popular with tourists and access to Duck Creek is via Tirga homestead.

Mining operations are simple. Shafts are dug with pick and shovel, and in some cases explosives, to intercept the opaline bands. The amount of driving at the levels is generally small and the mining is restricted to shallow depths (generally less than 50 feet).

The mode of occurrence of the opal is the same as that in the Eromanga area (Senior et al, 1968; Ingram 1968). The precious opal occurs in the kaolinised sediments of the Winton Formation. There are two main types of occurrence; "boulder opal" where opal occurs in ironstone concretions and "sandstone opal" where opal and iron oxides are associated with sandstone/mudstone interfaces in the profile. The concretions can form anywhere in the profile and may be isolated or form distinct bands where the concretions may be separate or joined. In some cases the iron oxides have been deposited around nuclei as at Yowah and in other cases they may be replacing calcareous concretions and beds in the original sediments. Opal occurs in these concretions as irregular, concentric, and radial veins. In some of them the opal forms the centre.

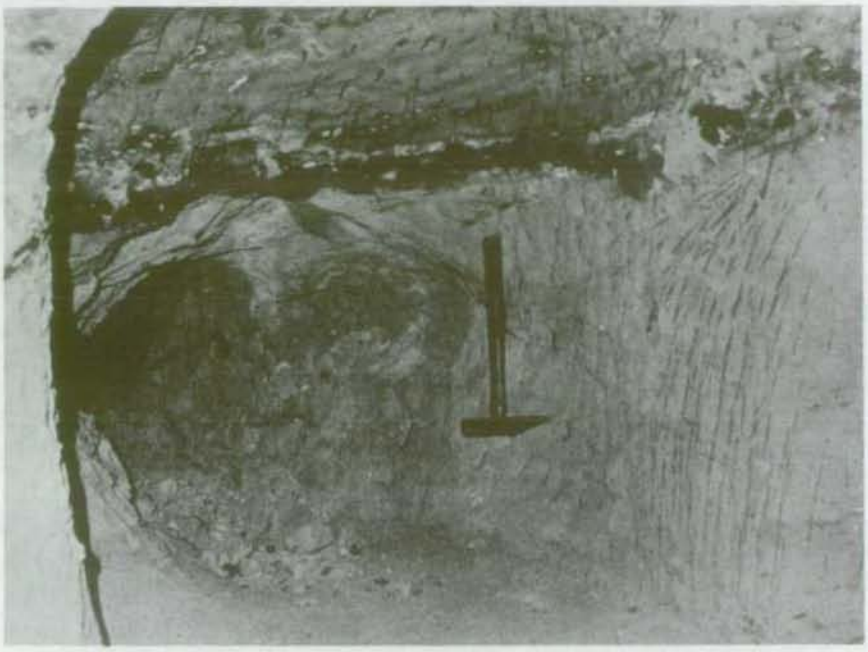
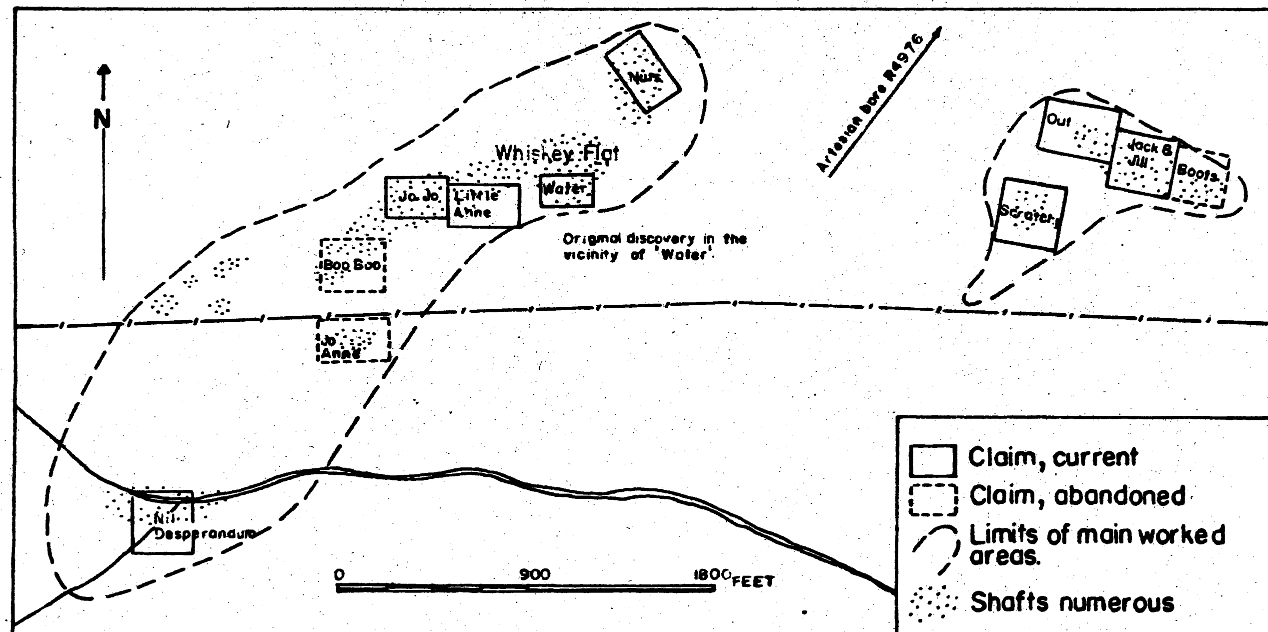


Photo 24: The "nut band" at Nil Desperandum within a thick sandstone of the Winton Formation (Toompine Sheet).

Photo 25: Undulation of the "nut band" at the 22 foot level in the Nil Desperandum mine. The best quality opal occurs in the lower part of each undulation. Note gypsum filled cracks in the sandstone (Toompine Sheet).

FIG. 11.

YOWAH OPAL WORKINGS



based on J.H. Brooks. G.S.Q. 1967.

To accompany record 1969/13 Q/A 209

Sandstone opal is also usually accompanied by iron enrichment. The iron oxides may be present as a thin band or as irregular veins and iron staining. There may also be some concretionary development, and iron oxides commonly replace the matrix in the sandstone. Precious opal is found both in the sandstone and the underlying finer grained bed. It occurs as thin veins or "seams" as irregular cavity fillings, as a replacement of parts of the rock, and as cylindrical "pipes" which may or may not be enclosed in an ironstone casing.

The configuration of the workings at Yowah is shown in Figure 11. The ground is flat and the only surface indications of opal are ironstone fragments with traces of precious opal ("colour"). The opal occurrence was examined at a mine on the claim known as Nil Desperandum (Photo 23). Here there are two levels. The first level at 22 feet which has been extensively mined by drives is known as the "nut band". It occurs in a white and grey fine to medium grained kaolinized sandstone which extends from the surface to a depth of 37 feet. The band is a conglomeratic bed within the sandstone containing abundant large mudstone clasts and varies from a few inches up to 2 feet thick. Iron enrichment and precious opalization have occurred in this bed. The iron oxides have been deposited around the clasts to form small concretions or "nuts" and the sandstone matrix surrounding these concretions is also ferruginous. The chocolate brown "nuts" are usually no bigger than two or three inches in diameter (Photos 24, 26). Precious and non precious opal form as thin veins in the concretions, replace the centres of some concretions and form a matrix in the sandstone. Some wood fragments in the band are ferruginized and in part replaced by opal.

The general attitude of the band is sub-horizontal but small undulations occur within it forming depressions a few feet across (Photo 5) which are apparently particularly prospective.

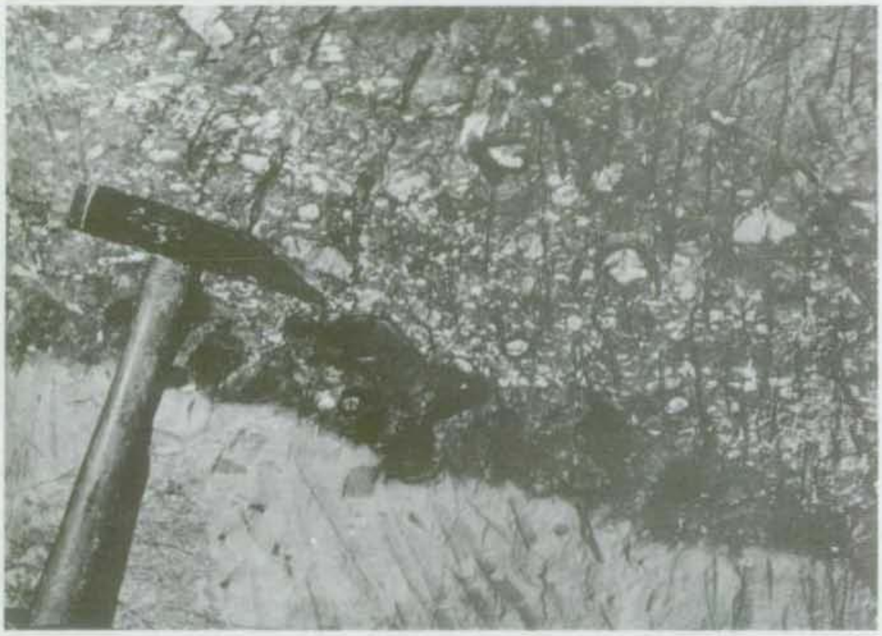
The second level at 37 feet occurs at the junction of the sandstone with an underlying white mudstone. Iron enrichment immediately above the mudstone is known as the "biscuit band" with irregular iron veining and staining and minor concretionary development. Precious opal occurs as "seams" and "pipes" in the band. This lower level at Nil Desperandum has not been worked extensively.

Apparently the most persistent band at Yowah is at 35feet-40 feet depth (biscuit band) with a less persistent but more productive band at 20 feet-26 feet (nut band) (Brookes, 1967).

Work being carried out in the vicinity of the Jo Anne claim (Fig. 11) is at shallow depth (3 feet-4 feet). A concretionary conglomeratic bed similar to the "nut band" occurs at the junction of a medium grained sandstone with an underlying white claystone. Similarly on the eastern side of Whiskey Flat an opalised band is close to the surface (Connah, 1966).

At the other mines visited, precious opal occurs in the usual fashion, as boulder and/or sandstone opal. There are some minor variations. At the Pride of the Hills Mine (Grid Ref. 236611) apart from the boulder opal there is abundant precious and non-precious opal apparently replacing small ferruginous wood fragments in an ironstone band at the base of a sandstone. At Duck Creek (Grid Ref. 251602) sandstone opal was mined, but in a few shafts on the south side of the creek there is no iron enrichment at the junction of the sandstone and underlying white and pink mudstone. Within the mudstone large amounts of white fibrous ?alunite are apparently replacing wood. Precious opal replaces some of the alunite and also occurs in the mudstone which is in parts silicified and was known as the "flint band" by the miners (Connah, 1966).

The mode of occurrence of opal in this part of Queensland compares closely with sedimentary opal in other parts of Australia where opal is related to kaolinized ("lateritized") sediments of Mesozoic and pre-Mesozoic age (Hiern, 1965). The age of the alteration is not established. It may have occurred prior to the deposition of the Tertiary sediments followed by subsequent leaching and silicification of these sediments. However it is assumed here that formation of precious opal occurred at the same time as the general chemical alteration of the Cretaceous sediments and that this alteration is possibly a Tertiary feature occurring after the deposition of the Glendower Formation, contemporaneously with the leaching and silicification of that Formation. The Glendower Formation,



hoto 26: Detail of the "nut band" showing its association with a thin mud clast conglomerate bed. Note iron oxide deposits around some of the clasts (Toompine Sheet).

Photo 27: Abandoned gold workings near Granite Springs homestead (Eulo Sheet). BMR Neg.No.M/831

although leached and silicified, is not known to contain precious opal. However, this is regarded as being due to unsuitability of the sediments for deposition of precious opal rather than prior deposition of the opal, (Ingram, 1968).

The most important effect of the alteration of the Cretaceous sediments was the breakdown of feldspars and clay minerals to kaolin and the release into solution of silica and iron. Silica apparently migrated down the profile either as a true solution or an aqueous sol. Flocculation of colloidal silica trapped above impervious barriers apparently lead to the formation of precious opal. These traps may be of sedimentary or structural origin. At Andamooka in South Australia, opal apparently occurs in a broad basin structure (Nixon, 1958) and at Coober Pedy in South Australia opal is related, in part, to faulting (Hiern, 1965). In south-west Queensland opalisation is unrelated to the broad structural pattern except in so far that the general distribution of kaolinised sediments is related to structure; that is that the sediments are generally eroded from structural highs.

However, it is possible that small local structural basins influenced deposition of opal. The influence of faulting does not appear to be significant in localising precious opal. The most important traps are probably purely sedimentary in origin. For example, at Yowah, minor undulations in the bedding surface form traps.

Precious opal has been shown to consist of close packed silica spheres whose regular packing causes diffraction effects, whereas non precious opal consists of small irregularly sized and distorted spheres (Sanders, 1964). It is possible that the slow rate of drying may be important in allowing particles to attain the required size and regular packing. The rate of percolation and drying would be controlled by the attitude and lithology of the sediments.

Opalisation took place in the zone of intermittent saturation with repeated wetting and drying of the sediments and probably occurred over a long period of time. Deposition of iron oxides and sulphates such as gypsum and alunite took place contemporaneously with the opaline silica. Replacement of gypsum and alunite by opal occurs but gypsum veins have also been noted to cut across the opaline horizons.

Non-precious opaline silica is very common in the profile whereas precious opal is restricted. Smale (1965), from petrographic studies of specimens from Coober Pedy, suggests that the precious opal may be of later origin than the non-precious opal in the body of the rock.

If the pre-requisites for precious opalisation were simply a kaolinized profile and suitable traps, vast areas would be prospective. However the most constant feature of opalisation is its patchy and unpredictable nature. It is obvious that several, as yet undefined, factors are important in opal formation.

Boulder opal is not related to a simple case of siliceous solutions trapped above impervious barriers. Sandstone opal and boulder opal are commonly found in the same vertical sequence and at any one place there are commonly several levels including sandstone opal and boulder opal separated by feet or tens of feet of sediment. As a considerable thickness of the profile in any one area is commonly prospective whereas adjacent areas may be completely barren of precious opal, it would appear that the over-riding factors in opalisation are regional and that the suitability of particular beds may be secondary. It has been suggested (Ingram, 1968) that the areas with precious opal may have been topographic highs at the time of opalisation with little or no capping of Tertiary sediments. Percolation by siliceous solutions then affected a thick section of Cretaceous sediments. Whereas in adjacent topographically low areas, probably with an accumulation of Tertiary fluviatile sediments, a thinner profile would have been affected by percolating water and this would have affected mainly the Tertiary sediments which were possibly unsuitable for precious opalisation.

The paucity of surface indications of precious opal makes prospecting difficult. Weathered fragments of opalised ironstone on the pediment surfaces which have been shed from partially or completely eroded horizons in the mesas are generally the only indication. An opalised level may be found to crop out but even so it is general for shafts to be sunk in search of other levels.

Shallow drilling by the B.M.R. with a Fox rotary drill revealed that in areas of known opalization a distinctive opalized horizon can be mapped out. Drilling at Quartpot Mine near Eromanga on a close grid pattern (100 feet intervals) mapped out a horizon which varied in depth from 17 feet to 46 feet over an area of about 200 square yards. The opalized interval was cored. Precious opal traces were picked up in four of the holes and ironstone occurred in all the holes.

It certainly appears that areas of known opalization can be extended outward using drilling as a prospecting method.

Gold

Four abandoned gold mines exist near Granite Springs homestead (Photo 27). The shafts follow a near vertical quartz reef. The quartz is approximately 2 feet wide and is bounded on either side by a muscovite schist. Probably the quartz was emplaced along a schistose fault zone. The only mineralization found was a small amount of iron pyrites occupying vuggy cavities in the quartz. Locally in small offshoot branches from the quartz body small quantities of tourmaline occur.

Several miners worked in this area in the early part of the century. Production figures are not known. All the shafts have collapsed apart from one which is partly flooded and is 97 feet deep.

A second group of gold workings are reported (Property owner, pers. comm.) near Ningaling homestead (Grid Ref. 212414) on on the eastern margin of the Paroo River. Even less is known about mining activity in this area and the shafts have been obliterated by caving and alluviation.

Other Minerals

Whitehouse (1954) reports that granites on the Eulo Shelf contain small amounts of copper sulphides. Small pegmatite veins occur in the vicinity of Granite Springs. Large alkali feldspar phenocrysts and muscovite plates are common in the pegmatite, but no mineralization was found.

BIBLIOGRAPHY

* Unpublished reports submitted in accordance with the requirements of the Petroleum Search Subsidy Acts; available for study at the Bureau of Mineral Resources, Canberra and Geological Survey of Queensland, Brisbane.

+ Unpublished reports available at the Geological Survey of Queensland, Brisbane; and the Bureau of Mineral Resources, Canberra.

* AMOSEAS, 1965 - Augathella seismic survey. Authority to Prospect 101 P Qld, American Overseas Petroleum Ltd (unpubl.)

* AOD, 1963 - Completion report Canaway well No. 1 ATP 98P. Alliance Oil Development N.L. (unpubl.).

BELFORD, D.J., 1958 - Micropalaeontological examination of samples from AOG scout bores No. 1 and No.2 Talbalba, Thallon Basin, Queensland. Bur. Miner. Resour. Aust. Rec. 1958/2 (unpubl.).

BROOKS, J.H., 1967 - A prospectors guide to opal in the Yowah-Eromanga area Qld Govt Min. J. 68, 453-57.

* CAMPBELL, I.R., 1965 - Final report of the Mitchell-Morven test drilling project. American Overseas Petroleum Ltd (unpubl.).

CAMPBELL, I.R., 1966 - Well completion report Tregole No. 1. ATP 101P American Overseas Petroleum Ltd (unpubl.).

CONNAH, T.H., 1966 - A prospectors guide to opal in western Queensland. Qld Govt Min. J. 67, 23-40.

CRIBB, H.G.S., 1948 - Opal deposits and the Hayricks Opal mine, Quilpie. Qld Govt Min. J. 59, 48-51.

CROLL, I.C.H., 1950 - The opal industry in Australia. Bur. Miner. Resour. Aust. Bull. 17.

* CUNDILL, MEYERS & ASSOCIATES, 1965 - Well completion report Quilberry No. 1. ATP 72P, Qld. Phillips Petroleum Company and Sunray D.X. Oil Company Rept. (unpubl.).

DARBY, F., 1966 - Adavale Basin semi-detailed gravity survey, south Queensland. Bur. Miner. Resour. Aust. Rec. 1966/164.

* DARBY, F. & INGALL, L.N., 1966 - Dartmouth area gravity survey, ATP. 109P, Queensland. Phillips Petroleum Co. Ltd (unpubl.).

