COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF
NATIONAL DEVELOPMENT

BUREAU OF MINERAL
RESOURCES, GEOLOGY
AND GEOPHYSICS

Record 1972/53

THE POST-PALAEOZOIC ROCKS OF THE DALBY-GOONDIWINDI AREA, QUEENSLAND AND NEW SOUTH WALES

by

N.F. Exon, A. Mond, R.F. Reiser* and D. Burger

(*Geological Survey of Queensland)

THE POST-PALAEOZOIC ROCKS OF THE DALBY-GOONDIWINDI AREA, QUEENSLAND AND NEW SOUTH WALES

by

N.F. Exon, A. Mond, R.F. Reiser* and D. Burger

(* Geological Survey of Queensland)

Record 1972/53

CONTENTS

SUMMARY

Pre-Permian rocks, deformed in the Kanimblan Orogeny and planed by erosion late in the Carboniferous, crop out in the Texas High in the southeast of the area, and form basement to little disturbed younger sediments in most of the area. A 1000 m sequence of Lower Permian marine sediments and volcanics and Upper Permian coal measures was deposited in the meridional Taroom Trough in the west. During the Permo-Triassic Hunter-Bowen Orogeny, basement and Permian rocks were uplifted in the Texas High and along its northerly extension, the Kumbarilla Ridge, and granites were emplaced in the southeast.

In Triassic times the Kumbarilla Ridge separated a western basin in which up to 1500 m of sediment was deposited (Taroom Trough of the Bowen Basin), from an eastern basin in which up to 1000 m of volcanics and sediment was deposited (Cecil Plains Syncline of the Ipswich-Moreton Basin).

After the Permo-Triassic Bowen Basin sequence in the west had been somewhat eroded, Surat Basin deposition began in the Lower Jurassic. The basal sands lapped onto the Kumbarilla Ridge, and thereafter sedimentation was continuous and similar in both Surat and Moreton Basins.

The Jurassic to lowermost Cretaceous (Neocomian) sediments, up to 2000 m thick, comprise clayey quartz-rich sandstone sequences alternating with labile sandstone, siltstone, and mudstone sequences, and were mostly deposited by streams or in deltas.

In the late Lower Cretacecus up to 1000 m of Aptian and Albian lithic sandstone, siltstone and mudstone were laid down in shallow marine, deltaic, and freshwater environments. Debris was probably largely provided by contemporary intermediate volcanics.

After the sea withdrew, the area was planed and deeply weathered in thelate Cretaceous and early Tertiary. As much as 100 m of Cainozoic stream sediments were laid down on either side of the Kumbarilla Ridge which formed a topographic high, and up to 150 m of basalt filled low areas in the east and south. Stream erosion and deposition has continued until the present day.

Although 100 petroleum exploration wells have been drilled, the only producing field is Moonie, which had a cumulative production to the end of 1971 of 16 million barrels of oil. The production is from the Lower Jurassic Precipice Sandstone.

Subartesian and artesian water is obtained from Jurassic and Lower Cretaceous sandstones in numerous bores; some water is too saline for human consumption, but all is suitable for stock. Stock water is also drawn from the alluvium of the Condamine River system. Basalt, quarried in the northeast, is used for aggregate and road metal.

INTRODUCTION

The Dalby and Goondiwindi 1:250,000 Sheet areas were mapped by Bureau of Mineral Resources and Geological Survey of Queensland geologists in 1968. N.F. Exon (party leader, BMR), A. Mond (BMR), and R.F. Reiser (GSQ) mapped the Dalby Sheet area and A. Mond and D. Burger (BMR) mapped the Goondiwindi Sheet area. J. Rivereau (1966) and C. Maffi (1968) prepared preliminary photo-geological maps of the Dalby and Goondiwindi areas, and D. Burger and E. Kemp investigated the palynology of samples from bores (see Appendices 3, 4, 5, and Burger, 1968). Plant collections were reported on by M. White (1969).

The area mapped is part of the eastern margin of the Mesozoic Surat Basin. Basement rocks of the Palaeozoic Texas High crop out on the eastern third of the Goondiwindi Sheet area, and on Dalby Sheet area lies the problematical boundary between the Ipswich-Moreton and Surat Basins. The regional dip is very gentle to the west, except in the west of the Sheets where dips steepen slightly into the meridional Mimosa Syncline, the axis of which is to the west of the area mapped. Extensive deep weathering has obscured the lithological differences between units over much of the area. There are several areas of Tertiary sediments, and alluvium covers about half of the area mapped.