DAY, R.W., 1964 - Stratigraphy of the Roma-Wallumbilla area. Geol. Surv. Qld Publ., 318

de JERSEY, N.J., 1966 - Devonian spores from the Adavale Basin. Geol. Surv. Qld Publ. 334 (palaeont. Pap. 3).

EVANS, P.R., 1966 - Mesozoic stratigraphic palynology in Australia. Aust. Oil Gas J. 12 (6) 58-63.

EVERNDEN, J.F., and RICHARDS, J.R., 1962 - Potassium-argon ages in eastern Australia. J. geol. Soc. Aust. 9(1) 1-49

EXON, N.F., 1966 - Revised Jurassic to Lower Cretaceous stratigraphy in the south-east Eromanga Basin, Queensland. Qld Govt Min.J. 67 233-240

EXON, N.F., GALLOWAY, M.C., CASEY, D.J., and KIRKEGAARD, A.G., 1966 - The geology of the Tambo, Augathella and Blackall 1:250,000 Sheet areas, Queensland. Bur. Miner. Resour. Aust. Rec. 1966/89 (unpubl.).

EXON, N.F., MILLIGAN, E.N., CASEY, D.J., and GALLOWAY, M.C., 1967 - The geology of the Roma and Mitchell 1:250,000 Sheet areas. Bur. Miner. Resour. Aust. Rec. 1967/63 (unpubl.).

EXON, N.F., 1968 - Eddystone Qld - 1:250,000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SG/55-7.

EVANS, P.R., 1964 - A correlation of some deep wells in the north-eastern Eromanga Basin, Queensland. Bur. Miner. Resour. Aust. Rec. 1964/197.

FITZPATRICK, B.F., JOHNSON, I.R., WALLIS, G.R., and WILSON, R.B., 1962 - Yantabulla geological 1:250,000 Sheet. N.S.W. Dept. Mines.

FITZPATRICK, B.F., FRENDA, G.A., JOHNSON, I.R., WALLIS, G.R., and WILSON, R.B., 1965 - Enngonia geological 1:250,000 Sheet. N.S.W. Dept. Mines.

* FJELSTUL, C.R., 1962 - Reconnaissance seismograph survey of Charleville north area. Phillips Petroleum Co Ltd and Sunray Mid-Continent Oil Co. Ltd (unpubl.).

* FJELSTUL, C.R., and BECK, R.E., 1962 - Geophysical report seismograph survey Gumbardo area ATP 84P, Qld. Phillips Petroleum Co. and Sunray Mid-Continent Oil Company Ltd (unpubl.).

* FJELSTUL, C.R., and BECK, R.E., 1963 - Geophysical report, detail seismograph survey of Quilberry Creek Prospect, ATP 72P, Qld. Phillips Petroleum Company Ltd (unpubl.).

* FJELSTUL, C.R., & RHODES, C.T., 1965 - Geophysical report of Adavale Basin detail survey, ATP 109P, Qld, Phillips Australian Oil Co. (unpubl.).

+ FREEMAN, R.N., and STAFFORD, P.T., 1966 - Well completion report, Lowood No. 1, Maryvale No.1, and Crichton No. 1. Orion Oil Company Ltd., (unpubl.).

GALLOWAY, M.C., in press - Adavale Qld - 1:250,000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes. SG/55-5.

GREGORY, C.M., SENIOR, B.R., and GALLOWAY, M.C., 1967 - The geology of the Connemara, Jundah, Canterbury, Windorah and Adavale 1:250,000 Sheet areas. Bur. Miner. Resour. Aust. Rec. 1967/16 (unpubl.).

HEIKKILA, H.H., 1966 - Palaeozoic of the Adavale Basin Qld. Proc. 8th Comm. Min. Met. Cong. 1965, 5, 157-65.

HIER, C.D., and SPIVEY, C.J., 1960 - Quilpie - Thargomindah - Charleville seismic survey Qld, 1959-1960 for Phillips Petroleum Co. Bur. Miner. Resour. Aust. Petrol. Search Subs. Acts Publ. 19.

* HIER, C.D., and SPIVEY, C.J., 1961 - Geophysical report seismograph survey Adavale area ATP 84P, Qld. Phillips Petroleum Co. and Sunray Mid-Continent Oil Co Ltd, (unpubl.).

* HIER, C.D., and FJELSTUL, C.R., 1961 - Geophysical reconnaissance seismic survey of Jundah - Yaraka - Blackwater - Langlo area, Qld, Phillips Petroleum Co. Ltd. (unpubl.).

HIERN, M.N., 1965 - Opal deposits at Coober Pedy. Quart. Geol. Notes Geol. Surv. S.Aust. 13, 6-7

HIERN, M.N., 1966 - Opal deposits in Australia. Quart. Geol. Notes Geol. Surv. S. Aust. 16

HILL, D., and DENMEAD, A.K.,(eds) 1960 - The Geology of Queensland. J. geol. Soc. Aust. 7.

INGRAM, J.A., 1968 - Notes on opalization in south-western Queensland. Bur. Miner. Resour. Aust. Rec. 1968/47 (unpubl.).

INGRAM, J.A., (in prep) Bulloo Qld - 1:250,000 Geological Series Bur. Miner. Resour. Aust. explan. Notes SG/54-4

JACKSON, C.F.V., 1902 - The opal mining industry and the formation of opal deposits in Queensland. Geol. Surv. Qld Rept. 177

JENNINGS, J.N., & MABBUTT, J.A., 1967 (eds) LANDFORM STUDIES FROM AUSTRALIA AND NEW GUINEA. A.N.U. press.

LANGFORD-SMITH, T., and DURY, G.H., 1965 - Distribution, character, and attitude of the duricrust in the northwest of New South Wales and the adjacent areas of Queensland. Amer. J. Sci. 263, 170-190.

JESSUP, R.W., 1960a - The lateritic soils of the south-eastern portion of the Australian arid zone. J. Soil Sci. 11, 106-113.

JESSUP, R.W., 1960b - The stony tableland soils of the south-east portion of the Australian Arid zone and their evolutionary history. J. Soil Sci. 11, 188-96.

* KNUTH, B.W., 1967 - Phillips-Sunray Dartmouth No. 1 ATP 109P, Qld, Well completion report Phillips Australian Oil Co. and Sunray D.X. Oil Co Rep. (unpubl.).

LANGRON, W.J., 1962 - Regional gravity traverse Quilpie to Roma, Qld. Bur. Miner. Resour. Aust. Rec. 1962/47 (unpubl.).

* LEWIS, J.H., 1962 - Phillips - Sunray Etonvale No. 1, A.T.P. 84P, Qld, Well completion report Phillips-Petroleum Co. and Sunray Mid-Continent Oil Co Rept. (unpubl.).

LONSDALE, G.F., 1965 - Southern Queensland contract reconnaissance gravity survey using helicopters, 1964. Bur. Miner. Resour. Aust. Rec. 1965/25 (unpubl.).

MABBUTT, J.A., 1962 - Geomorphology of the Alice Springs area. C.S.I.R.O. Aust. Land Res. Ser. 6.

MARBUTT, J.A., 1965 - The weathered land surface in Central Australia. Z. geomorph. N.F. 9 (1) 82-114.

* McDONACH, G., KNUTH, B.W., and PATTERSON, W.A., 1966 - Phillips-Sunray Leopardwood No. 1, ATP 109P, Qld, Well completion report. Phillips Australian Oil Co. and Sunray D.X. Oil Co Rept. (unpubl.).

McKELLAR, R.C., 1966 - Devonian marine Fossils from the subsurface Adavale Basin Queensland Geol. Surv. Qld Publ. 332 (palaeont. Pap.2, 1-6).

NIXON, L.G.B., 1958 - Andamooka Opalfield. Min. Rev. Adelaide 109, 13-23.

NOAKES, L.C., 1949 - The relationship of lateritization to the origin of opal in Australia. Bur. Miner. Resour. Aust. Rep. 1949/99. (Geol. Ser. 67).

OGILVIE, C., 1954 - The hydrology of the Queensland portion of the Great Australian Artesian Basin, Appendix H. to Artesian Water Supplies in Queensland. Dept Co-Ord. Gen. Pub. Works.

* PATTERSON, W.A., 1966 - Phillips-Sunray Bury No. 1, ATP 109P, Qld, Well completion report Phillips Australian Oil Co. and Sunray D.X. Rep. (unpubl.).

PHILLIPS, 1964 - New names in Queensland stratigraphy. Palaeozoic rocks of the Adavale Infra-basin, proposed and submitted by Phillips Petroleum Co. Aust. Oil Gas J. 10, 26-27.

* PHILLIPS-SUNRAY 1962 - Well completion report Buckabie No. 1. Bur. Miner. Resour. Aust. Petrol. Search Subs. Acts Publ. 41.

* PHILLIPS-SUNRAY 1963 - Well completion report, Gumbardo No. 1 ATP 84P Qld, Phillips Petroleum Co. and Sunray D.X. Oil Co. Rept (unpubl.).

* PHILLIPS-SUNRAY 1966 - Lissoy No. 1 ATP 109P, Qld. Well completion report Phillips Australian Oil Co. and Sunray D.X. Oil Co. Rept. (unpubl.).

* ROLLINS, J.C., STEENLAND, N.C., and HIER, C.D., 1961 - Aeromagnetic survey of the Quilpie - Charleville - Thargomindah Areas, Qld, Phillips Petroleum Co. (unpubl.).

SENIOR, B.R., GALLOWAY, M.C., INGRAM, J.A., and SENIOR, DANIELE, 1968 - The geology of the Barrolka, Eromanga, Durham Downs, Thargomindah, Tickalara and Bulloo, 1:250,000 Sheet areas, Queensland. Bur. Miner. Resour. Aust. Rec. 1968/35 (unpubl.).

SANDERS, J.V., 1964 - Colour of precious opal. Nature, 204, 1151-1153.

+ SLANIS, A.A., and NETZEL, R.K., 1967 - Geological Review of Authorities to Prospect 109P and 125P, Queensland, Australia. Phillips Australian Oil Co. and Sunray D.X. Oil Co. Rept (unpubl.).

SMALE, D., 1965 - Opal-bearing rocks from Coober Pedy, Appendix to HIERN, M.N., 1965, Coober Pedy Opalfield. Min. Rev. S.A. Dept of Mines, 122, 5-27.

* SMART, 1961 - Report on a gravity survey of the Eromanga area 85P, Qld, L.H. Smart Oil Exploration Co.Ltd., (unpubl.).

SMART, 1962 - Grey Range seismic survey, Qld, 1959 by L.H. Smart Exploration Co. Ltd, Bur. Miner. Resour. Aust. Petrol Search Subs. Acts Publ. 29.

* SMART 1963 - Eromanga seismic reflection - refraction survey Qld., by L.H. Smart Exploration Co. Ltd., ATP 99P Qld (unpubl.).

SPRIGG, R.C., 1958(a) - A new look at the Great Artesian Basin. Aust. Oil Gas J., 5(2), 13-17.

SPRIGG, R.C., 1958(b) - Petroleum prospects of western part of Great Artesian Basin, Bull. Amer. Assoc. Pet. Geol. 42, 2465-491.

SPRIGG, R.C., 1961 - On the structural evolution of the Great Artesian Basin. A.P.E.A. J. 1961, 37-56.

SPRIGG, R.C., 1966(a) - Palaeogeography of the Australian Permian in Relation to Oil Search. A.P.E.A. J. 1966, 17-29.

SPRIGG, R.C., 1966(b) - Progress of exploration for petroleum in the central and western Great Artesian Basin. 8th Comm. Min. Metall. Cong. 1 5, 167-178.

* TALLIS, N.G., and FJELSTUL, C.R., 1966 - Geophysical report reconnaissance and detail seismograph survey of Lake Dartmouth Area, A.T.P. 84P, Qld. Phillips Petroleum Co. Ltd Rept (unpubl.).

TANNER, J.J., 1966 - Distribution of Palaeozoic rocks beneath the Great Artesian Basin, A.P.E.A. J. 1966, 116-20.

TANNER, J.J., 1968 - Devonian of the Adavale Basin, Qld, Aust., Contribution to Devonian Symposium, Calgary, 1967.

TERPSTRA, G.R.J., and BURGER, D., 1969 - Micropalaeontology and palynology of samples from BMR Bulloo No. 1 scout hole. Bur. Miner. Resour. Aust. Rec. 1969/39

* UNITED GEOPHYSICAL CORPORATION, 1963 - Final Report on the Bollon - Dirranbandi Seismic Survey, Surat Basin, Queensland, for Union Oil Development Corporation (unpubl.).

VINE, R.R., 1966 - Recent geological mapping in the northern Eromanga Basin, Queensland, A.P.E.A. J. 1966.

VINE, R.R., and DAY, R.W., 1965 - Nomenclature of the Rolling Downs Group, northern Eromanga Basin, Queensland. Qld Govt Min. J. 66, 416-21.

VINE, R.R., DAY, R.W., CASEY, D.J., MILLIGAN, E.N., GALLOWAY, M.C., and EXON, N.F., 1967 - Revised nomenclature of the Rolling Downs Group, Eromanga and Surat Basins. Qld Govt Min. J. 68, 144-51.

WHITE, MARY. 1969 - Report on the 1968 collection of Plant Fossils from the Eromanga Basin, Qld Bur. Miner. Resour. Aust. Rec. 1969/54

WHITEHOUSE, F.W., 1926 - The Cretaceous Ammonoidea of eastern Australia. Mem. Qld Mus. 8, 195-242.

WHITEHOUSE, F.W., 1930 - The Geology of the Queensland - Handbooks of the Australian Association for the Advancement of Science-Brisbane Meeting, 1930, 23-39.

WHITEHOUSE, F.W., 1940 - Studies in the late geological history of Queensland. Univ. Qld Dept Geol. Pap. 2, 2-40

WHITEHOUSE, F.W., 1941 - The surface of western Queensland. Proc. Roy. Soc. Q. 53, 1-22.

WHITEHOUSE, F.W., 1945 - Geological Work on the Great Artesian Basin - First interim report of the Committee appointed by the Queensland Government to investigate certain aspects relating to the Great Artesian Basin (Qld Sect.) with particular reference to the problem of diminishing supply February, 1945.

WHITEHOUSE, F.W., 1952 - The Mesozoic environments of Queensland. Aust. Ass. Adv. Sci. Rept, 29, 83-106.

WHITEHOUSE, F.W., 1954 - The geology of the Queensland portion of the Great Australian Artesian Basin. App. 6. to Artesian water supplies in Queensland. Dept Co-ord Gen. Pub. Works. Qld Parl. Pap. A, 56-1955.

WILLIAMS, G.D., 1966 - The Great Artesian Basin - Origin and History. A.P.E.A. J. 1966, 88-92.

WOOLNOUGH, W.G., 1927 - Presidential Address. Part 1 - The chemical criteria of peneplantation; Part II - The duricrust of Australia. J. Roy. Soc. N.S.W., 61.

WOOLNOUGH, W.G., 1930 - The influence of climate and topography in the formation and distribution of products of weathering. Geol. Mag. 67, 123-32.

WOOLNOUGH, W.G., 1932 - Sub-surface structure in the Great Artesian Basin of Australia in reference to possibility of oil production (unpubl.). B.M.R. library file.

+ WOOLLEY, J.B., 1941 - Geological report on the area north-east of Tambo. Shell (Queensland) Development Pty Ltd Rep. 5, (unpubl.).

WOPFNER, H., 1960 - On some structural development in the central part of the Great Australian Artesian Basin. Trans. Roy. Soc. S. Aust. 83, 179-93.

WOPFNER, H., 1963 - Post Winton sediments of probable Upper Cretaceous age in the central Great Artesian Basin. Trans. Roy. Soc. S. Aust. 86, 247-253.

WOPFNER, H., 1964 - Permian-Jurassic history of the western Great Artesian Basin. Trans. Roy. Soc. South Aust. 88, 117-28.

WOPFNER, H., and TWIDALE, C.R., 1967 - Geomorphological history of the Lake Eyre Basin. in Landform studies from Australia and New Guinea, Jennings, J.N. & Mabbutt, J.A. (eds.) A.N.U. Press, Canberra.

APPENDIX I

Summary of Results from Petroleum Wells on open file at the Bureau of Mineral Resources

The following information has been extracted from oil exploration completion reports. All are available for inspection at the Bureau of Mineral Resources, Canberra and the Geological Survey of Queensland. The nomenclature used is that of oil companies.

Dartmouth No. 1

Company. Phillips Australian Oil Company and Sunray D.X. Mid-Continent Oil Co.

Completed. 22.10.66.

Tenement. 109P Total Depth 10,010 feet

Status. Plugged and completed as a water bore.

Dartmouth No. 1 was drilled on a pre-Mesozoic structure which has no surface expression but was defined by seismic and gravity. It is located on the south-west edge of the sub-surface Langlo Embayment which is a north-easterly lobe of the Cooladdi Trough. The well was proposed to determine the lithology of the pre-Jurassic sediments and to evaluate the petroleum potential of the north Dartmouth Anticline.

No significant hydrocarbon shows were encountered in the Dartmouth Well. No oil fluorescence was observed in any of the drill cuttings or cores. The Mesozoic sandstone beds have good porosity and permeability but were all fresh water bearing.

The thick lower Permian section containing porous sandstones was tested but produced only fresh water.

The Devonian sediments have very low porosity and negligible permeability. No potential reservoir rocks were penetrated in the Devonian section.

Quilberry No. 1

Company. Phillips Australian Oil Company and Sunray DX Mid-Continent Oil Company

Completed. 28.5.65.

Tenement. 72P Total Depth 10,013 feet

Status. Plugged and abandoned.

Quilberry No. 1 was drilled near the culmination of a surface-expressed anticline, on the north flank of the Cooladdi Trough. It was drilled to investigate thick Devonian marine sediments unconformably below the Mesozoic.

The Mesozoic sandstones contain fresh water and no Permian is present above the unconformity. Pre-Permian sediments are impermeable.

The "D-2" limestone is tight, but had traces of dull gold fluorescence and a very poor cut. Lateral extensions of both this unit and the underlying "D-3" may have porosity. The "D-3" dolomitic limestone is massive, but has traces of fine vugular porosity and wire line logs indicated very low permeability.

The pre "D-3" sediments are marine shale containing several thin limestone interbeds, which may have been important source beds. The lower part is mainly tight sandstone. The undrilled deeper section cannot be evaluated but the presence of coarser clastics toward final depth might be indicative of reservoirs at a greater depth.

Buckabie No. 1

Company. Phillips Petroleum Company and Sunray D.X. Mid-Continent Oil Company.

Completed. 8.7.61

Tenement. 84P

Status. Plugged and later completed as a water bore.

Total Depth. 9,070 feet.

Buckabie No. 1 well was dry with no significant indication of gas or oil in the gas detectors, nor oil fluorescence in the cutting samples.

The Lower Cretaceous-Jurassic sequence had numerous beds which were porous and permeable. No hydrocarbons were noted except for a slight yellow fluorescence between 3880 and 3930 feet. Electric logs indicate that the formation fluid in the Mesozoic section is fresh water.