The alluvial plains of the Condamine River system support a rich farming industry, wheat being the main cash crop. Other crops are grown, both as cash crops, and for fodder on mixed farms. Cotton is produced around Cecil Plains. Dairying is the main activity in the hilly northeastern corner of the Dalby Sheet area. Both sheep and cattle are grazed on the poorer sandy country of the central part of the Sheet area, which is predominantly forestry reserve; the small areas of good soil are normally ploughed for feed crops. There are several timber mills in this area. On the black soil plains of the western third of the Sheets wheat farming is generally combined with sheep raising.

On Goondiwindi Sheet most properties have diversified from sheep raising into wheat growing and cattle fattening, but sheep raising remains the dominant industry towards the west. Cattle are grazed on the more rugged eastern area where basement crops out, and where forestry reserves are common.

The main centres of population are Dalby (population 9000) and Goondiwindi (population 3500). There are commercial airline flights from both these centres to the coast. Dalby lies on the Western Highway linking Brisbane and Roma; Goondiwindi is on the Cunningham Highway, extending from Brisbane through Warwick, and is the northern terminal of the Newell and Bruxner Highways from the south. The Condamine Highway, between Dalby and Roma, traverses the central northern part of the area. The Moonie Highway, sealed for most of its length, crosses Dalby Sheet area from Dalby in the northeast to the southwestern corner and thence west to St George. The Surat Development Road links Dalby with Tara and, via Meandarra and Glenmorgan west of this area, with Surat. Millmerran (population 1,100) is linked by sealed road with Toowoomba. Sealed roads are common around Dalby, where population density is fairly high; they are less common around Goondiwindi, but main access roads are generally sealed. Formed roads give good access throughout the area mapped. All formed but unsealed roads in black soil areas are passable only with difficulty after heavy rain; light rain renders unformed roads impassable. Many secondary tracks in forestry reserves can be traversed only by four-wheel-drive vehicles because of deep loose sand; main tracks through forestry areas, are, however, excellent. The Western

Railway links Dalby with Toowoomba and Chinchilla. Another line connects Dalby to Glenmorgan, and other lines run from Millmerran and Cecil Plains to Toowoomba. A railway line runs across Goondiwindi Sheet from Warwick to Goondiwindi and thence to Dirranbandi. A branch line connects Texas to Inglewood. In New South Wales a line runs from Bogabilla to Moree south of this area.

Air-photographs taken by Adastra Airways in 1963 at an approximate scale of 1:83 000 are available for the whole area. Planimetric maps of the two Sheet areas, at a scale of 1:250 000, are currently being produced by the Royal Australian Survey Corps and were used as bases for the geological maps.

Water supplies are obtained by bores from various aquifers. In general they are pumped from shallow depths, but there are a few flowing bores in the west. Earth tanks and dams are particularly common in the north and east.

Details of 8 shallow stratigraphic holes drilled during the field season, and their grid references are given in Exon (1972). Graphic logs are shown in Figures 6-12. Cores and cuttings are stored at the Bureau of Mineral Resources Core and Cuttings Laboratory, Fyshwick, A.C.T.

Plant fossil collections were described by White (1969) and are stored at the Bureau of Mineral Resources. Localities given in brackets thus (320540) refer to the 10 000 yard military grid shown on the 1:250 000 Sheets.

Nomenclature

Crook's (1960) classification of arenites is followed with slight modification. 'Arenite' is used as the generalized non-genetic term for sand-sized clastic material. The generally accepted arbitrary figure of 75% matrix is taken as the division between arenite and mudstone. All the arenites described fall into Crook's genetic subdivision of 'sandstone' - traction current deposits. Sandstones in which quartz form more than 90% of the clasts are called 'quartzose'; 75-90%, 'sublabile'; less than 75%, 'labile'; and less than 30%, 'very labile'. If the feldspar:lithics ratio is greater than 3:1, or less than 1:3 respectively, the qualifying terms 'feldspathic' or 'lithic' can be used with 'sublabile sandstone'; 'labile sandstone' can be 'feldspathic sandstone' or 'lithic sandstone'; and very labile sandstone can be 'very feldspathic' or 'very lithic'.

'Siltstone' is used as a grainsize term (1/16 to 1/56 mm). The term 'mudstone' is used as a general term for non-fissile sediments of the lutite class, and 'shale' is defined as a fissile mudstone. 'Claystone' is used for sediment consisting dominantly of clay minerals.

The Wentworth Scale has been followed for grainsize terminology (Pettijohn, 1957).

PREVIOUS INVESTIGATIONS

Geological investigations

The first geological mapping on Dalby and the Queensland part of Goondiwindi Sheet areas was by R.L. Jack in 1894. Using the three-fold subdivision of the Mesozoic then current, he mapped 'Ipswich Beds', 'Blythesdale', and 'Rolling Downs'. His 'Ipswich Beds'correspond very roughly with the Marburg Sandstone of the present mapping. He mapped a 'Blythesdale' - 'Rolling Downs' boundary which approximates to the contact between deeply weathered and normal Kumbarilla Beds. He later used this mapping as a basis for a discussion of artesian water in inland Queensland (Jack, 1895).

Jackson (1902) examined a coal occurrence at Bringalilly Creek, parish of Murgimarry, near Inglewood; he placed the coal in the Ipswich beds (now mapped as Marburg), and concluded that it was of too poor quality for economic use. Wade (1941) mentioned Mesozoic rocks overlying Palaeozoic basement in the Inglewood area.

Whitehouse (1954) gave an account of underground water resources and potential in the Great Artesian Basin, presenting a synthesis of general structure and stratigraphy. He followed previous workers in his stratigraphic subdivision on the area mapped. Whitehouse's broad picture of the geology differs little from the present one. In his report, he suggested that the line of the Weir River (roughly the Goondiwindi-Moonie Fault) marked a geological change: southeast of this line, abundant supplies of water were obtained at shallow depth; northwest, supplies at shallow depth were small. It is possible that this difference reflects the contrast between coarser, cleaner, porous sediments deposited in the shelf environment around the structural high, and finer, less porous sediments deposited farther from source in the Mimosa Syncline.

A summary report by Mott (1954) gave a general picture of the geology which agrees closely with that presented here. In a more detailed report, Laing & Allen (1955, unpubl.) defined three formations, two of which occur in the Goodiwindi and Dalby Sheet areas; these are the ?Jurassic to Lower Cretaceous 'Moonie Formation' and the Lower Tertiary Glenmorgan Formation. Thomas & Reiser (1968) showed the Glenmorgan Formation to be part of the deep weathering profile developed on the Mesozoic sediments. The 'Moonie Formation' is thought to be the Kumbarilla Beds of current mapping.

Isbell (1957) studied the soils of a region which included most of the area mapped. In his discussion of the geology, he used a fourfold subdivision of the Mesozoic: Bundamba Group, Walloon Coal Measures, Blythesdale Group, and Rolling Downs Group. He also proposed and defined a new Cainozoic unit, the Moonie Formation, a completely different unit from that of Laing & Allen (1955). All of Isbell's Bundamba Group, and most of his Walloon Coal Measures which rest on basement, have now been mapped as Marburg Sandstone. Isbell's Blythesdale Group is the Kumbarilla Beds and, in the area mapped, his Rolling Downs Group corresponds with the Griman Creek Formation. Isbell's Moonie Formation is of such limited extent that it does not warrant, on the regional scale at least, separation from the other Tertiary sediments.

In a later paper (Isbell, 1962), the same author dealt specifically with soils which supported a brigalow-dominated tree community. He found two main categories of soil: deep gilgaied clay soil confined, almost without exception, to the alluvial plains of the western part of the area mapped, and sedentary clay soils confined to areas of Walloon Coal Measures outcrop, or areas closely underlain by Walloon sediments.

A photogeological interpretation by Bell (1962) showed the Blythesdale to cover much the same area as our Kumbarilla Beds; his 'Jw' (Walloon Coal Measures) in the south covers much of the area now regarded as basal Jurassic Marburg Formation.

Mack (1963) included the area mapped in a survey of the southern part of the Surat Basin. He used four formations within his Artesian Group, with gradational boundaries between each formation and the next:

Roma Formation (our Griman Creek Formation): marine sandstone and shale

Blythesdale Formation (our Kumbarilla Beds): quartzose sandstone

Walloon Formation: coal and shale

Bundamba Formation (our Marburg Sandstone): continental quartz clastics

Where the Mesozoic rocks onlapped the New England Batholith, he used one name, the Intake Formation, arguing that thinning of the sequence, progressive transgression, and consequent facies changes made the unit indivisible. Mack equated the sandstone and conglomerate onlapping the northern end of the New England Batholith with the upper parts of the Bundamba Formation mapped elsewhere. The overlying fine-grained Walloon Formation was said to be 'progressively overlapped and partly replaced by a sandstone facies mapped as part of the Blythesdale', to the south of Millmerran.