The continental Buckabie Formation has no potential as source beds for the generation of petroleum. These sediments have low porosity and poor reservoir characteristics as indicated by drillstem tests which failed to produce any formation fluids.

Tregole No. 1
Company. American Overseas Petroleum Company
Tenement. 101P
Status. Plugged and Abandoned.
Total Depth. 2475 feet

The objective of this well was to test the Lower Jurassic sequence for hydrocarbons in stratigraphic traps. Targets were the Evergreen Formation, Boxvale and Precipice Sandstones. The well was located on the west flank of the Nebine Ridge, in a shallow basement valley.

No significant oil shows were encountered and the target beds are water flushed.

Alba No. 1
Company. American Overseas Petroleum Company.
Completed. 29.3.65
Tenement. 101P
Status. Completed as a water bore.
Total Depth. 2713 feet.

Alba No. 1 is located on the western side of the Nebine Ridge. This basement ridge separates the Eromanga Basin from the Surat Basin. The well was favourably positioned to test possible up-dip migration of hydrocarbons towards stratigraphic traps in the Nebine Ridge area. The main interest was in the Evergreen Shale and the Precipice Sandstone which have some evidence of marine or brackish water elements in their depositional history.

Good porosity and permeability characteristics were found in the Hutton Sandstone, Injune Creek Group and the Hooray Sandstone. However all of the sandstones in these formations are water flushed.

Log-derived porosities for the Boxvale Sandstone range between 14 and 16% and for the Precipice Sandstone from 16% to 20%.

No shows of oil or gas were found in this well except for spotty fluorescence with a very weak $C.Cl_4$ cut from a sidewall core from 2630 feet.

Maryvale No. 1, Crichton No. 1 and Lowood No. 1
Company. Orion Oil Company.
Tenement. 117P
Year drilled. 1966
Status. All three wells were plugged and abandoned.
Total depths. Maryvale, 2772', Crichton, 2670', Lowood, 2522'.

These wells were drilled to explore for oil and gas accumulations in the Boxvale Sandstone and Evergreen Shale, the Upper Precipice Sandstone and the Lower Precipice Sandstone of Lower Jurassic age. The wells were positioned on the western flank of the Nebine Ridge. The Precipice Sandstone was the primary objective and it was hoped to encounter strand line (pinch out) stratigraphic traps.

The following indications of hydrocarbons were encountered during the drilling of the 3 wells:

Methane gas was detected on the gas analyser from the Hooray Sandstone and Westbourne Formation, from the interval 1100 feet - 1430 feet in Lowood No. 1. Fresh water aquifers in this interval carry methane gas in solution.

Cores from Maryvale No. 1 showed fluorescence and cut in the interval 2715 feet to 2722 feet in the Lower Precipice Sandstone. A drill stem test of this interval yielded 2240 feet of clear fresh water.

Talbalba Nos. 1 and 2

Company. Australian Oil and Gas Corporation

Completed. 1957

Status. Plugged and abandoned.

These two scout holes were drilled adjacent to a water bore Reg. No. 4654 (Talbalba No. 6). Oil had been reported in the driller's log of the water bore at a depth of 723 feet 6 inches. Scout No. 1 was abandoned at 774 feet and No. 2 at 1000 feet without any oil and gas shows.

APPENDIX 2

PALYNOLOGY OF SUBSURFACE SAMPLES FROM THE EULO, WYANDRA, CUNNAMULLA AND CHARLEVILLE 1:250,000 SHEET AREAS, QUEENSLAND

D. Burger

A.O.G. TALBALBA NOS. 1 AND 2 SCOUT HOLES CUNNAMULLA SHEET AREA

Three samples from cuttings, taken from the marine Lower Cretaceous interval of A.O.G. Talbalba Nos. 1 and 2 Scout Holes, Cunnamulla Sheet area, Eromanga Basin, were examined for spores, pollen grains and microplankton. Depth of the samples, serial number (MFP) and age are summarized below.

Well No.	MFP.	Depth Interval	Age	Spore Units
No. 1	4860	280-290 ft	(Middle?) Albian	K 2a
No. 1	4861	682-688 ft		
No. 2	4859	952-956 ft	Aptian	K 1b-c

The microfloras extracted were rich in species, the preservation was moderate to excellent. Microplankton was scarce, constituting less than 1% of the total assemblage.

Sample 4859

Contained the following microfossils that have stratigraphic importance:

Spores:
- Classopollis cf. simplex
- Cicatricosisporites australiensis
- Dictyotosporites speciosus
- Cyclosporites hughesi (fragment)
- Pilosisporites notensis
- Lycopodiumsporites circolumenus

Microplankton: Muderongia tetracantha (fragment)
cf. Baltisphaeridium sp.
Hystrichosphaeridium sp.

The presence of D. speciosus, C. australiensis and P. notensis, combined with the absence of Crybelosporites striatus and Pilosisporites parvispinosus, indicates a palynological age of not younger than unit K 1b-c. The microplankton form M. tetracantha is known to occur together with spores of K 1b to K 2a age; the absence of Odontochitina operculata might indicate the Dingodinium cerviculum Zone (Evans 1966a), although the index form D. cerviculum was not encountered in the preparation.

Spore unit K 1b-c is known from the Aptian Doncaster Member of the Wallumbilla Formation in the northern and central Eromanga Basin (Evans 1966a,b; Burger 1968b; also non-published data), as well as in the eastern Eromanga and Surat Basins (Evans 1966b; Burger 1968a,c). Foraminifera studied by Belford (1958) indicate a Lower Cretaceous age for the beds penetrated by Talbalba Nos. 1 and 2 between 336 feet and 995 feet. An Aptian age may therefore be assumed for sample 4859.

Sample 4861

Contained the following moderately preserved index types:

Spores: Classopollis sp.,
Cicatricosisporites australiensis,
C. hughesi,
Dictyotosporites speciosus,
Cyclosporites hughesi,
Crybelosporites striatus,
Pilosisporites parvispinosus,
Contignisporites multimuratus,
Osmundacidites cf. mollis,

Microplankton: Fromea amphora
Hystrichosphaeridium sp. (fragment)

This spore assemblage is typical of unit K 1d. Fromea amphora is a rarity in the Great Artesian Basin and has been observed in the Lower Cretaceous only a few times. Unit K 1d is identified within the (Lower to Middle) Albian Ranmoor and Coreena Members in the

Eromanga Basin (Evans 1966b; Burger 1968b), as well as in the (Albian) Coreena Member in the western Surat Basin (Burger 1968c). However, as Aptian foraminifera have been identified from higher in the same drilled section (Terpstra, Appendix 7, this Record), an Albian age is considered very improbable for sample 4861. On the other hand an Aptian age is inconceivable for unit K 1d (Burger, in prep.), so that most probably the sample is not representative of the depth interval, being thoroughly contaminated by caving of higher parts of the well during drilling. No conclusions are therefore drawn from the microfloral assemblage.

Sample 4860

Well preserved assemblage, containing the following forms:

Spores:	Cicatricosisporites australiensis
	Crybelosporites striatus
	Coptospora paradoxa
	Dictyotosporites speciosus
	Pilosisporites grandis (fragment)
	Reticulatisporites pudens
Microplankton:	Chlamydophorella nyei

The co-occurrence of C. australiensis, C. paradoxa and D. speciosus is sufficient to indicate spore unit K 2a. The overlap in the ranges of C. paradoxa and D. speciosus is very narrow and is known in the Eromanga Basin and western Surat Basin only in the interval that includes the upper part of the Coreena Member, the Toolebuc Limestone (where present), while lower Allaru Mudstone samples are known to produce microfloras of the succeeding unit K 2b (Burger 1968b,c; Evans 1966a). Micropalaeontological data from this level in the Talbalba bores is not available (Belford 1958). Further to the north unit K 2a is only associated with Albian sediments, as macrofaunal study has established an Albian age for both the Coreena/Ranmoor Member and the Allaru Mudstone (Vine & Day 1965; Day in Exon et al. 1966). Hence an Albian (Middle Albian?) age is most likely for sample 4860.

SUMMARIZING: the three samples from Talbalba Nos. 1 and 2 represent an interval of sediments that is the spore equivalent of the Wallumbilla Formation in the Eromanga Basin. Microplankton points to brackish, near-coast depositional environments.

B.M.R. CHARLEVILLE NO. 1 CORE 2

Age determination on the basis of plant microfossils was successfully carried out on a sample (MFP 4843) from B.M.R. Charleville Scout Hole, core 2, at a depth of 212' 4-6". A poorly preserved but reasonably rich microfloral assemblage was extracted, in which the following stratigraphically significant species were identified:

Spores:	Cicatricosisporites hughesi
	C. cf. pseudotripartitus
	Microfoveolatosporis canaliculatus
	Cyclosporites hughesi
	Lycopodiumsporites rosewoodensis
	cf. Biretisporites spectabilis
Microplankton:	Odontochitina operculata
	Goniaulax edwardsii
	cf. Muderongia sp.

The presence of Cicatricosisporites sp. in combination with O. operculata and G. edwardsii points to marine Cretaceous. M. canaliculatus is known to occur in the Lower Cretaceous of eastern Australia only together with Coptospora paradoxa (Dettmann 1963; Burger 1968c,b). This means that the assemblage belongs to Dettmann's Paradoxa Assemblage, i.e. within the interval of spore units K 2. Cyclosporites hughesi is a persistent form in eastern Australian Lower Cretaceous microfloras. Detailed investigation established its last appearance in the Great Artesian Basin at the level where the first angiospermous (tricolpate) pollen grains are introduced, marking the base of spore unit K 2b (Burger 1968c,b). Therefore the presence of C. hughesi restricts the age of the microfossils to unit K 2a.

The microplankton assemblage gives no detailed information about its position within the suite of Dinoflagellate Zones designated by Evans (1966a) O. operculata is known to occur in association with K 1d and K 2 microfloras, while G. edwardsii may occur from the Aptian throughout the Upper Cretaceous.

Regarding the K 2a age of the spores, the sample is to be regarded as the equivalent of the uppermost Coreena, eventually also the lowermost Allaru Mudstone further north.

B.M.R. WYANDRA NO. 1, CORE 1.

Well preserved spores and pollen grains were extracted from a sample (MFP 4858) taken from core 1, depth 190' 6-7", B.M.R. Wyandra No. 1 Scout Hole, Eromanga Basin. The assemblage contained a large number of plant microfossil species, among which the most common forms were: Cyathidites minor, C. australis, C. concavus, Stereisporites antiquasporites, Lycopodiumsporites austroclavatidites, Alisporites grandis, A. similis, Microcachryidites antarcticus, Ceratosporites equalis, Baculatisporites comaumensis.

The following stratigraphically important forms were also recognized:

Classopollis spp.
Cicatricosisporites australiensis
Coptospora paradoxa (1 specimen)
Crybelosporites striatus
Laevigatosporites ovatus
Trilobosporites trioreticulosus (2 specimens)
Lycopodiumsporites circolumenus
Pilosisporites parivspinosus (fragment)
Arcellites (al. Pyrobolospora) reticulatus (fragment)
Foraminisporis dailyi
cf. Podocarpidites epistratus
cf. Dictyotosporites speciosus (1 specimen)
cf. Kraeuselisporites majus

The presence of C. australiensis and Coptospora paradoxa indicates that the assemblage belongs to the interval of spore units K 2. Although the index species are scarcely represented, a K 2 age of the assemblage is also suggested by the relative abundance of C. striatus and F. dailyi, as well as the presence of the megaspore A. reticulatus and also L. ovatus. A K 2a age is suggested but not proved, as D. speciosus, which together with C. paradoxa characterizes unit K 2a, was not identified in the assemblage beyond doubt. However, the absence of angiospermous pollen grains, which are introduced in the spore sequence in the interval of succeeding units K 2b+ in the eastern Eromanga and Surat Basins (Burger 1968c,b), also favours a K 2a age for the microflora. The absence of Appendicisporites (al.Plicatella) tricornitatus, which is widely known from K 2b+ assemblages in northern Queensland and Papua (Evans 1966a, Burger 1968b), may also be significant, although the spore did not occur in basal K 2b assemblages in the central Surat Basin (Burger 1968c).

Summarizing the evidence: the assemblage is most likely of K 2a age, although more positive indications would be desirable. From lack of comparative spore data in the area the possibility of a slightly younger (K 2b) age for the assemblage cannot be altogether excluded. In the Eromanga Basin K 2a microfloras were described from the upper part of the Coreena and the Toolebuc Limestone (Burger 1968b), in the western Surat Basin (B.M.R. Surat No. 1 Scout) unit K 2a was also recognized from the upper part of the Coreena interval (Burger 1968c). Spore unit K 2b has in various instances been recognized in the Eromanga Basin from the Allaru Mudstone (Evans 1966d; Burger 1968b; also non-published data).

Regarding the age of the microfossils the sample is most likely to be correlated with the upper part of the Coreena, eventually also with the lowermost Allaru Mudstone.

The absence of marine microplankton points to terrestrial environments of deposition.

B.M.R. EULO NO. 1 SCOUT HOLE

Pollen grains, spores and microplankton were examined from B.M.R. Eulo No. 1, Eromanga Basin, which was drilled through presumed marine Lower Cretaceous argillaceous sediments, and entered quartzose sandstone, regarded as the Hooray Sandstone, at a depth of 402 feet. Samples from three cores, two in the higher argillaceous interval and one from the top of the Sandstone, were selected for closer palynological age determination.

Sample 4939
(core 3, depth 411 feet)

The rock specimen consisted of whitish-yellow sandy siltstone, from which only very few microfossils could be extracted. The assemblage consisted of the following types:

Spores:	Gleicheniidites circiniidites
	Classopollis cf. simplex
	aff. Dictyophyllidites mortoni (Deltoidospora rafaeli?)
	Osmundacidites cf. mollis
	cf. Concentrisporites hallei
Microplankton:	cf. Canningia sp.
	cf. Goniaulacysta edwardsi (damaged specimen)
	Muderongia sp.
	M. tetracantha
	M. mcwhaei

Various species of microplankton, mainly the group of Muderongia, dominate the assemblage, thus pointing to fully marine depositional environment for the sample. Muderongia is a well-known genus in the Lower Cretaceous of the Great Artesian Basin (Evans 1966a; Burger 1968) and the Murray Basin area (Evans & Hawkins 1967). In the Eromanga Basin, Evans (1966a) reports the earliest occurrence of Muderongia from K 1a assemblages, in the interval of the D. cerviculum/S. attadalense Zone. This agrees with similar discoveries from the Surat Basin (Burger, in prep.). M. tetracantha and M. mcwhaei are also common in younger assemblages; M. tetracantha was encountered as high as the interval of unit K 2a in the Surat Basin (Burger 1968c).

All except one of the identified spores are common forms in Jurassic and Cretaceous microfloral assemblages. O. cf. mollis, which is an inconspicuous trilete spore, seems to be restricted in occurrence to the Lower Cretaceous. Dettmann (1963) reports the type from the interval of her Speciosus Assemblage, which is approximately equivalent to spore units K 1b-d. In the Great Artesian Basin the spore has been tentatively identified in K 1b to K 2a microfloras (Burger 1968c,b), but its stratigraphic range is not accurately known so far.

From this evidence no palynological age can be determined for the sample, except that the microflora is probably not older than unit K 1a. Little accurate spore information exists of the Hooray Sandstone in the Eromanga Basin. Microplankton bearing horizons similar to that of sample 4939 still have to be found further north and northwest, although the stratigraphically equivalent Ronlow Beds in the Longreach Sheet area contained Lower Cretaceous microplankton (Evans 1966c). The existence however, of at least near-marine environments for the Hooray Sandstone, west of the Nebine Ridge, is suggested by the presence of glauconite in Amoseas Westbourne No. 1 Well (Gerrard 1964) and BMR Mitchell Nos. 4 and 7 (Exon et. al. 1966), coupled with the presence of acritarchs in Mitchell No. 4 (Evans, in Exon et al. 1967)

Microfossils have proven the overlying argillaceous strata of the basal Wallumbilla Formation throughout the Eromanga and Surat Basins to be of marine origin.

Sample 4935

(core 2, depth 287 feet)

This sample yielded a rich and well preserved microfloral assemblage, among which the following marker fossils were encountered:

Spores: Cicatricosisporites australiensis
Cyclosporites hughesi
cf. Dictyotosporites speciosus
Lycopodiumsporites rosewoodensis
Foraminisporis dailyi

Microplankton: Odontochitina operculata
Chlamydophorella nyei
Dingodinium cerviculum
cf. Muderongia tetracantha (fragments)
Various types of acritarchs

The co-occurrence of C. hughesi and F. dailyi indicates an age for the assemblage within the interval of units K 1b - K 2a. In the Great Artesian Basin, O. operculata does not appear earlier than Crybelosporites striatus, i.e. at the base of unit K 1d (Burger 1968a,b; also unpublished data). M. tetracantha and C. nyei are common species in the marine Lower Cretaceous of Queensland. D. cerviculum is mainly associated with K 1 a and K 1b-c microfloras. Slight overlap of its range and that of O. operculata has been reported from the Richmond area (Burger 1968b) and from the Surat Basin (Burger 1968c). This overlap was associated with the basal Ranmoor Member in the Richmond area; it was noticed in the Surat Basin in association with basal Coreena horizons. The co-occurrence of the two species in sample 4935 implies that the overlap of their vertical ranges can be traced throughout the Great Artesian Basin as a horizon of great stratigraphic value in the marine Lower Cretaceous. The presence of both forms, coupled with the absence of C. striatus, indicates an uppermost K 1b-c age for the microflora. The uppermost K 1b-c approximates in Eulo No. 1 with the Doncaster Coreena boundary.

Sample 4876

(core 1, depth 216 feet)

Sample No. 4876 yielded a poorly preserved assemblage, in which microplankton and acritarchs accounted for a few percent of the total microfossils. The following forms of stratigraphic significance were identified:

Spores:	Cicatricosisporites australiensis
	Cyclosporites hughesi
	Lycopodiumsporites nodosus
Microplankton:	Odontochitina operculata
	cf. Muderongia tetracantha (fragments)

The presence of O. operculata points to an age equivalent no older than spore unit K 1d. The presence of C. hughesi indicates an age not younger than unit K 2a (Burger 1968c). The absence of Coptospora paradoxa and Microfoveolatosporites canaliculatus favours a K 1d rather than a K 2a age for the microflora. The rock specimen may therefore be correlated with somewhere in the Coreena Member.

REFERENCES

BELFORD, D.J., 1958 - Micropaleontological examination of samples from A.O.G. Scout Bores No. 1 and No. 2, Talbalba, Thallon Basin, Queensland. Bur. Miner. Resour. Aust. Rec. 1958/2 (unpubl.).

BURGER, D., 1968a - Stratigraphy and palynology of upper Mesozoic sections in some deep wells in the Surat Basin, Queensland. Ibid. 1968/24 (unpubl.).

BURGER, D., 1968b - Palynology of marine Lower Cretaceous strata in the northern and eastern Eromanga Basin, Queensland. Ibid. 1968/62 (unpubl.).

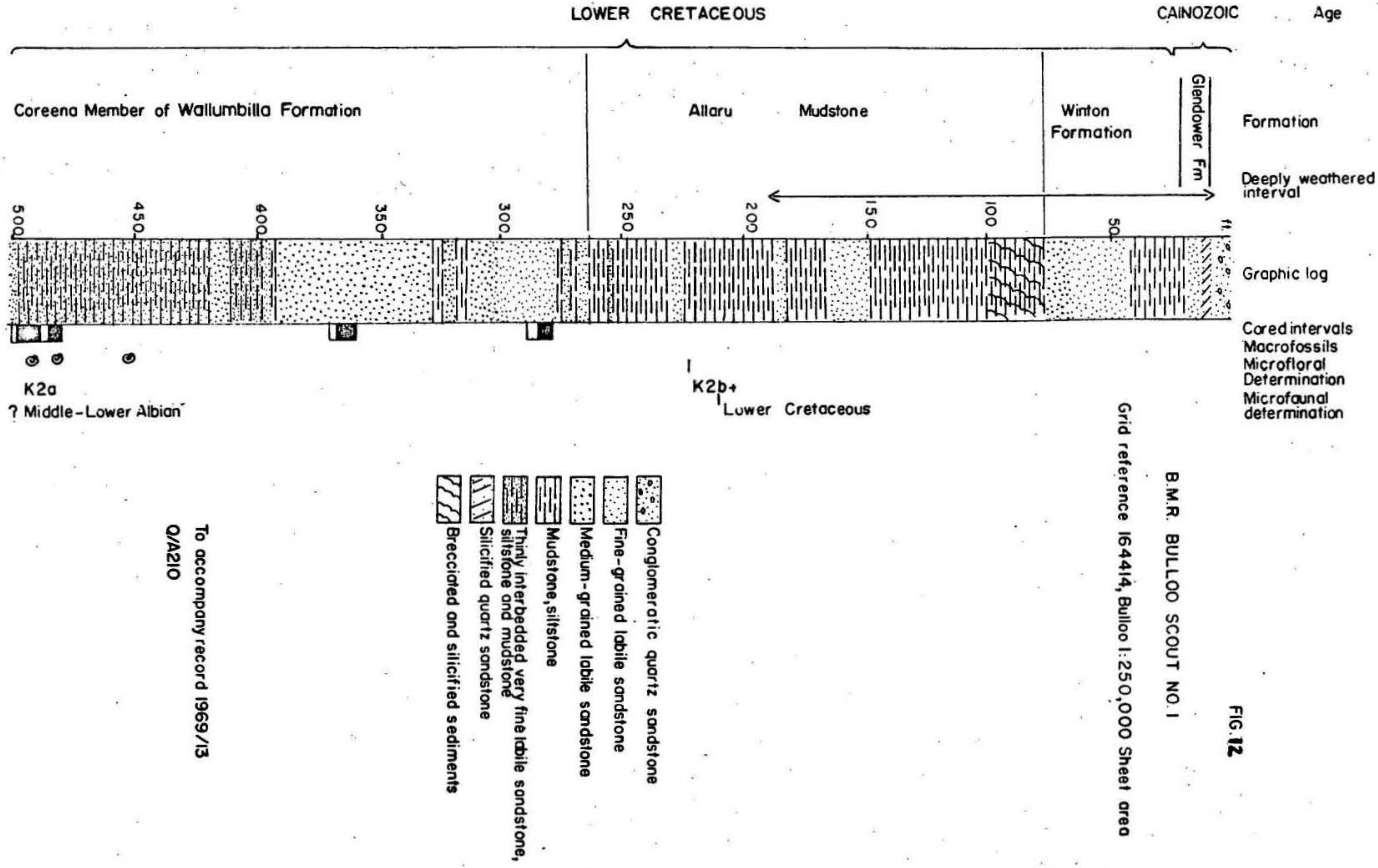


FIG. 12

B.M.R. BULLOO SCOUT NO. 1

Grid reference 164414, Bulloo 1:250,000 Sheet area

To accompany record 1969/13

Q/A210

BURGER, D., 1968c - Relationship of palynology to stratigraphy in the Lower Cretaceous of the Surat Basin in Queensland. Ibid. 1968/125 (unpubl.).

DETTMANN, Mary E., 1963 - Upper Mesozoic microfloras from south-eastern Australia. Proc. Roy. Soc. Vict. 77(1); 1-148.

EVANS, P.R., 1966a - Contribution to the palynology of northern Queensland and Papua. Bur. Miner. Resour. Aust. Rec. 1966/198 (unpubl.).

EVANS, P.R., 1966b - Mesozoic stratigraphic palynology in Australia. Aust. Oil Gas Journ. 12 (6); 58-63.

EVANS, P.R., 1966c - Palynological studies in the Longreach, Jericho, Galilee, Tambo, Eddystone and Taroom 1:250,000 Sheet areas, Queensland. Bur. Miner. Resour. Aust. Rec. 1966/61 (unpubl.).

EVANS, P.R., and HAWKINS, P.J., 1967 - The Cretaceous below the Murray Basin. Ibid. 1967/137 (unpubl.).

EXON, N.F., GALLOWAY, M.C., CASEY, D.J., and KIRKEGAARD, A.G., 1966 - The geology of the Tambo, Augathella and Blackall 1:250,000 Sheet areas, Queensland. Ibid. 1966/89 (unpubl.).

EXON, N.F., CASEY, D.J., and GALLOWAY, M.C., 1967 - The geology of the northern half of the Mitchell 1:250,000 Sheet area, Queensland. Ibid. 1967/63 (unpubl.).

GERRARD, M.J., 1964 - American Overseas Petroleum Ltd. Westbourne No. 1 Well Completion Report (unpubl.).

VINE, R.R., and DAY, R.W., 1965 - Nomenclature of the Rolling Downs Group, Northern Eromanga Basin, Queensland. Qld. Govt. Mining Journ. 66 (767); 417-421.

APPENDIX 3

SUMMARY OF DRILLING RESULTS CARRIED OUT IN THE EROMANGA BASIN 1968

Introduction

Seventeen scout holes were drilled in 1968 in areas adjacent to the mapped area. Eleven of these holes were part of a specific project to test the feasibility of using a drilling rig to prospect for precious opal. Three holes were drilled to test a circular depression which was thought to be a meteorite crater. The remaining three holes were drilled for additional stratigraphic information and to collect samples for palaeontological studies. Individual results of these operations are listed below.

Bulloo No. 1

Location Lat. 28°55' Long. 143°47'

Depth 500 feet

Completed June 1968

Objective & Results

This bore was sited to find what Cretaceous units are present beneath the sand plain in the south east part of the Bulloo Sheet area. Existing water bores and gamma ray logs indicate shallow basement (approximately 2,000 feet). Winton Formation sediments outcrop in the vicinity and a rather compressed Cretaceous section was expected in the hole. The results are shown diagrammatically in Figure 12. The interpretation of the stratigraphy is problematic and a detailed analysis of this bore is given by Terpstra and Burger (1969).

Canterbury No. 4

Location Lat. 25°21' Long. 142°28'
Depth 400 feet
Completed June 1968
Objective & Results

This was the third attempt to drill through downfolded Late Tertiary and Quaternary sediments in the northern part of the Cooper Syncline. It was hoped that sediments of the Glendower Formation with silcrete beds would be intersected thus adding evidence to the hypothesis that this formation has been folded and that silcrete is a useful structural marker. The hole was successful in both objectives and the results are illustrated diagrammatically (Fig. 13).

Windorah No. 5

Location Lat. 25°26' Long. 142°39'
Depth 270 feet
Objective & Results

This hole was drilled to collect an unweathered core of Winton Formation for palynological study. In the Windorah area the Winton Formation from geophysical and drilling evidence reaches its maximum thickness of approximately 4000 feet. The upper age limit of this formation has not yet been established. The core collected was found to be barren.

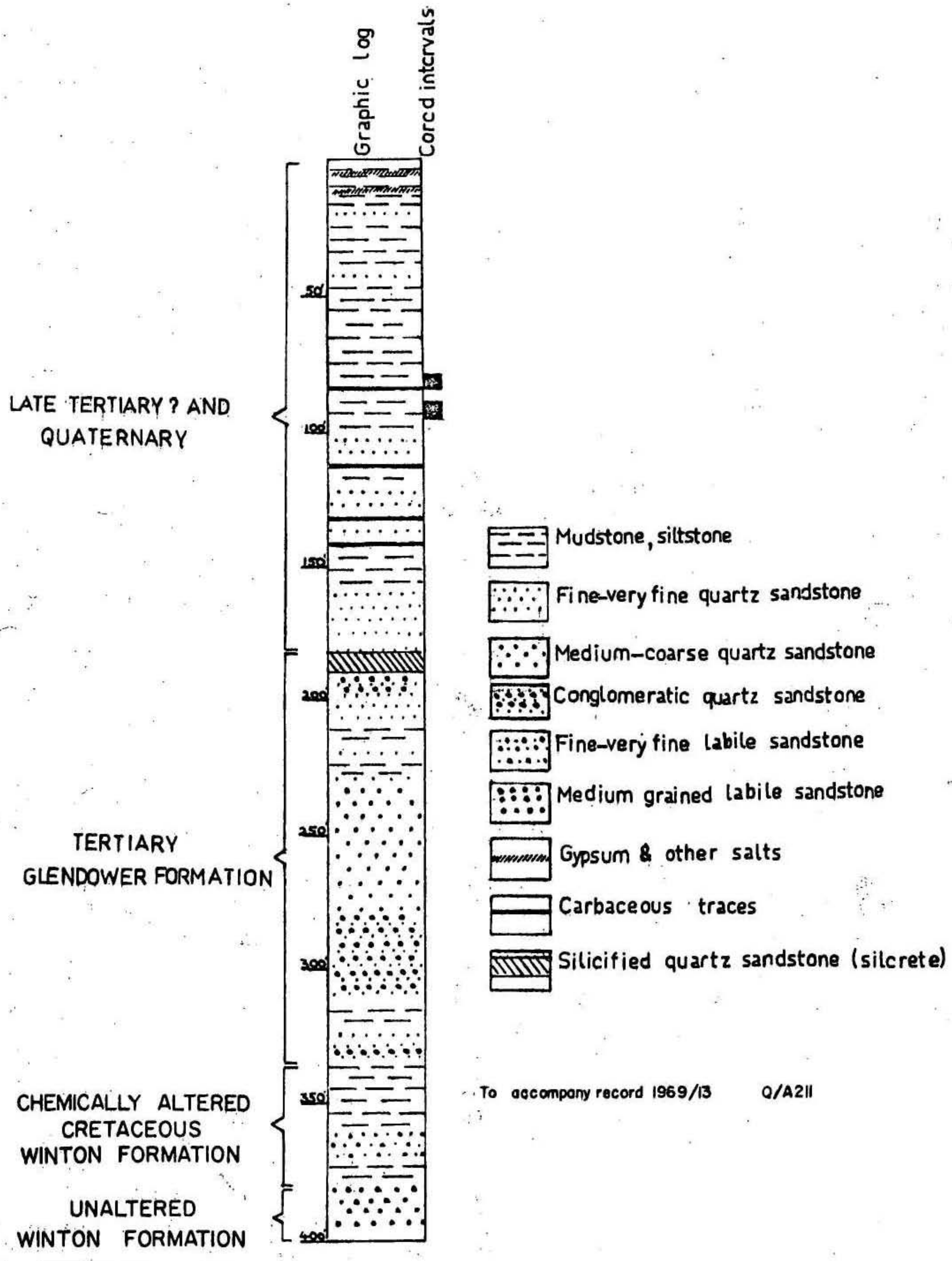
Dirranbandi Nos. 1a, 1b and 1c.

Location Lat. 28°13', Long. 147°45'
Depths No. 1a 100feet; No. 1b, 50 feet, and No. 1c, 270 feet.
Completed. October 1968
Objective & Results

FIG. 13.

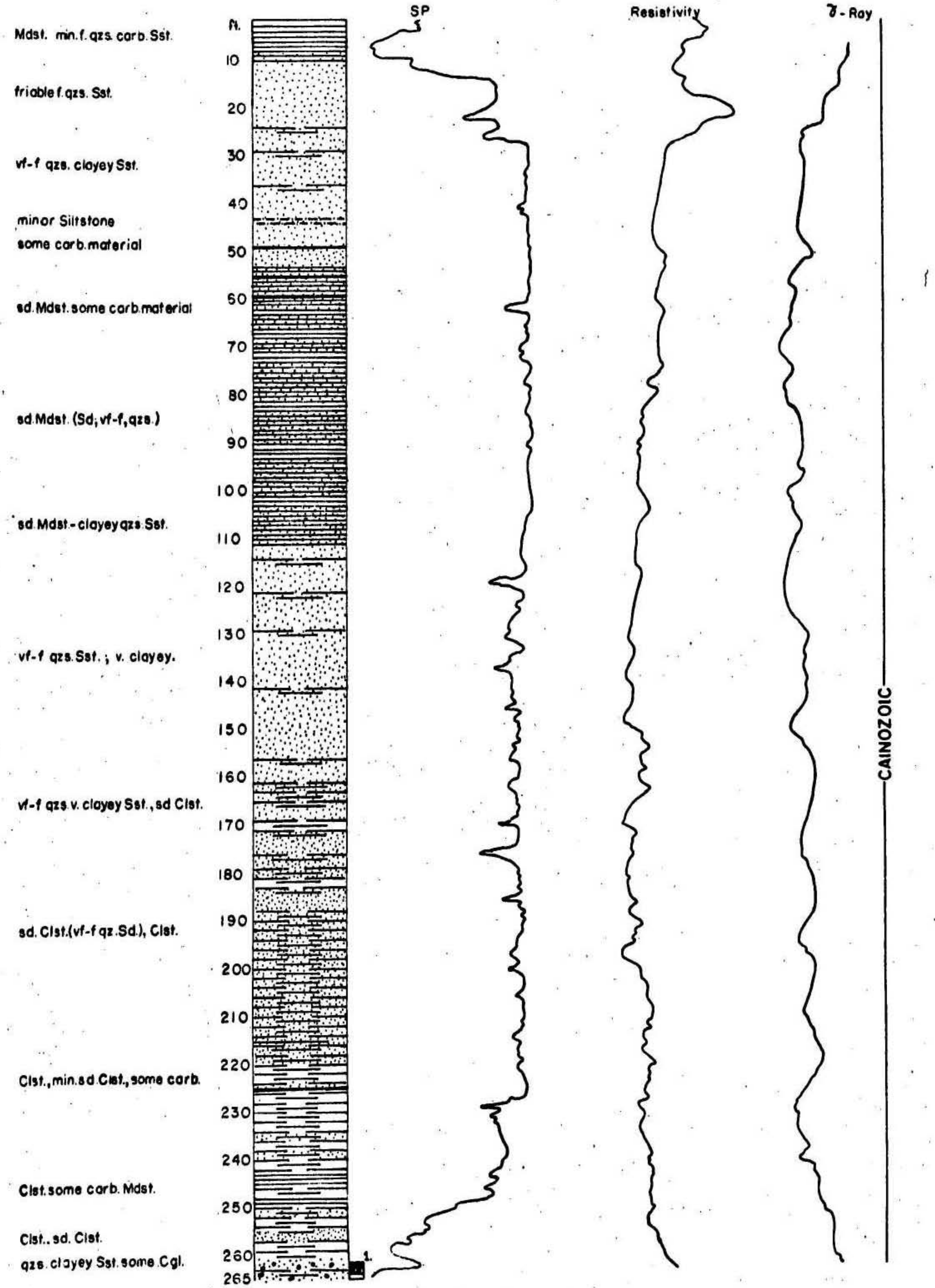
B.M.R. CANTERBURY SCOUT NO 4

Grid ref. 558848 Canterbury 1:250,000 Sheet area.



To accompany record 1969/13 Q/A211

B.M.R DIRRANBANDI SCOUT NO.1c. Grid ref 587498 FIG.14.



To accompany record 1969/13

A shallow surface depression which is circular in shape was regarded by Professor R.A. Binns (University of New England) as a possible meteorite crater. No. 1a hole was sited in the centre of the depression, No. 1c on the periphery, and No. 1b approximately a quarter of a mile from the peripheral ridge. No evidence was obtained that the feature was an impact structure during drilling, and microscopic examination of the cuttings did not reveal any unusual features. All holes were completed in late Tertiary or Quaternary sand and silt beds. (Fig. 14).

Eromanga Nos. 3 to 14
Location Lat. 26°29', Long. 143°05'
Depths 20 to 70 feet
Method 100 feet grid spacing between drill centres.
Completed June 1968
Objective & Results

Detailed drilling of a known area of opalization was carried out to see if a drilling rig is a suitable prospecting tool. It was found that on closely spaced levelled drill sites an opalized band could be mapped. Some precious opal was obtained in a few cores. It is likely, therefore, that a small rotary rig could be used economically to prospect for extensions from known opal fields.