Mack (1963) named the Weir Lineament (see also Whitehouse, 1954, above), which he saw in surface expression as the line of demarcation between an area to the northwest with abundant development of Tertiary and Quaternary sediments and an area to the southeast where soil and alluvium are the only representatives of the Cainozoic. Mack postulated that the Brisbane-Darling Shear Zone, Weir Lineament, and Weir Inlier, occurring on St George Sheet to the west, extended across the western part of this area. However, their presence has not been confirmed by later seismic surveys (Senior, 1971). The Weir Inlier is part of a much larger area where Cretaceous sediments protrude through extensive Cainozoic deposits.

Keller (1960) discussed the Cabawin Trend, Mack (1964 a, b, c) the Moonie and Crowder-Weir Trends and the Undulla Nose, and Mack & Keller (1965) the Crowder-Moonie area. Both Keller and Mack were Union Oil Development geologists and these reports refer to essentially subsurface features.

McDougall & Wilkinson (1967) discussed the results of isotopic dating of basalts in New South Wales. Small outcrops of basalt belonging to their 'Central Province' occur on southern Goodiwindi Sheet. Webb, Stevens & McDougall (1967) dated the Main Range basalts near Toowoomba; they extend onto northeastern Dalby Sheet. Both basalt areas are probably of Oligocene-Miocene age.

TABLE 1: GEOPHYSICAL SURVEYS

AREA	TYPE OF SURVEY (Duration)	ORGANIZATION AND CONTRACTOR	REFERENCE
Surat Basin	Seismic reconnaissance	BMR	Lodwick & Watson, 1960
* Surat - Bowen Basin	Aeromagnetic	Union, Adastra Airways	Adastra Airways, 1960
Surat Basin	Magnetometer	Union	Not Subsidised, 1960
Cabawin Area	Seismic	Union, United	Sloat, 1960
Dalby	Seismic (January - May 1961)	Phillips, Geo Surveys	Not subsidized, 1961
Dalby	Seismic (January, February 1962)	Phillips, AGP	Not subsidised, 1962
Moree - Miles	Aeromagnetic	Union, United	Kahanoff, 1962a
Moonie	Seismic	" "	" 1962b
Miles - Dulacca	Seismic	" "	" 1962c
Surat Basin	Seismic reconnaissance, 1960	BMR	Smith & Lodwick, 1962
* Southern Surat Basin	Seismic, 1961	BMR	Lodwick & Bigg-Wither, 1962
Kogan	Seismic (Nov. 1961 - Jan, 1962) (February, 1962) (May - June, 1962)		Fjelstul & Beck, 1963
Dunmore	" (March - May, 1962)	Phillips, AGP	"
Dunmore	" (February - July, 1962)	Phillips, Petty	"
Kumbarilla	" (May - June, 1962)	Phillips, Petty	Not subsidized, 1962
Kumbarilla	" (August - Sept, 1962)	" "	Fjelstul & Beck, 1963
Cecil Plains	" (May - September, 1962)	" "	"
Cecil Plains	" (July - October, 1962)	" "	"
Cecil Plains	" (February - December, 1962)	Phillips, AGP	"
Cecil Plains	" (January, 1963)	" "	Not subsidized, 1963
Cecil Plains (Extension)	" (January - February, 1963)	" "	Fjelstul & Beck, 1963
* Surat - Bowen Basin	Aeromagnetic	Union, Aero Services Ltd	Aero Service Ltd, 1963
+ McIntyre	Seismic	Union	Kahanoff, S., 1963
* Middle Creek	Seismic	Union, United	Maureira, 1963
* Moonie River	Seismic	" "	Butcher, 1964
Tipton	Seismic (November 1964 - Jan. 1965)	Phillips, AGP	Tallis & Fjelstul, 1965
* Surat Shelf, Flinton & Goondiwindi - St George	Seismic	Union, United	Nickerson, 1965
Central & Southern Queensland	Gravity readings across seismic traverses	BMR	Darby, 1965
Surat Basin, Qld, N.S.W.	" " " " "	BMR	Gibb, 1965
Southern Queensland	Reconnaissance Gravity, using helicopters	BMR, Wongela	Lonsdale, 1965
* Boolooroo	Seismic	Union, United	Nickerson, 1967
* North-Eastern N.S.W. & South-Eastern Queensland	Regional Gravity	BMR	Langron & Van Son, 1967
Dalby 1:250,000	Bouguer Anomalies	BMR	BMR, 1967
* Northern N.S.W. & Southern Queensland	Reconnaissance Helicopter Gravity, 1968	BMR	Darby, 1969
Horrane	Seismic (April - May, 1970)	Amalgamated, GSI	Haskett & Buckley, 1970