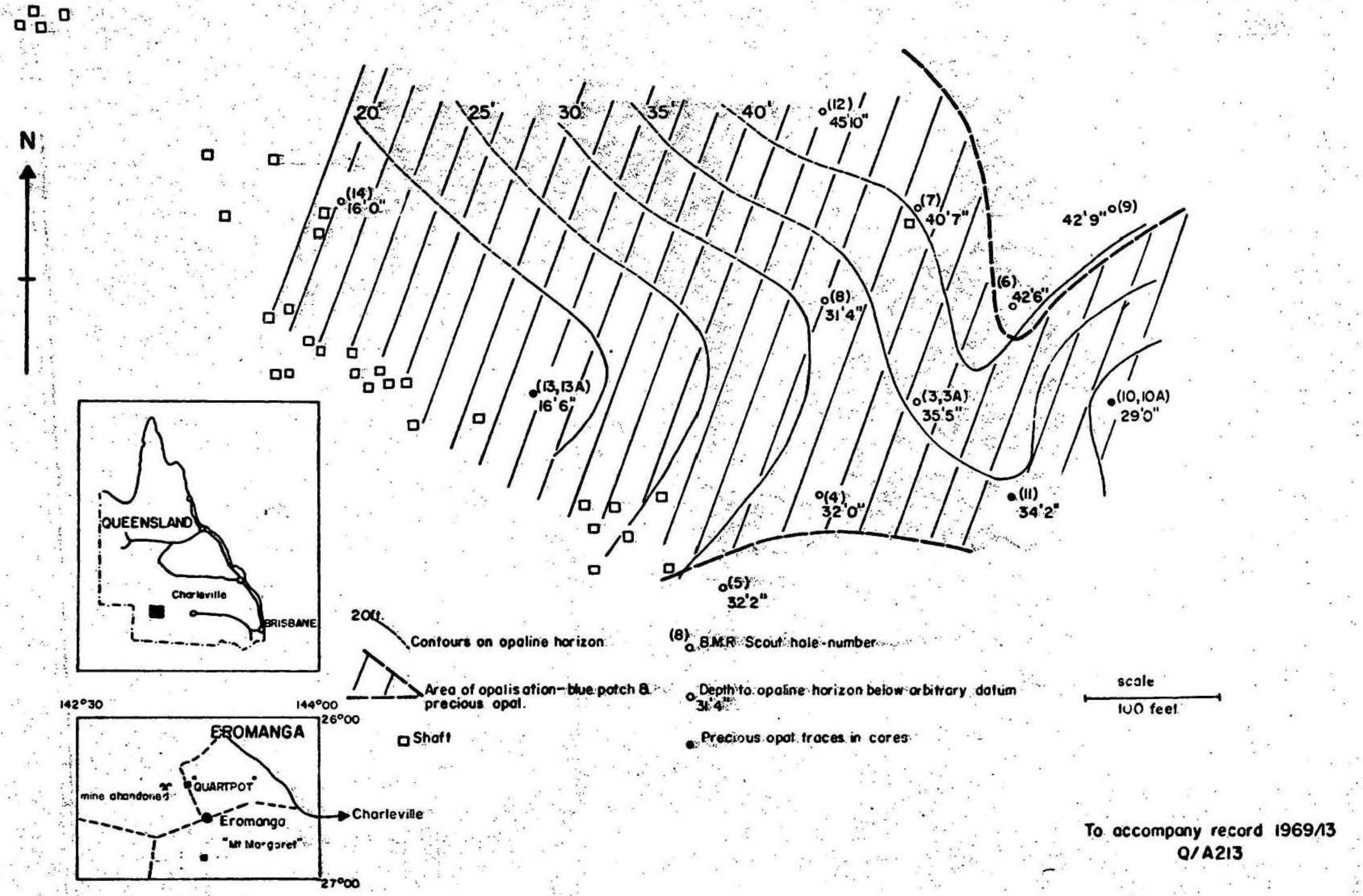
The results were inconclusive to add anything to the current hypothesis that opal enrichment takes place in or near the bottom of shallow, basin like structural depressions. The results of the drilling are given diagrammatically in Figure 15.

REFERENCE

TERPSTRA, G.R.J., and BURGER, D., 1969 - Micropalaeontology and palynology of samples from BMR Bulloo No. 1 scout hole. Bur. Miner. Resour. Aust. Rec. 1969/39

RESULTS OF DRILLING AT QUARTPOT OPAL MINE, EROMANGA

FIG. 15.



To accompany record 1969/13

Q/A213

APPENDIX 4

GENERAL PHYSIOGRAPHY

by J.A. Mabbutt

The survey area covers about 90,000 km^2 and contains the alluvial flats and adjoining sandplains developed along the middle sectors of the Bulloo, Paroo, and Warrego Rivers in the south, and the uplands and stony plains which constitute drainage divides, more particularly in the north of the area. The highest ground is in the northeast, near Charleville, where the Mulga Tableland is extensively above 350 m and where uplands locally exceed 450 m. From this region there is a general decline in upland levels westwards across the north of the area, to less than 250 m. However, the main fall is to the south, where the plains along the State boundary lie close to 130 m above sea-level.

The area is divided into two relief provinces by a line running from the southwest corner along the Paroo to Eulo, then east to Cunnamulla and up the Warrego to the confluence of Angellala Creek, whence east again to the boundary of the area. North and west of this line are dissected low plateaux generally with less than 50 m relief, traversed by river plains; to the south and east are extensive sandplains with pans and low fixed dunes, and the broad alluvial tracts transitional to the riverine plains of the Murray-Darling system.

The survey area is drained as follows:

53% to the Warrego
32% to the Paroo
15% to the Bulloo

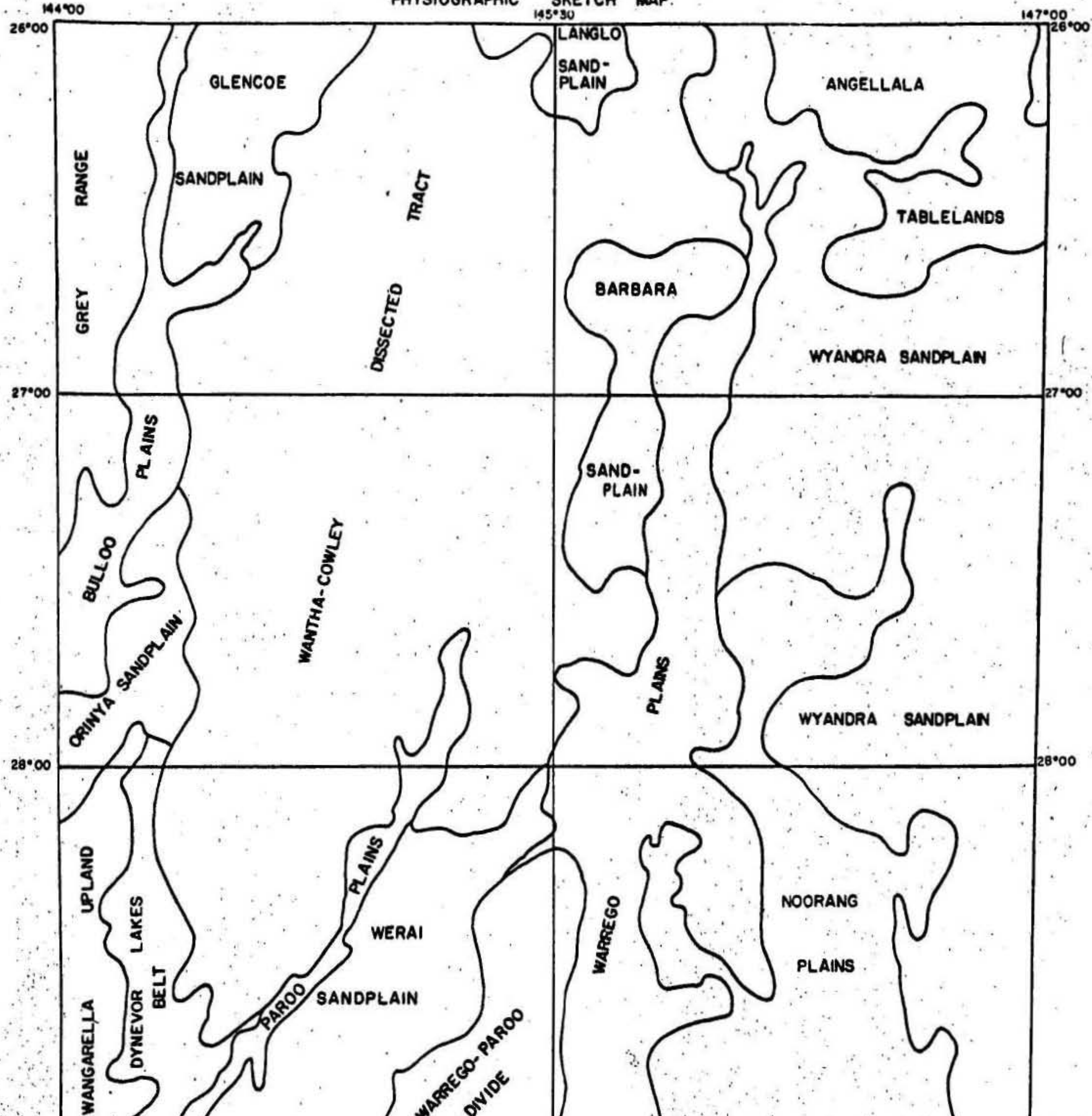
Of the main rivers, the Bulloo and the Warrego rise to the north of the survey area, whereas the head channels of the Paroo are included in it. The trend of major drainage reflects the regional tectonic grain, the main channels generally being separated by positive structures with meridional axes. The structural divide of the Eulo Ridge marks an important drainage parting.

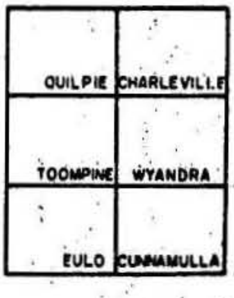
On the northwest side, the Bulloo swings southwestwards into a separate interior drainage basin, defeated by neotectonism and advancing aeolian sand; on the other side the Paroo and the Warrego persist southwards to join the Darling, although with diminished size. All the main channels have the braiding habit characteristic of the Channel Country, and the Paroo and Warrego have several deltaform distributary networks in the south of the area, these serving as feeders to lateral sump basins. Windblown sand becomes increasingly extensive within the river plains southwards, particularly along the Paroo.

Mean annual rainfall at Charleville, in the northeast of the area, is 50.0 cm, whence it declines southwards and westwards, to 33.0 cm at Quilpie and 36.3 cm at Cunnamulla. The wettest period is between December and March. With potential evaporation in excess of 200 cm, all streams are ephemeral. The tributary systems begin to flow with between 1.5 and 3.0 cm of local rain of at least moderate intensity, but the major channels are dependent on widespread rain, particularly in the north of the survey area and beyond. The Bulloo, with a catchment of about 25,000 km^2 above Kiandra, (Grid ref. 190584) has an estimated possible yield of 200,000 acre-feet annually, the Warrego, with a better-watered, hillier catchment of about 50,000 km^2 north of the State border, has a potential yield of 700,000 acre-feet. The main channels flow at intervals of between one and two years; intervals increas southwards. Floods in the Warrego reach the Darling each second year, on an average, but the Paroo flows less regularly, and discharges into the Darling River at intervals of 3-4 years. Extensive flooding of the alluvial plains occurs about twice per decade, on the average, following rainfalls in excess of 10 cm.

The area comprises the following landscape types as shown in Figure 16 .

PHYSIOGRAPHIC SKETCH MAP.





To accompany record 1969/13

Q/A214

Fig. 16

1. Uplands and Upland Complexes.

Flattish or moderately-tilted indurated horizons associated with deep weathering profiles give rise to a range of plateau forms, from the extensive Mulga Tableland east of Charleville to groups of small mesas in dissected areas. Relief generally does not exceed 50 m. Silcrete cappings are thin compared with areas further west (Mabbutt 1967, 1968) and have apparently been stripped from large areas, leaving the underlying 'fragmental zone' (Wopfner and Twidale 1967) to build the plateau surfaces and escarpment breakaways. In other areas, patches of silcrete may survive more or less disturbed. In view of the variation and the many transitional forms, no attempt has been made to map uplands with intact silcrete cappings separately from thos with stripped surfaces, as in previous years. In gross form there is little to distinguish them save that escarpments with silcrete cappings have a sharper upper angle and are simpler in plan, whereas those formed in the fragmented horizon usually consist of a narrow zone in which blocks have fallen or slid on vertical partings parallel with the escarpment edge, as a result of the prominent fractures and pipes in the fragmental zone.

The upland surfaces include:-

(a) rocky, gently undulating upland plains eroded in the fragmental zone

(b) lower, more stable tracts with fine-textured residual or transported soils derived from the fragmental zone

(c) sandplain locally grading into the above, but particularly characteristic of areas with quartz sandstone in the profile

(d) silcrete-capped surfaces ranging from rock pavements with blocky or columnar jointing to raised patches of rounded silcrete boulders with varying disturbance and lowering

2. Stony Slopes and Plains.

These are lowlands extending from bounding escarpments and eroded in fresh or weathered Cretaceous rock. Because of the smaller extent and amplitude of most of the tectonic structures in this area compared with those further west, erosion has only locally penetrated below the weathering front and there are no extensive open undulating clay plains of 'rolling downs' type. Generally, these landforms are pediments and spurs with silcrete or Cretaceous rock fragments derived from the retreating escarpments and locally studded with duricrested remnant mesas, but small areas of 'rolling downs' are included.

3. Red Earth Plains.

Surfaces with residual or transported fine sandy red earths are characteristic of the lower backslopes of structural uplands capped by the fragmental zone of the weathered profile. With undissected surfaces sloping at between 0.5 and 1° and subject to sheet flow, they commonly exhibit a transverse banding of trees (see Senior et al., 1968 Photo 8). These surfaces commonly grade into sandplain in their lower parts.

4. Alluvial Plains.

Broad alluvial plains are developed along the main rivers and generally increase in extent southwards. Between 20 and 25% of the area consists of mappable alluvium. In the upper sectors, confined by higher ground, there is typically a belt of interlacing channels up to 5 km wide, well exemplified along the Bulloo River and in the Warrego above Cunnamulla. These channels form the elongate, rectangular braids which Whitehouse (1944) described as "reticular", and at intervals they link in long, straight waterholes. The lower sectors, as in the Warrego downstream from Cunnamulla, are broad open plains with divergent drainage as fan-shaped distributory nets, or "deltoids" (Whitehouse 1941), which may lead into lateral sumps. The alluvial deposits range from dark, cracking clays in the lower parts of the floodplains to silts and fine sands in levee belts and meander scrolls in present and prior channel zones, and there are islands of wind-sorted sand which increase in extent downstream.

5. Aeolian Sand Surfaces.

These make up 25% of the area and consist of well-sorted fine to medium quartz sand with reddish coatings of iron oxides, with increasing clay admixture in subsurface horizons. As is generally the case in arid Australia, aeolian sand is closely associated with the lower sectors of river plains, and it becomes increasingly extensive in the south of the area, adjoining the plains of the Warrego, Paroo and Bulloo Rivers. However, sandplain also extends over upland surfaces with eroded silcrete cappings associated with quartzose Tertiary sediments, as in a belt east of the Bulloo River.

By far the commonest form is flat to broadly undulating vegetated sandplain. These lack local surface drainage and comprise some of the most uniform and monotonous landscapes in the survey area. Many sandplain tracts receive run-on from adjoining areas, and here there may be many claypans aligned along elongate shallow depressions which mark disintegrated former drainage lines. This type of country is particularly extensive between the Warrego and Paroo Rivers, where floods from the Warrego have been reported as connecting with the Paroo. The pans commonly have low sand lunettes on their smooth eastern rims.

Smaller areas of longitudinal sand ridges occur, particularly in the far southwest. These are aligned parallel ridges up to 5 m high, spaced fairly regularly between 200 and 300 m apart and not generally exceeding 5 km in length. Their subdued outlines and vegetated rounded crests attest to their present stability. Dune trend is west to east, parallel with the dominant westerly winds, and there is general evidence of growth eastwards. Islands of less regular dunes occur within the alluvial plains, particularly along the Warrego, and their less regular patterns, lighter-coloured sand, and locally greater mobility point to their younger age.

In Figure 16 these landscape types are grouped into physiographic regions with constituent landscapes as follows:

Angellala Tablelands:	Plateaux with dissected margins and flanking stony plains; the uplands, which include the extensive Mulga Tabeland in the south, bear a cover of silcrete, red earth, or aeolian sand.
Wantha-Crowley Dissected Tract:	An area of structural complexity and differential erosion, largely comprising the upland catchment of the Paroo River; several anticlinal lowlands with fringing ridges; between these, long structural valleys such as Beechal Creek, following the predominant N-S grain.
Sandy Tablelands: Glencoe Sandplain, Langlo Sandplain, Barbara Sandplain, Orinya Sandplain	These sandplain tracts mark areas in which intact or moderately stripped relicts of the Tertiary land surface bear a cover of aeolian sand; in the north, they form low tablelands with fringing escarpments, and they grade southwards into sandy plains which are generally featureless, but with pans in lower parts.
Grey Range:	A belt of dissected tablelands rising westwards towards the N-S summit escarpment of the Canaway Fault.
Wangarella Upland:	In the north, groups of duricrusted mesas in extensive stony plains; in the south, a dissected low tableland
Dynevor Lakes Belt:	This sandy lowland trends north south in the same direction as the Bulloo Plains;along its western margin is sited a series of large lakes with prominent lunette barriers on the east

Sandplain with Pans: Werai Sandplain Wyandra Sandplain	Sandplain with lines of claypans marking disintegrated prior drainage systems; those of the Werai plains formerly headed south-west, parallel with the Paroo River, and those in the Wyandra plains headed south; Werai Creek in the former, and Nebine Creek in the latter, are the only significant continuous drainage lines.
Noorang Plains:	Equal areas of alluvium and sandplain, originating as prior distributary plains of the Warrego River east of its present floodplain.
Major Floodplains: Warrego Plains Paroo Plains Bulloo Plains	Alluvial floodplains with sandy to silty channel tracts with anastomosing channels and sandy islands, and clay backplains with sump basins; distributary channel systems typify the lower Warrego Plains
Warrego-Paroo Divide:	Broadly undulating or lightly dissected stony surface with less than 15 m local relief and rising less than 30 m above adjacent river plains

REFERENCES

MABBUTT, J.A., 1967 - Appendix 4 Geomorphology of the area in Gregory, C.M., Senior, B.R., and Galloway, M.C. The geology of the Connemara, Jundah, Canberbury, Windorah and Adavale 1:250,000 Sheet areas, Queensland. Bur. Miner. Resour. Aust. Rec. 1967/16.

MABBUTT, J.A., 1968 - Appendix 3 Geomorphology of the area in Senior, B.R., Galloway, M.C., Ingram, J.A., and Senior, Daniele. The geology of the Barrolka, Eromanga, Durham Downs, Thargomindah, Tickalara and Bulloo 1:250,000 Sheet areas, Queensland. Bur. Miner. Resour. Aust. Rec. 1968/35.

WHITEHOUSE, F.W., 1941 - The surface of Western Queensland. Proc. Roy. Soc. Qld, 53, 1-22.

WHITEHOUSE, F.W., 1944 - The natural drainage of some very flat monsoonal lands . (The plains of western Queensland) Aust. Geog. 4, 183-196.

WOPFNER, M. and TWIDALE, C.R., 1967 - Geomorphological history of the Lake Eyre Basin in J.N. Jennings and J.A. Mabbutt (eds.) Landform Studies from Australia and New Guinea. ANU Press, Canberra, 118-143

APPENDIX 5

REPORT ON A PLEISTOCENE VERTEBRATE FOSSIL LOCALITY ON BOONDOONA CREEK

by M. Plane

A taxonomically poor, but typically late Pleistocene, assemblage of vertebrate fossils was found by the party in a stream channel of Boondoona Creek Penaroo Station, southwest Queensland. (Toompine Sheet Grid ref. 279537).

The faunal list comprises:

lung fish (scales and bones)
turtles (scutes)
crocodiles (scutes and teeth)
lizards (teeth and bone)
small wallabies (isolated teeth)
browsing kangaroos (isolated teeth)
grazing diprotontids (bones and associated teeth)

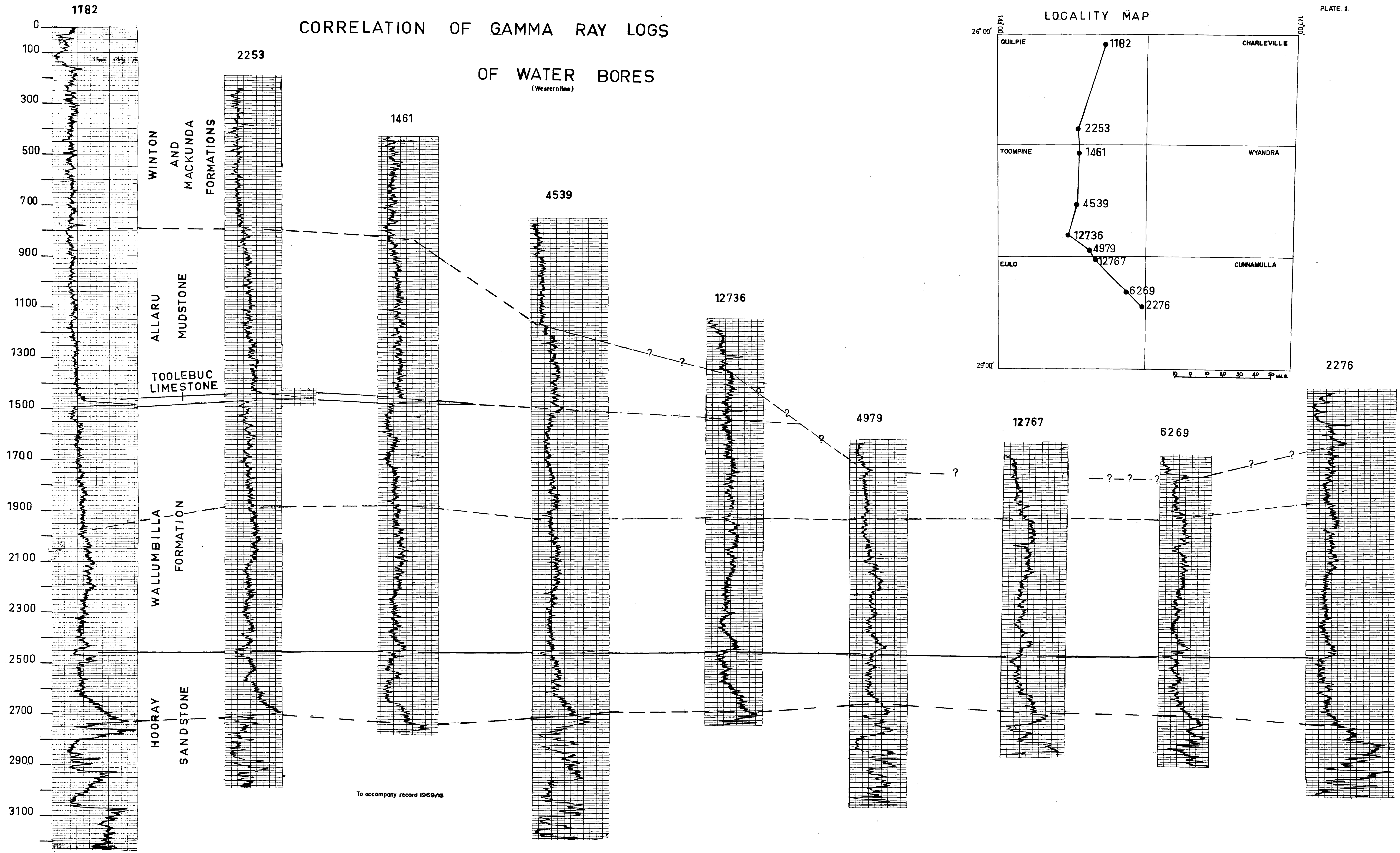
The genera represented are Megalania, Crocodylus, Wallabia, Sthenurus, Zygomaturus, and Diprotodon. The only specific assignment which can be made is D. optatum.

Some biogeographic conclusions seem warranged. There was more effective precipitation during the late Pleistocene than there is now. Breeding populations of large slow moving quadrupedal herbivors need year round feed in considerable quantities, while crocodiles require bodies of standing water. Little is known of the conditions which were suitable for the browsing kangaroo Sthenurus but it is normally found in association with forms which need fairly good conditions. Other elements of the fauna add nothing in terms of paleoclimatic reconstruction.

PLATE. 1.

CORRELATION OF GAMMA RAY LOGS OF WATER BORES

(Western line)



To accompany record 1969/13

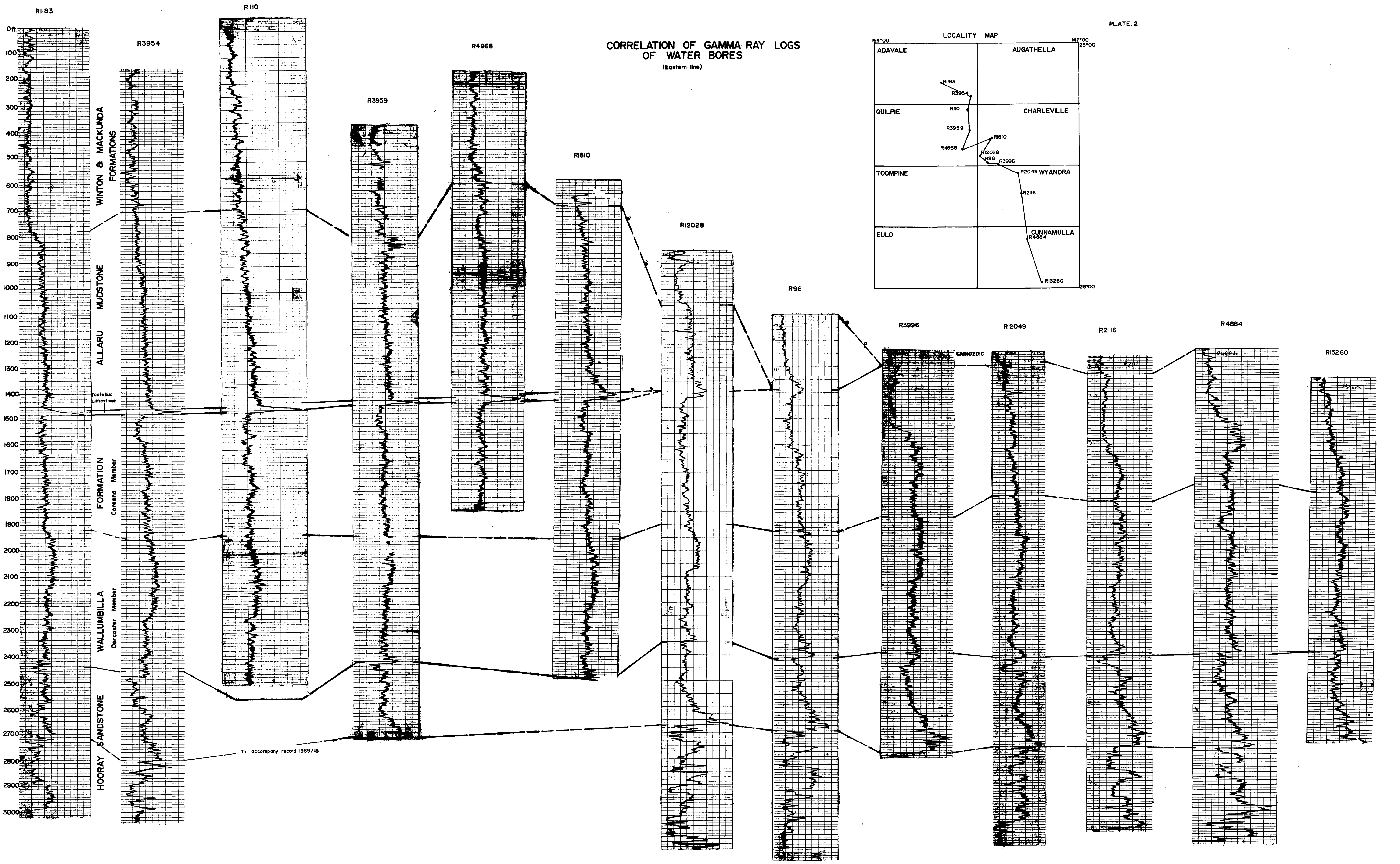


PLATE. 2
CORRELATION OF GAMMA RAY LOGS OF WATER BORES
(Eastern line)
LOCALITY MAP
144°00
147°00
25°00
29°00
ADAVALE
AUGATHELLA
QUILPIE
CHARLEVILLE
TOOMPINE
WYANDRA
EULO
CUNNAMULLA
R1183
R3954
R110
R3959
R4968
R1810
R12028
R96
R3996
R2049
R2116
R4884
R13260
WINTON & MACKUNDA FORMATIONS
ALLARU MUDSTONE
Toolebuc Limestone
WALLUMBILLA FORMATION
Coreena Member
Doncaster Member
HOORAY SANDSTONE
CAINOZOIC
To accompany record 1969/13

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

QUILPIE
QUEENSLAND

SHEET SG 55-9

Reference

CAINOZOIC	QUATERNARY		Q	Undifferentiated
			Qa	Alluvium: sand, silt, clay, soil, minor gravel
			Qs	Quartz sand
			Qc	Gravel, mostly silcrete
			Qr	Sandy red earth, minor gravel
	TERTIARY	Glendower Formation	Tg'	Silcrete (silicified quartz sandstone); quartzose sandstone, sandy conglomerate
MESOZOIC	LOWER TO UPPER CRETACEOUS	Winton Formation (Rolling Downs Group)		Chemically altered (kaolinized, silicified and ferruginized) sediments
			Kw	Labile sandstone, siltstone and mudstone; in part calcareous; minor coal
	LOWER CRETACEOUS	Mackunda Formation (Rolling Downs Group)	Klm	Labile sandstone, siltstone and mudstone; in part calcareous; coquinite
		Allaru Mudstone (Rolling Downs Group)	Kla	Mudstone, siltstone, in part calcareous; minor limestone
		Toolebuc Limestone (Rolling Downs Group)	Klo	Calcareous shale
		Wallumbilla Formation (Rolling Downs Group)	Klu	Mudstone, siltstone, labile sandstone; in part calcareous
	UPPER JURASSIC TO LOWER CRETACEOUS	Hooray Sandstone	J-Kh	Sublabile sandstone, quartz sandstone, conglomerate
		Undifferentiated (Injune Creek Group)	Ji	
	UPPER JURASSIC	Westbourne Formation (Injune Creek Group)	Juw	Siltstone, mudstone, quartz sandstone
	MIDDLE TO UPPER JURASSIC	Adori Sandstone (Injune Creek Group)	Ja	Labile sandstone, siltstone, mudstone
	MIDDLE JURASSIC	Birkhead Formation (Injune Creek Group)	Jmb	Labile sandstone, siltstone; calcareous in part
	LOWER JURASSIC	Hutton Sandstone	Jlh	Quartz sandstone, minor siltstone and mudstone
PALAEOZOIC	LOWER PERMIAN		Pl	Sandstone, siltstone, conglomerate
	UPPER DEVONIAN TO LOWER CARBONIFEROUS	Buckabie Formation	D-Cb	Red sandstone, siltstone and mudstone, vari coloured in part
	MIDDLE DEVONIAN	Etonvale Formation (Adavale Group)	Dme	Siltstone, mudstone and sandstone; in part calcareous; dolomite
		Boree Salt Member (Adavale Group)	Dmb	Crystalline halite, minor anhydrite, minor shale interbeds
		Cooladdi Dolomite Member (Adavale Group)	Dmc	Silty and argillaceous dolomite; minor limestone
		Log Creek Formation (Adavale Group)	Dml	Mudstone and siltstone, minor sandstone, labile and sublabile sandstone
		Bury Limestone Member (Adavale Group)	Dmu	Limestone, dolomite, minor calcareous siltstone
		Gumbardo Formation	Dmg	Andesite and andesitic tuff in the west, arkose and arkosic conglomerate in the east
	LOWER PALAEOZOIC		Pzl	Metamorphics, volcanics, granite

Section Only (Kw to Pzl)

- Geological boundary
- Anticline } Showing plunge
- Syncline } Showing plunge
- Monocline
- Fault

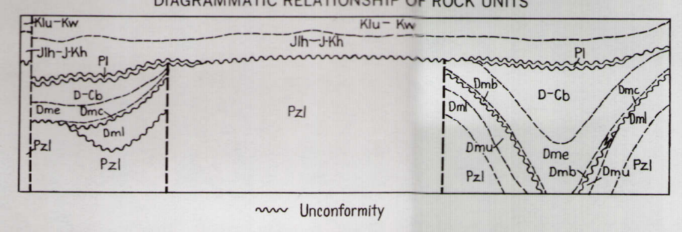
Where location of boundaries, folds and faults is approximate line is broken, where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes

- Dip <5°-air photo interpretation
- •Op Minor mineral occurrence; Op Opal
- Abandoned dry oil exploration well
- Abandoned water bore or well
- Sub-artesian water bore or well } of post-Allaru aquifer system
- Artesian water bore } of post-Allaru aquifer system
- Artesian water bore } of pre-Wallumbilla aquifer system
- Artesian water bore ceased to flow } of pre-Wallumbilla aquifer system

R4968 refers to bore registration number of Queensland Irrigation and Water Supply Commission Records

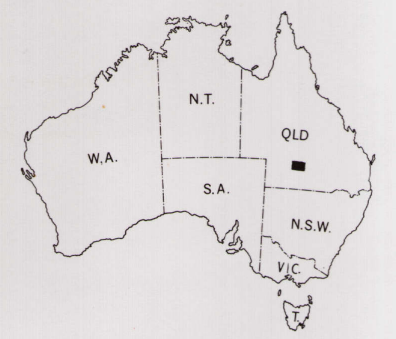
- Bore drain
- E Earth tank
- Dam on stream
- WH Waterhole
- Road
- Vehicle track
- Railway with siding
- Fence
- Town
- "Coolabah" Homestead
- Landing ground
- Building
- Yd Yard
- •804' Height in feet: datum, mean sea level
- Astronomical station
- (PD) Position doubtful

DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



Unconformity

Issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Issued under the authority of the Hon. David Fairbairn, Minister for National Development. Base map compiled by the Division of National Mapping from aerial photography at 1:50,000 scale. Transverse Mercator Projection



INDEX TO ADJOINING SHEETS
Showing Magnetic Declination 1965

CONNEMARA SG 54-3	JUNDAH SG 54-4	BLACKALL SG 55-1	TAMBO SG 55-2	SPRINGSURE SG 55-3
CANTERBURY SG 54-7	WINDORAH SG 54-8	ADAVALE SG 55-5	AUGATHELLA SG 55-6	EDDYSTONE SG 55-7
BARROLKA SG 54-11	EROMANGA SG 54-12	QUILPIE SG 55-9	CHARLEVILLE SG 55-10	MITCHELL SG 55-11
DURHAM DOWNS SG 54-15	THARGOMINDAH SG 54-16	TOOMPINE SG 55-13	WYANDRA SG 55-14	HOMEBOIN SG 55-15
TICKALARA SH 54-3	BULLOO SH 54-4	EULO SH 55-1	CUNNAMULLA SH 55-2	DIRRANBANDI SH 55-3

ANNUAL CHANGE 2°30'E

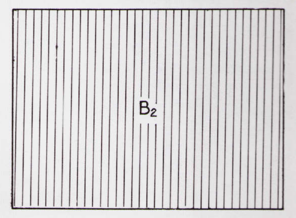
Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

Geology, 1968; by: B.R. Senior and B.M. Thomas
Compiled, 1968, by; B.R. Senior, B.M. Thomas and D.A. Senior
Cartography by; Geological Branch (B.M.R.)
Drawn, 1969, by; R.D. Cooper

GEOLOGICAL RELIABILITY DIAGRAM

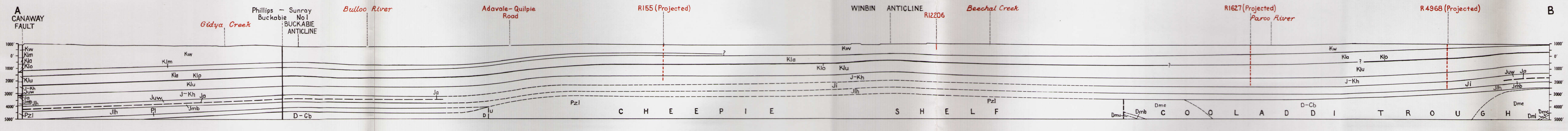


Geology B_2 General reconnaissance; many traverses and air-photo interpretation

Section

Cainozoic sediments omitted from section

Scale: $\frac{V}{H} = 4$



PRELIMINARY EDITION, 1969
SUBJECT TO AMENDMENT

NO PART OF THIS MAP IS TO BE REPRODUCED FOR PUBLICATION WITHOUT THE WRITTEN PERMISSION OF THE DIRECTOR OF THE BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS, DEPARTMENT OF NATIONAL DEVELOPMENT, CANBERRA, A.C.T.