AGP - Australian Geo Prospectors; Amalgamated - Amalgamated Petroleum Exploration P.L.; Petty - Petty Geophysical Engineering Co.; Phillips - Phillips Petroleum (Aust.) P.L.; Union - Union Oil Development Corp.; Union - United Geophysical Corp.; Wongela - Wongela Geophysical P.L.

* Dalby and Goondiwindi Sheet areas.

\+ Goondiwindi Sheet area.

N.B. All other surveys are confined to Dalby Sheet area.

TABLE 2: PETROLEUM EXPLORATION WELLS IN DALBY SHEET AREA TO THE END OF 1971

COMPANY : NAME	Year	Location Latitude	Longitude	Total Depth (m)	Hydrocarbons	Interval	Status	Compl. Report GSQ Librar
AMALGAMATED PETROLEUM EXPLORATION								
Horrane 1 *	1970	27 33	151 14	1 329			Plugged and abandoned	-
AUSTRALIAN ROMA OIL								
20 (Dalby)	1935	27 11	151 16	1 080			Converted to water well	-
PHILLIPS - SUNRAY								
Cecil Plains 1 *	1963	27 32	151 15	1 677			Plugged and abandoned	1318
Cecil Plains South 1 *	1965	27 36	151 13	1 118			" "	1798
Cecil Plains West 1 *	1965	27 33	151 10	1 162			" "	1688
Dunmore Creek 1	1965	27 33	150 48	1 366			" "	-
Durabilla 1 *	1962	27 33	150 52	1 328			" "	978
Durabilla West 1 *	1963	27 34	150 47	1 350			" "	1252
Kogan 1 *	1962	27 05	150 48	1 048			" "	1006 PSSA 5[illegible]
Kogan South 1 *	1962	27 09	150 48	1 073			" "	1026 PSSA 5[illegible]
Kumbarilla 1 *	1963	27 26	150 47	267				1276
Kumbarilla 1A	1963	27 26	150 47	1 230			Converted to water well above 258 m	-
Kumbarilla East 1	1965	27 21	150 50	1 307			Converted to water well	-
Millmerran 1 *	1965	27 47	151 15	585			Plugged and abandoned	1755
Station Creek 1	1965	27 47	150 59	1 031			" "	-
Tinker Creek 1 *	1963	27 45	150 48	1 282			" "	1237
Tipton 1 *	1965	27 24	151 12	1 165			" "	1664
Waggaba 1 *	1963	27 42	150 55	1 227			" "	1233
Wilkie 1	1965	27 46	150 55	1 206	Methane 427-907 m	Birkhead Formation Hutton Sandstone	" "	-
Yarrala 1 *	1965	27 07	151 11	901			" "	1643
Zig Zag 1 *	1963	27 53	150 56	1 677			" "	1258
UNION - KERN - A.O.G.								
Bennett 1	1965	27 13	150 13	1 744	1 625-1 632 m Gas to surface 35 min. at 30 Mcf/d, 1 311 m 43° oil.	Precipice Sandstone	Shut in and suspended as oil and gas producer	1828
Bennett 2	1965	27 13	150 14	1 728	Oil traces 1 595-1 601 m and 1 649-1 653 m	" "	Converted to water well	-
Bennett North 1	1966	21 12	150 13	1 710			Plugged and abandoned	2039
Booroondoo 1 *	1964	27 52	150 21	1 778			" "	1479
Braemar 1	1965	27 17	150 42	1 343			Converted to water well	1579
Brigalow Creek 1*	1964	27 37	150 20	1 761			Plugged and abandoned	1367
Cabawin 1 *	1961	27 28	150 11	3 668	62 b/d, 534 Mcf/d from 21 cm sandstone in top Blackwater Group	Blackwater Group. Other minor shows at various levels	Suspended oil and gas well	699 PSSA 43
Cabawin 2	1963	27 29	150 12	3 156	205 Mcf/d from 3 085-3 092 m		Plugged and abandoned	-
Cabawin East 1 *	1961	27 29	150 15	3 685	Minor gas shows, scattered fluorescence from 1 942 m to TD	Rewan Formation Blackwater Group Back Creek Group	" "	900 PSSA 44
Cobbareena 1 *	1963	27 06	150 17	1 576			Converted to water well	1486
Condamine 1 *	1964	27 02	150 18	1 529			Plugged and abandoned	1517
Cooloomala 1 *	1964	27 03	150 16	1 522			" "	1486
Crowder 1 *	1962	27 53	150 16	1 782			Converted to water well from Kumbarilla Beds	1053
Crowder East 1	1964	27 53	150 17	1 680			Converted to water well	1372
Crowder North 1 *	1964	27 52	150 15	1 739			Plugged and abandoned	1479
Crowder South 1	1964	27 54	150 17	1 615			" "	1338