QUILPIE
SHEET SG 55-9

Complimentary

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

CHARLEVILLE
QUEENSLAND

SHEET SG 55-10

Reference

CAINOZOIC	QUATERNARY		Q	Undifferentiated	
			Qa	Alluvium: sand, silt, clay, soil, minor gravel	
			Qs	Quartz sand	
			Qr	Sandy red earth, minor gravel	
			Qc	Gravel, mostly silcrete	
			Cz	Quartz sandstone, conglomerate	
	TERTIARY	Glendower Formation	Tg	Silcrete (silicified quartz sandstone); quartzose sandstone, sandy conglomerate	
			T	Silcrete (silicified quartz sandstone); quartzose sandstone, sandy conglomerate	
MESOZOIC	LOWER TO UPPER CRETACEOUS		Kld — Kw	Chemically altered (kaolinized, ferruginized and silicified) sediments	
		Winton Formation	Kw	Labile sandstone, siltstone and mudstone; in part calcareous; minor coal	
	LOWER CRETACEOUS	Rolling Downs Group: Mackunda Formation	Klm	Labile sandstone, siltstone and mudstone; in part calcareous; Coquinite	
		Allaru Mudstone	Kla	Mudstone, siltstone; in part calcareous; minor limestone	
		Toolebuc Limestone	Klo	Calcareous shale	Section only
		Wallumbilla Formation	Klu		Section only
		Coreena Member	Klc	Labile sandstone, siltstone, mudstone; in part calcareous	
		Doncaster Member	Kld	Mudstone, minor sandstone and siltstone; in part calcareous	
	UPPER JURASSIC TO LOWER CRETACEOUS	Hooray Sandstone	J-Kh	Sublabile sandstone, quartzose sandstone, conglomerate	Section only
	MIDDLE TO UPPER JURASSIC	Injune Creek Group	Ji	Siltstone, mudstone, micaceous quartzose to labile sandstone; minor lignite and coal	Section only
	LOWER JURASSIC	Hutton Sandstone	Jlh	Quartzose sandstone, minor siltstone and mudstone	Section only
			Jl	Sandstone, siltstone, mudstone	Section only
PALAEOZOIC	LOWER PERMIAN		Pl	Sandstone, siltstone, conglomerate	Section only
	UPPER DEVONIAN TO LOWER CARBONIFEROUS	Adavale Group: Buckabie Formation	D-Cb	Red sandstone, siltstone and mudstone, vari coloured in part	Section only
		Etonvale Formation	Dme	Siltstone, mudstone and sandstone in part calcareous; dolomite	Section only
	UNDIFFERENTIATED		Pz	Schist, phyllite, gneissic granite	Section only

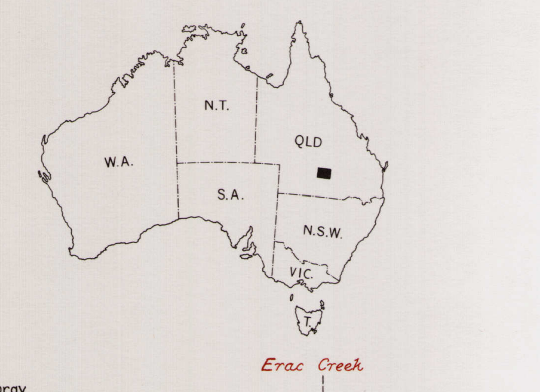
Geological boundary
Anticline } Showing plunge
Syncline } Showing plunge
Fault
Lineament
Where location of boundaries, folds and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes
Strike and dip of strata
Dip <5°; air-photo interpretation

Macrofossil locality
Plant fossil locality
CH1 Locality reference number

Dry abandoned oil exploration well
SH BMR scout hole
Abandoned water bore or well
Sub-artesian water bore or well { of post-Wallumbilla aquifer system
Sub-artesian water bore
Artesian water bore
Artesian water bore ceased to flow } of pre-Wallumbilla aquifer system
R50 refers to bore registration number of the Queensland Irrigation and Water Supply Commission records
Bore drain
E Earth tank
Dam on stream
WH Waterhole

Highway
Road
Vehicle track
Railway with station and siding
Fence
Town
"Bicton" Homestead
Airport
Landing ground
Yd Yard
Building
1140' Height in feet : datum, mean sea level
Astronomical station
(PD) Position doubtful
(abd) Abandoned

Issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Issued under the authority of the Hon. David Fairbairn, Minister for National Development. Base map compiled by the Division of National Mapping from aerial photography at 1:50,000 scale. Transverse Mercator Projection



INDEX TO ADJOINING SHEETS
Showing Magnetic Declination 1965

JUNDAH SG 54-4	BLACKALL SG 55-1	TAMBO SG 55-2	SPRINGSURE SG 55-3	BARALABA SG 55-4
WINDORAH SG 54-8	ADAVALE SG 55-5	AUGATHELLA SG 55-6	EDDYSTONE SG 55-7	TAROOM SG 55-8
EROMANGA SG 54-12	QUILPIE SG 55-9	CHARLEVILLE SG 55-10	MITCHELL SG 55-11	ROMA SG 55-12
THARGOMINDAH SG 54-16	TOOMPINE SG 55-13	WYANDRA SG 55-14	HOMEBOIN SG 55-15	SURAT SG 55-16
BULLOO SH 54-4	EULO SH 55-1	CUNNAMULLA SH 55-2	DIRRANBANDI SH 55-3	SAINT GEORGE SH 55-4

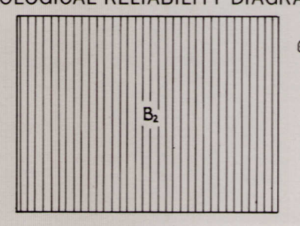
ANNUAL CHANGE 2°30'E

Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

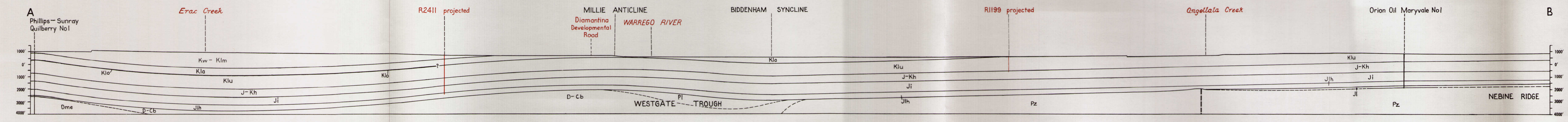
GEOLOGICAL RELIABILITY DIAGRAM



Geology B_2 General reconnaissance: many traverses and air-photo interpretation

Geology, 1968, by, B.R. Senior and D.A. Senior
Compiled, 1968, by, D.A. Senior and B.R. Senior
Cartography by, Geological Branch (B.M.R.)
Drawn by, R.D. Cooper

Section
Cainozoic sediments omitted from section
Scale $\frac{V}{H} = 4$



PRELIMINARY EDITION, 1969
SUBJECT TO AMENDMENT

NO PART OF THIS MAP IS TO BE REPRODUCED FOR PUBLICATION WITHOUT THE WRITTEN PERMISSION OF THE DIRECTOR OF THE BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS, DEPARTMENT OF NATIONAL DEVELOPMENT, CANBERRA, A.C.T.

CHARLEVILLE
SHEET SG 55-10

Complimentary

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

TOOMPINE

QUEENSLAND

SHEET SG55-13

Reference

CAINOZOIC	QUATERNARY		Q	Undiffentiated
			Qa	Alluvium: sand, silt, clay, gravel
			Qr	Sandy red earth
			Qs	Quartz sand, minor silt
			Qc	Gravel, mostly silcrete
	TERTIARY	Glendower Formation	Tg	Quartz sandstone, conglomerate, minor siltstone and mudstone, silcrete (silicified sandstone)
MESOZOIC	LOWER CRETACEOUS	Rolling Downs Group		Chemically altered (kaolinized, silicified and ferruginized) sediments. Weathered mantle
		Winton Formation	Kw	Labile sandstone, siltstone, mudstone, in part calcareous. Minor coal. Plant fossils
		Allaru Mudstone	Kla	Mudstone, minor sandstone and siltstone; in part calcareous (Section only)
		Wallumbilla Formation Coreena Member	Klc	Labile sandstone, siltstone, mudstone; in part calcareous. Cone in cone limestone, Shelly fossils
		Doncaster Member	Kld	Mudstone, minor sandstone and siltstone; in part calcareous. Cone in cone limestone, Shelly fossils
	UPPER JURASSIC TO LOWER CRETACEOUS	Hooray Sandstone	J-Kh	Sublabile sandstone, quartz sandstone conglomerate (Section only)
PALAEOZOIC			Pz	Steeply dipping, indurated sediments low grade metasediments, granite (Section only)

Geological boundary

Syncline

Anticline

Fault (U, D indicate relative movement up or down)

Where location of boundaries, folds and faults is approximate line is broken; where inferred, querried; where concealed boundaries and folds are dotted, faults are shown by short dashes

Strike and dip of strata

Dip < 5°: air-photo interpretation

Macrofossil locality

Vertebrate fossil locality

To 5 Locality reference number

Mine

Abandoned mine

Prospect

Op Opal

Abandoned water bore

Sub-artesian water bore or well — of Wallumbilla or younger aquifer system

Artesian water bore — of Wallumbilla or younger aquifer system

Artesian water bore ceased to flow — of Wallumbilla or younger aquifer system

Artesian water bore — of pre-Wallumbilla aquifer system

Artesian water bore ceased to flow — of pre-Wallumbilla aquifer system

R4542 refers to bore registered number of the Queensland Irrigation and Water Supply Commission records

E Earth tank

Dam on stream

Spring

m Mound spring

WH Waterhole

Road

Vehicle track

Fence

"Goora" Homestead

Landing ground

Building

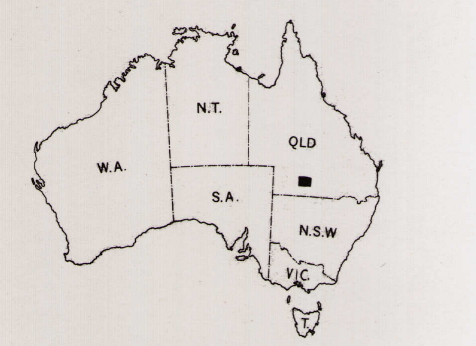
Yd Yard

·779' Height in feet, datum: mean sea level

Astronomical station

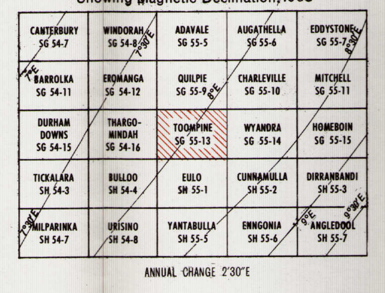
(PD) Position doubtful

Issued by the Bureau of Mineral Resources Geology and Geophsics, Department of National Development. Issued under the authority of the Hon. David Fairbairn, Minister for National Development. Base map compiled by the Division of National Mapping from aerial photography at 1:50,000 Transverse Mercator Projection



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination, 1965



Scale 1:250,000

5 0 5 10 15 MILES

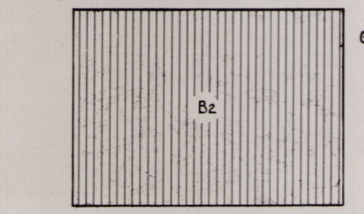
5 0 5 10 15 20 25 KILOMETRES

Section

Cainozoic sediments omitted from section

Scale: $\frac{V}{H} = 4$

GEOLOGICAL RELIABILITY DIAGRAM



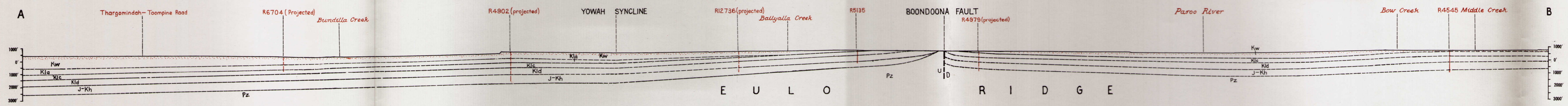
Geology B2 General reconnaissance; many traverses and air-photo interpretation

Geology, 1968, by; J.A. Ingram
Compiled, 1968, by; J.A. Ingram and D.A. Senior
Cartography, by; Geological Branch (B.M.R)
Drawn by; R. D Cooper

PRELIMINARY EDITION, 1969

SUBJECT TO AMENDMENT

NO PART OF THIS MAP IS TO BE REPRODUCED FOR PUBLICATION WITHOUT THE WRITTEN PERMISSION OF THE DIRECTOR OF THE BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS, DEPARTMENT OF NATIONAL DEVELOPMENT, CANBERRA, A.C.T.



TOOMPINE

SHEET SG55-13

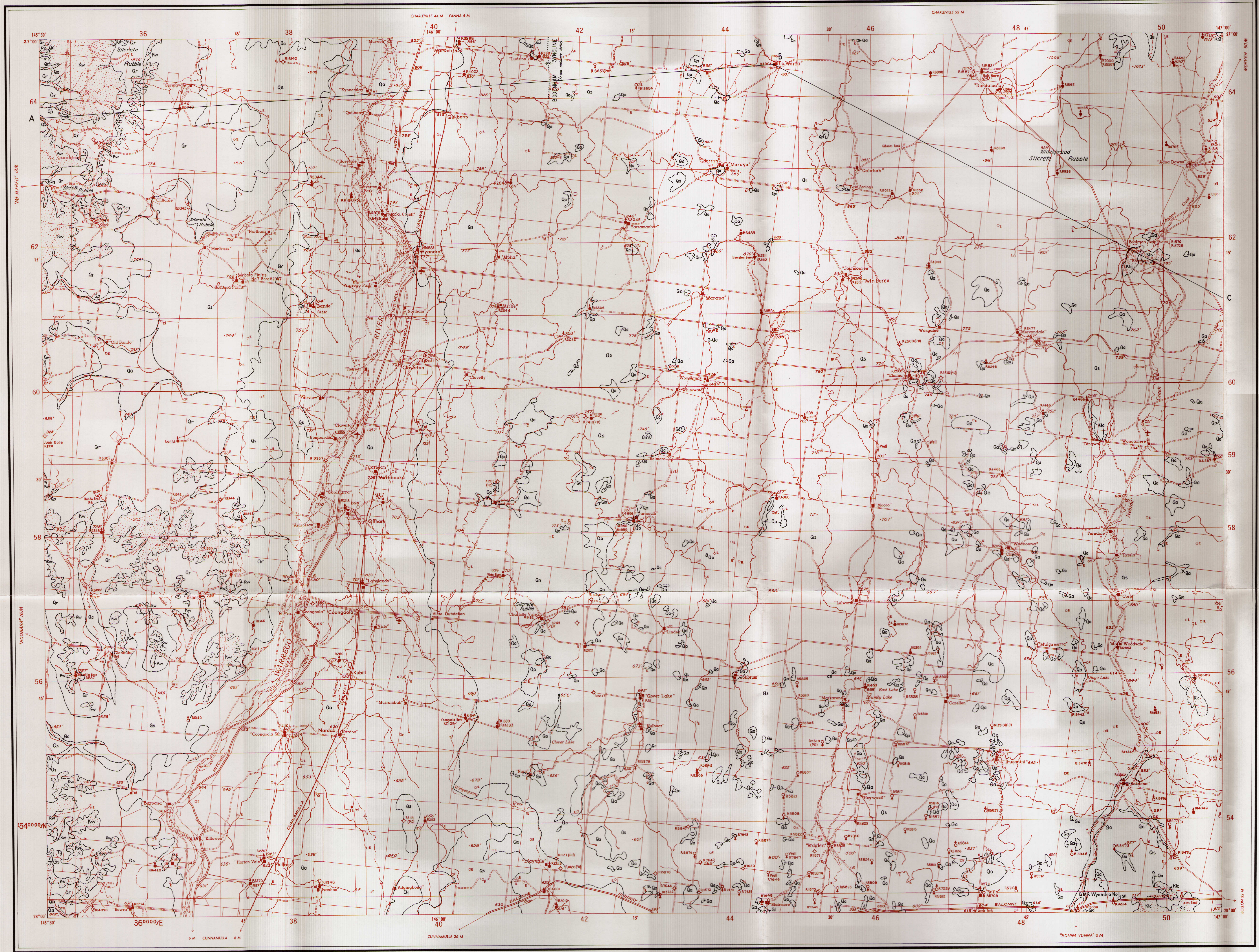
Complimentary

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

WYANDRA

QUEENSLAND

SHEET SG 55-14



Reference

CAINOZOIC	QUATERNARY		Qa	Alluvium; sand, silt, clay, gravel
			Qs	Quartz sand, silt, clay
			Qr	Sandy red earth
			Ql	Limestone
			Cz	Quartz sand, silt, clay, ironstone laminae (Section only)
	TERTIARY	Glendower Formation	Tg	Silcrete (silicified quartz sandstone) quartz sandstone, sandy conglomerate
			T	Silcrete (silicified quartz sandstone) quartz sandstone, sandy conglomerate
MESOZOIC	LOWER TO UPPER CRETACEOUS		Kld-Kw	Chemically altered (kaolinized, silicified and ferruginized) sediments
		Rolling Downs Group: Winton Formation	Kw	Labile sandstone, siltstone, mudstone, mudclast conglomerate; in part calcareous
	LOWER CRETACEOUS	Rolling Downs Group: Wallumbilla Formation, Coreena Member	Klc	Labile sandstone, some siltstone, mudstone and intraformational conglomerate
		Doncaster Member	Kld	Mudstone, minor labile sandstone
	UPPER JURASSIC TO LOWER CRETACEOUS	Hooray Sandstone	J-Kh	Sublabile sandstone, quartzose sandstone; minor siltstone, mudstone
	MIDDLE TO UPPER JURASSIC	Injune Creek Group	Ji	Siltstone, mudstone, micaceous sandstone; minor lignite and coal
PALAEOZOIC	MIDDLE DEVONIAN	Adavale Group	Da	Sandstone, siltstone, shale, volcanics
	DEVONIAN		Dg	Granite
	LOWER PALAEOZOIC		Pzl	Slate, schist

(J-Kh to Pzl: Section only)

Geological boundary

Syncline

Where location of boundaries and folds is approximate line is broken; where inferred, queried; where concealed dotted

SH Scout hole

Abandoned water bore or well

Sub-artesian water bore or well } of Wallumbilla or younger aquifer system

Artesian water bore

Sub-artesian water bore or well } of pre-Wallumbilla aquifer system

Artesian water bore

Artesian water bore, ceased to flow

R100 refers to bore registration number of the Queensland Irrigation and Water Supply Commission records

Bore drain

Spring

E Earth tank

Dam on stream

WH Waterhole

Highway

Road

Vehicle track

Railway with station

Fence

"Corfu" Homestead

Building

Landing ground

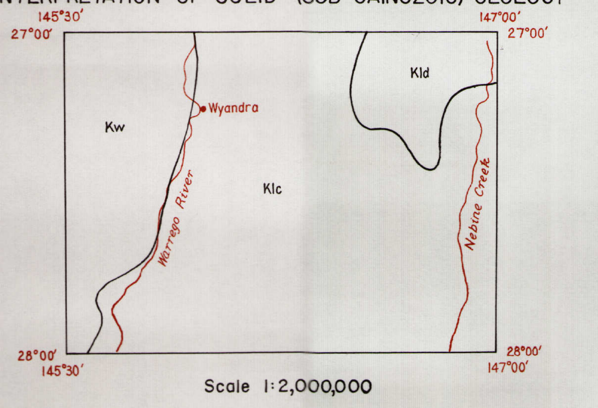
Yd Yard

·591' Height in feet; datum, mean sea level

Astronomical station

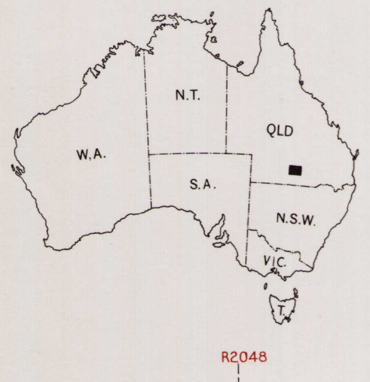
(PD) Position doubtful

INTERPRETATION OF SOLID (SUB CAINOZOIC) GEOLOGY



Scale 1:2,000,000

Issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Issued under the authority of the Hon. David Fairbairn, Minister for National Development. Base map compiled by the Division of National Mapping from aerial photography at 1:50,000 scale. Transverse Mercator Projection



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination 1965

WINDORAH SG 54-8	ADAVALE SG 55-5	AUGATHELLA SG 55-6	EDDYSTONE SG 55-7	TAROOM SG 55-8
EROMANGA SG 54-12	QUILPIE SG 55-9	CHARLEVILLE SG 55-10	MITCHELL SG 55-11	ROMA SG 55-12
THARGOMINDAH SG 54-16	TOOMPINE SG 55-13	WYANDRA SG 55-14	HOMEBOIN SG 55-15	SURAT SG 55-16
BULLOO SH 54-4	EULO SH 55-1	CUNNAMULLA SH 55-2	DIRRANBANDI SH 55-3	SAINT GEORGE SH 55-4
URISINO SH 54-8	YANTABULLA SH 55-5	ENNGONIA SH 55-6	ANGLEDOOL SH 55-7	MOREE SH 55-8

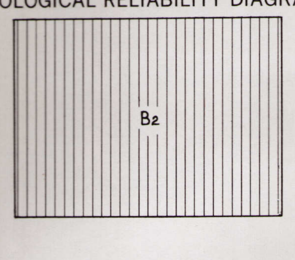
ANNUAL CHANGE 2°30'E

Scale 1:250,000

5 0 5 10 15 MILES

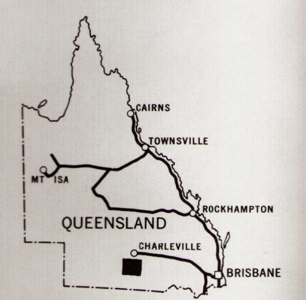
5 0 5 10 15 20 25 KILOMETRES

GEOLOGICAL RELIABILITY DIAGRAM



Geology B2 General reconnaissance: many traverses, and air-photo interpretation

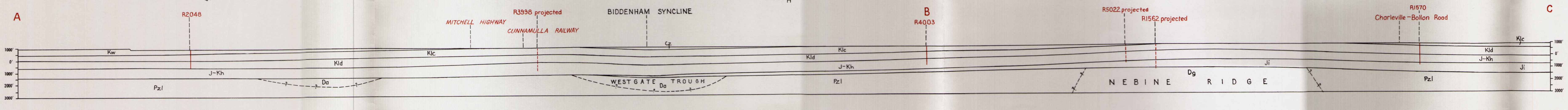
Geology, 1968, by, B.M.Thomas
Compiled, 1968, by, B.M.Thomas and D.A.Senior
Cartography by, Geological Branch, B.M.R.
Drawn, 1969, by, R.D.Cooper



Section

Superficial cainozoic sediments omitted from section

Scale: $\frac{V}{H} = 4$



PRELIMINARY EDITION, 1969

SUBJECT TO AMENDMENT

NO PART OF THIS MAP IS TO BE REPRODUCED FOR PUBLICATION WITHOUT THE WRITTEN PERMISSION OF THE DIRECTOR OF THE BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS, DEPARTMENT OF NATIONAL DEVELOPMENT, CANBERRA, A.C.T.