Table 2: (Continued)

COMPANY : NAME			Location Latitude		Longitude		Total Depth (m)	Hydrocarbons	Interval	Status	Compl. Report GSQ Library
Currajong 1		1965	27	55	150	13	1 872			Converted to water well	1677
Davidson 1		1965	27	12	150	10	541			" " "	1700
Dockerill 1	*	1964	27	51	150	17	1 831			" " "	1479
Goodar Road 1		1964	27	56	150	16	1 670	Sl. gassy 84 m	Kumbarilla Beds	Plugged and abandoned	1382
Hayes Creek 1		1966	27	40	150	10	2 350			" "	1948
Humbug Creek 1		1965	27	10	150	12	1 761	Oil scum 762 m	Kumbarilla Beds	" "	1736
Humbug Creek 2		1965	27	10	150	12	1 722			" "	1760
Iminbah 1	*	1964	27	52	150	15	1 730			" "	1479
Killaloe 1		1965	27	50	150	14	1 811	Sl. gas and oil scum 1 227 m	Birkhead Formation	" "	1751
Lawson 1	*	1964	27	07	150	25	1 650			" "	1486
Leichhardt 1		1966	27	15	150	12	1 883	5-6 Mcf/d 1 537-1 540 m	Precipice Sandstone	Potential gas well	1881
Leichhardt 2		1966	27	15	150	12	1 763	Oil shows but test did not yield		Plugged and abandoned	-
Liddell 1	*	1963	27	35	150	22	1 745			" "	1367
Malara 1		1967	27	06	150	26	1 545			" "	2384
Marmadua 1	*	1964	27	25	150	35	1 503			" "	1569
Middle Creek 1	*	1962	27	39	150	19	1 867			" "	899
Miles Creek 1	*	1964	27	01	150	20	1 338			" "	1395 PSSA 57
Minnabilla 1	*	1964	27	56	150	15	1 684	1 638-1 643 m gassy watery mud with scum of oil	Precipice Sandstone	" "	1479
Moonie 1 (also 2-31)	*	1961	27	45	150	15	1 861	1 765 bbl/day at 1 768 m 125 Mcf/d 1 767-1 780 m	" "	Oil well (+ 15 producing wells)	909 PSSA 45
Moonie North 1		1967	27	41	150	18	1 832			Converted to water well	-
Mundagai 1	*	1964	27	42	150	25	1 787			Plugged and abandoned	1479
Paget 1	*	1963	27	28	150	32	1 637			" "	1367
Piebald 1	*	1964	27	28	150	39	1 130			" "	1367
Pring 1		1966	27	50	150	12	1 842			" "	1834
Retreat 1		1965	27	45	150	23	1 900			Converted to water well	1835
Rock Creek 1		1965	27	22	150	43	1 311			Plugged and abandoned	1647
Rogers 1		1965	27	08	150	12	1 648			" "	1849
Southwood 1	*	1963	27	43	150	14	3 321	Methane 2 248 m, oil odour 2 437 m		" "	1113 PSSA 57
Sussex Downs 1		1966	27	46	150	08	3 336			" "	2018
Tara 1	*	1962	27	21	150	30	2 071			" "	1020
Tara South 1		1965	27	23	150	29	1 725	1 533-1 551 m: sl. gas cut muddy water	Evergreen Formation	" "	1642
Tartha 1	*	1964	27	37	150	11	2 429			" "	1413
Tey 1	*	1963	27	09	150	14	1 640			Converted to water well	1395
Toombilla 1	*	1963	27	33	150	26	1 777			Plugged and abandoned	1367
Toombilla East 1	*	1963	27	32	150	28	1 689			" "	1367
Undulla 1	*	1963	27	14	150	16	2 697			" "	1077
Uranilla 1		1967	27	59	150	40	1 198			" "	2165
Wamb[illegible] Creek 1		1965	27	06	150	36	1 346			" "	1603
Warrigabie 1	*	1964	27	57	150	16	1 679	1 705 m; 1 633 m; 1 636 m - residual hydrocarbons	Pre-Precipice Sandstone	" "	1479
Weir 1	*	1963	27	51	150	25	1 595			" "	1479
Widgewa 1		1967	28	00	150	16	1 885			Converted to water well	2208
Wieambilla 1	*	1964	27	04	150	26	1 487			Plugged and abandoned	1486
Willowbe 1		1967	27	54	150	15	1 732			" "	2117
Wybar 1		1965	27	56	150	17	1 574			" "	1752
UNION - TENNECO - A.O.G.											
Bennett 3		1970	27	15	150	12	1 730			Plugged and abandoned	-
Bennett 4		1970	27	15	150	12	1 714	1 614-1 620 m recovered 990 m of clean green oil (143° API)	Precipice Sandstone	Completed oil well	-
Dilbong 1		1969	27	34	150	23	1 759			Plugged and abandoned	-
Leichhardt 3		1970	27	15	150	12	1 776			" "	-
Myra 1		1969	27	12	150	22	1 945			" "	-

* Commonwealth subsidy granted - Completion reports available at Bureau of Mineral Resources.

PSSA = Bureau of Mineral Resources, Petroleum Search Subsidy Acts publication.

TABLE 3 : PETROLEUM EXPLORATION WELLS DRILLED IN THE GOONDIWINDI SHEET AREA TO THE END OF 1971

Name	Year Drilled	Location		Total depth (m)	State	Status
		Lat.	Long.			
UKA Yarrill Creek No. 1	*1962	28°05'	150°25'	1 384	Qld	Converted to water well
UKA Minima No. 1	*1962	28°22'	150°07'	2 177	Qld	Plugged and abandoned
UKA Tingan No. 1	*1963	28°25'	150°12'	1 815	Qld	Converted to water well
UKA Goondiwindi No. 1	*1964	28°38'	150°11'	2 223	NSW	Plugged and abandoned
UKA Limebon No. 1	*1967	28°49'	150°04'	2 010	NSW	Plugged and abandoned
UKA Paringa No. 1	1968	28°23'	150°07'	2 083	Qld	Converted to water well
UTA Nomby No. 1	1969	28°14'	150°17'	1 579	Qld	Converted to water well
Woods Billa Billa No. 1	1970	28°02'	150°23'	1 398	Qld	Plugged and abandoned
Woods Thompson No. 1	1971	28°14'	150°25'	1 158	Qld	Plugged and abandoned

* Commonwealth subsidy granted - completion reports available at Bureau of Mineral Resources.

TABLE 4: WATER BORES AND PETROLEUM EXPLORATION WELLS WIRELINE LOGGED BY BMR IN THE DALBY SHEET AREA

Name	Regd. No.	G.L. (m)	Depth drilled (m)	Depth log (m)	Gamma Ray	Δt	Salinity ppm NaCl	Source of water	Water Level
Wahroonga 1	11 555	-	342	330	yes	yes	-	JKk	29
Warroon	12 447	-	610	561	yes	yes	870	Jug, Klm	Flow
Greenfield	12 569	290	602	591	yes	no	-	Jug	Flow
Strathalbyn	13 030	290	644	627	yes	no	-	Jug	Flow
Bellevue Park	13 140	290	458	439	yes	no	-	Jug	Pump
Barramornie 3	13 455	282	541	530	yes	no	-	Jug	Flow
Warrowa	16 234	-	762	760	yes	yes	800	JKk	Flow
Pippinford	16 550	-	673	635	yes	no	1 050	JKk	Flow
Currajong 3	17 435	-	869	825	yes	yes	900	JKk	Flow
Willara	17 511	-	466	462	yes	yes	1 100	JKk	Flow
Biddybrook 2	35 251	-	643	629	yes	yes	750	JKk	Flow
UKA Bennett 2	-	287	1 728	628	yes	yes	-	JKk	20
UKA Cobbareena 1	-	333	1 576	422	yes	yes	-	JKk	41
UKA Crowder 1	-	261	1 787	771	yes	yes	-	JKk	5
UKA Crowder East 1	-	262	1 670	764	yes	yes	-	JKk	8
UKA Currajong 1	-	257	1 872	855	yes	no	-	JKk	4
UKA Davidson 1	-	284	2 293	471	yes	yes	1 200	JKk	Flow
UKA Dockerill 1	-	254	1 830	497	yes	yes	850	JKk	Flow
UKA Moonie North 1	-	270	1 832	742	yes	yes	-	JKk	13
UKA Retreat 1	-	278	1 900	665	yes	yes	-	JKk	20
UKA Tey 1	-	289	1 638	508	yes	yes	900	JKk	Flow
UKA Widgewa 1	-	243	1 885	834	yes	yes	-	JKk	9