WYANDRA

SHEET SG 55-14

Complimentary

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

EULO

QUEENSLAND

SHEET SH 55-1

Reference

CAINOZOIC	QUATERNARY		Q	Undifferentiated
			Qa	Alluvium: sand, silt, clay, minor gravel
			Qs	Quartz sand
			Qc	Gravel, mostly silcrete
			Qr	Sandy red earth, minor gravel
		Undifferentiated	Cz	Quartz sand, conglomerate, silt, clay (Section only)
	TERTIARY	Glendower Formation	Tg	Silcrete (silicified quartz sandstone) quartz sandstone, conglomerate
MESOZOIC	LOWER TO UPPER CRETACEOUS	Rolling Downs Group	Klu-Kw	Chemically altered (kaolinized, silicified and ferruginized) sediments
		Winton Formation	Kw	Labile sandstone, siltstone and mudstone; in part calcareous; minor coal
	LOWER CRETACEOUS	Allaru Mudstone	Kla	Mudstone, minor calcareous labile sandstone (Section only)
		Wallumbilla Formation	Klu	(Section only)
		Coreena Member	Klc	Labile sandstone, siltstone, mudstone; in part calcareous (Section only)
		Doncaster Member	Kld	Mudstone, minor sandstone and siltstone; in part calcareous
	UPPER JURASSIC TO LOWER CRETACEOUS	Hooray Sandstone	J-Kh	Sublabile sandstone, quartz sandstone, conglomerate (Section only)
PALAEOZOIC	MIDDLE DEVONIAN		Dmg	Granite, adamellite, minor quartz veins, pegmatite, schist
	LOWER PALAEOZOIC		Pzl	Schist, phyllite (Section only)

Geological boundary

D / U Fault (D,U indicate relative movement down or up)

Lineament

Where locality of boundaries, and fault is approximate, line is broken, where inferred, queried; where concealed, boundaries are dotted, faults are shown by short dashes

Dip < 5° ; air-photo interpretion

Macrofossil locality

Eu I Fossil locality reference number

Abandoned mine

·Op Minor mineral occurrence,

Op Opal

Au Gold

SH B.M.R scout hole

Abandoned water bore or well

Sub-artesian water bore or well: of post Wallumbilla aquifer system

Artesian water bore

Artesian water bore ceased to flow

of pre Wallumbilla aquifer systems

R5603 refers to bore registration number of the Queensland Irrigation and Water Supply Commission records

Bore drain

Spring

m Mound spring

E Earth tank

Dam on stream

WH Waterhole

Road

Vehicle track

Fence

Settlement

"Gumaha" Homestead

Landing ground

Building

Yd Yard

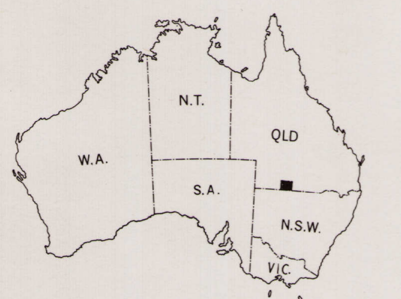
State boundary

Astronomical station

·646′ Height in feet; datum: mean sea level

(PD) Position doubtful

Issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Issued under the authority of the Hon. David Fairbairn, Minister for National Development. Base map compiled by the Division of National Mapping from aerial photography at 1:50,000 scale. Transverse Mercator Projection



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination 1965

BARROLKA SG 54-11	EROMANGA SG 54-12	QUILPIE SG 55-9	CHARLEVILLE SG 55-10	MITCHELL SG 55-11
DURHAM DOWNS SG 54-15	THARGO-MINDAH SG 54-16	TOOMPINE SG 55-13	WYANDRA SG 55-14	HOMEBOIN SG 55-15
TICKALARA SH 54-3	BULLOO SH 54-4	EULO SH 55-1	CUNNAMULLA SH 55-2	DIRRANBANDI SH 55-3
MILPARINKA SH 54-7	URISINO SH 54-8	YANTABULLA SH 55-5	ENNGONIA SH 55-6	ANGLEDOOL SH 55-7
COBHAM LAKE SH 54-11	WHITE CLIFFS SH 54-12	LOUTH SH 55-9	BOURKE SH 55-10	WALGETT SH 55-11

ANNUAL CHANGE 2′30″E

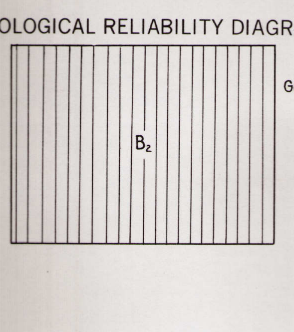
Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

Geology, 1968, by: B.R. Senior, J.A. Ingram and D.A. Senior
Compiled, 1966, by: D.A. Senior, B.R. Senior and J.A. Ingram
Cartography by Geological Branch (B.M.R.)
Drawn by: R.D. Cooper

GEOLOGICAL RELIABILITY DIAGRAM



Geology B_2 General reconnaissance; many traverses and air-photo interpretation

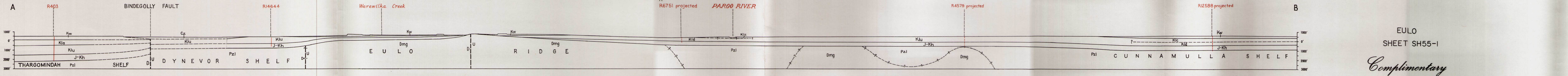
PRELIMINARY EDITION, 1969

SUBJECT TO AMENDMENT

NO PART OF THIS MAP IS TO BE REPRODUCED FOR PUBLICATION WITHOUT THE WRITTEN PERMISSION OF THE DIRECTOR OF THE BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS, DEPARTMENT OF NATIONAL DEVELOPMENT, CANBERRA, A.C.T.

Section

Superficial cainozoic sediments omitted from section



EULO

SHEET SH55-1

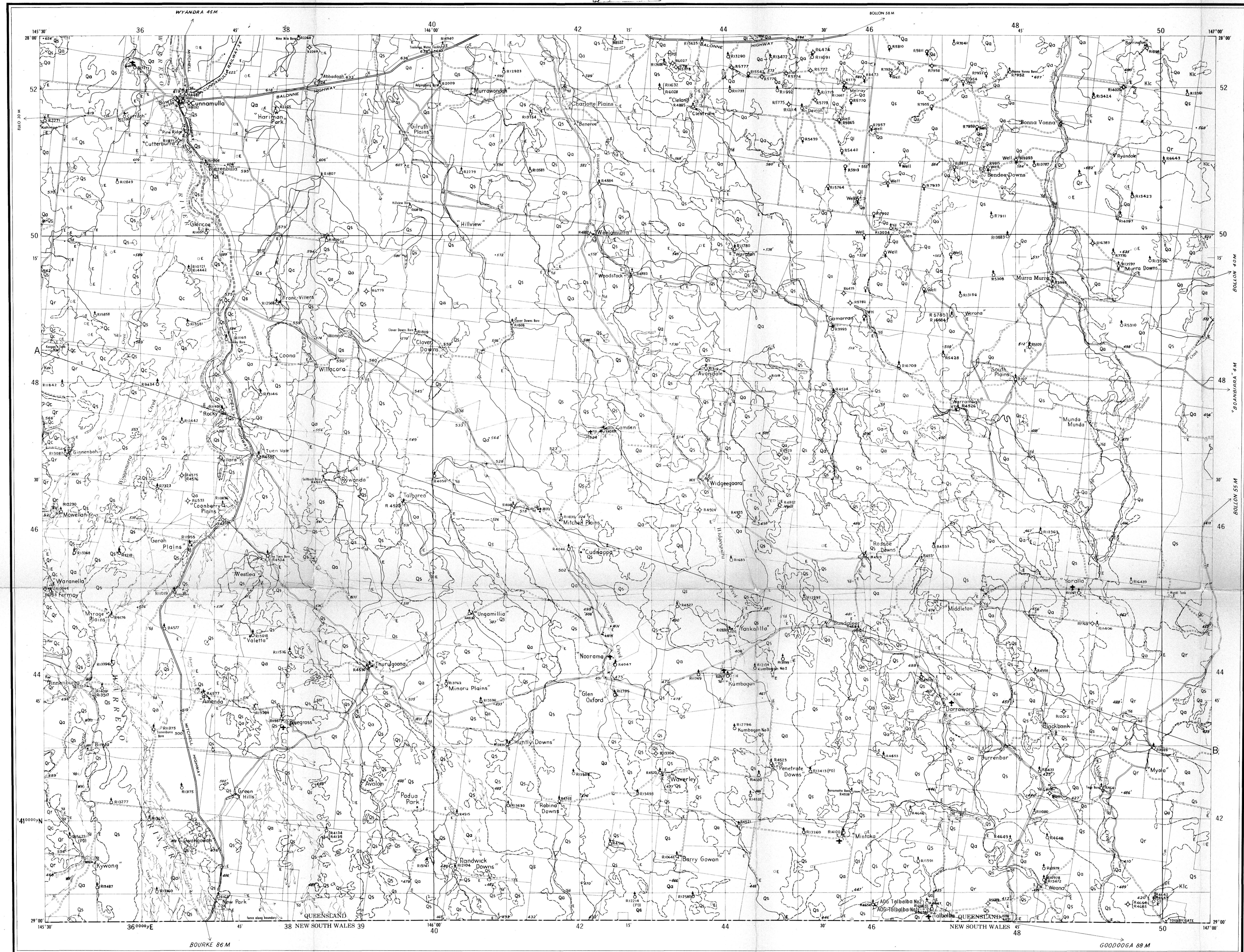
Complimentary

CUNNAMULLA

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

CUNNAMULLA
QUEENSLAND

SHEET SH 55-2



Reference

CAINOZOIC	QUATERNARY		Qa	Alluvium: sand, silt, clay, gravel
			Qs	Quartz sand, argillaceous sand, minor red earth
			Qr	Sandy red earth, minor gravel
			Qc	Gravel, mostly silcrete
			Ql	Limestone
MESOZOIC	LOWER TO UPPER CRETACEOUS		Klc-Kw	Chemically altered (Kaolinized, silicified and ferruginized) sediments
		Rolling Downs Group: Winton Formation	Kw	Labile sandstone, siltstone, mudstone, in part calcareous
	LOWER CRETACEOUS	Wallumbilla Formation: Coreena Member	Klc	Labile sandstone, siltstone, mudstone and intraformational conglomerate
		Doncaster Member	Kld	Mudstone, minor calcareous labile sandstone (Section only)
	UPPER JURASSIC TO LOWER CRETACEOUS	Hooray Sandstone	J-Kh	Quartzose to labile sandstone, some siltstone and mudstone (Section only)
PALAEOZOIC	LOWER PALAEOZOIC		Pzl	Slate, schist, phyllite (Section only)

Geological boundary

Oil exploration well, dry, abandoned

R14532 Artesian bore, flowing

Artesian bore, ceased to flow

Sub-artesian bore

Abandoned bore or well

R14532 refers to bore registered number of the Queensland Irrigation and Water Supply Commission records

E Earth tank or dam

Dam on stream

WH Waterhole

WH Waterhole on stream

m Mound spring

Bore drain

Highway

Road

Vehicle track

Railway with station

Landing ground

"Mintaka" Homestead

Building

Yd Yard

Fence

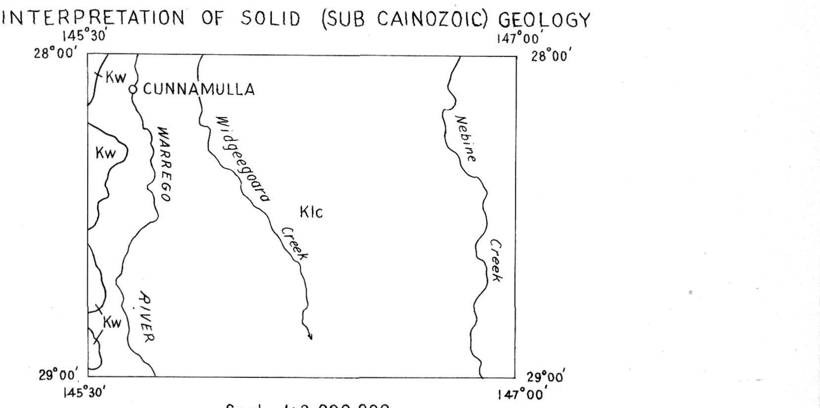
State boundary

Astronomical station

·469′ Elevation in feet, barometric, datum: mean sea level

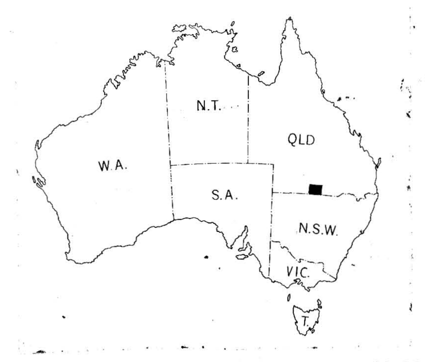
(PD) Position doubtful

INTERPRETATION OF SOLID (SUB CAINOZOIC) GEOLOGY



Scale 1:2,000,000

Issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Issued under the authority of the Hon. David Fairbairn, Minister for National Development. Base map compiled by the Division of National Mapping from aerial photographs at 1:50,000 scale. Transverse Mercator Projection



INDEX TO ADJOINING SHEETS
Showing Magnetic Declination (1965)

EROMANGA SG 54-12	QUILPIE SG 55-9	CHARLEVILLE SG 55-10	MITCHELL SG 55-11	ROMA SG 55-12
THARGOMINDAH SG 54-16	TOOMPINE SG 55-13	WYANDRA SG 55-14	HOMEBOIN SG 55-15	SURAT SG 55-16
BULLOO SH 54-4	EULO SH 55-1	CUNNAMULLA SH 55-2	DIRRANBANDI SH 55-3	SAINT GEORGE SH 55-4
URISINO SH 54-8	WANTABULLA SH 55-5	ENNGONIA SH 55-6	ANGLEDOOL SH 55-7	MOREE SH 55-8
WHITE CLIFFS SH 54-12	LOUTH SH 55-9	BOURKE SH 55-10	WALGETT SH 55-11	NARRABRI SH 55-12

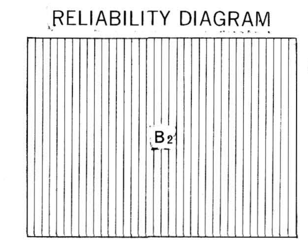
ANNUAL CHANGE 2′30″

Scale 1:250,000

5 0 5 10 15 MILES

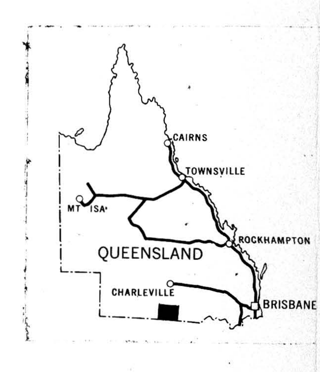
5 0 5 10 15 20 25 KILOMETRES

RELIABILITY DIAGRAM

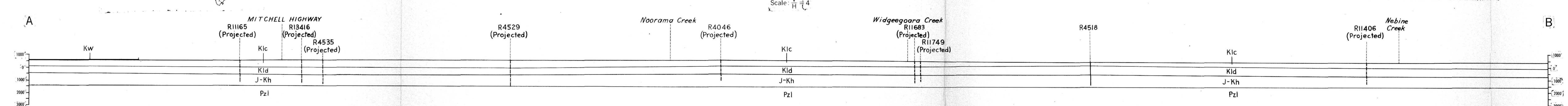


Geology B2 General reconnaissance; many traverses and air-photo interpretation

Geology 1968 by B.M.Thomas
Compiled 1968 by B.M.Thomas and D.A.Senior
Cartography by Geological Branch (B.M.R.)
Drawn by D.E.Brentnall



Section
Cainozoic sediments omitted
Scale V/H 14



PRELIMINARY EDITION 1969
SUBJECT TO AMENDMENT
NO PART OF THIS MAP IS TO BE REPRODUCED FOR PUBLICATION WITHOUT THE WRITTEN PERMISSION OF THE DIRECTOR OF THE BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS, DEPARTMENT OF NATIONAL DEVELOPMENT, CANBERRA, A.C.T.

CUNNAMULLA
SHEET SH 55-2

Complimentary