G.L. = Elevation at ground level

Δ t = Differential temperature

TABLE 5: WATER BORES AND PETROLEUM EXPLORATION WELLS WIRELINE LOGGED BY BMR IN THE GOONDIWINDI SHEET AREA

Name	Regd. No.	Depth drilled (m)	Depth logged (m)	Gamma ray	Δ t	Salinity (ppm NaCl)
North Callandoon	2822	960	940	yes	yes	600
Bentwood	12639	616	596	yes	no	-
Euloma	11645	356	284	yes	yes	840
Lapunyah	16039	1006	974	yes	yes	1300
O.K. (2)	16140	648	643	yes	yes	-
Undabri	16354	682	651	yes	yes	-
Kulai	16275	337	328	yes	yes	1000
UKA Tingan No. 1		1815	1004	yes	yes	1000

G.L. = Elevation at ground level

Δt = Differential temperature

All bores are flowing

Revised nomenclature for the Surat Basin was formally proposed by Exon & Vine (1970) and Reiser (1970) and an excellent description by Power & Devine (1970) on the subsurface stratigraphy, history, and petroleum of the Surat Basin includes this area.

A summary of ideas arising from macrofossil studies in the basin is given by Day (1969).

Explanatory notes on the geology of the adjacent Surat, Roma, and Chinchilla 1:250,000 Sheet areas have been published (Reiser 1971a, Exon 1971, and Reiser 1971b) and those on Dalby and Goodiwindi and the adjacent St George and Warwick 1:250,000 Sheet areas are in press (Mond, Senior D., Senior D., and Olgers respectively).

Geophysical investigations and exploratory drilling for oil and gas

A summary of petroleum exploration in Queensland prior to 1960 has been compiled by the Geological Survey of Queensland (1960). A.R.O. No. 20 (Dalby), the first petroleum exploration well to be drilled in the area, was completed in 1935. No gas or oil shows were recorded and it is now used as a water well for town supply.

In 1959 the Bureau of Mineral Resources made a seismic survey between Surat and Tara (Lodwick & Watson, 1960). The survey revealed a major north-trending local structure in the Cabawin area. This encouraged the Union Oil Development Corporation to undertake detailed geophysical exploration in this area. In September 1960, a drill site on a faulted closure in Permian strata was selected for the initial test well, U.K.A. Cabawin 1, which produced small quantities of oil and gas from a Permian sandstone.

After additional drilling and geophysical work U.K.A. Moonie 1 was proposed to test a closure on a structure 32 km south of Cabawin 1. In December 1961, Moonie 1 flowed 1 765 bbl/day through a 1-inch choke during a drill-stem test of a sandstone at 1 768 m (5 800 ft): the first commercial discovery of oil in Australia. The Moonie discovery provided a strong incentive for oil exploration in this area and encouraged general exploration activity throughout Australia.

The western part of the area was explored by Union Oil Development Corporation and the east by Phillips Petroleum Company. Geophysical surveys are listed in Table 1 and exploration wells in Tables 2 and 3.

As a part of the Union Oil exploration program Mack (1963) made the first systematical investigation of the Surat Basin, based on reconnaissance geological mapping supported by interpretation of data from geophysical work and exploratory drilling. The results of Union Oil activities are summarized in company reports and numerous publications (Graves, 1963; Moran & Gussow, 1963; Pyle & Buckley, 1965; Carey & Kurash, 1969; Buckley, Bradley & Zehnder, 1969).

A geological reconnaissance and photogeological interpretation of the eastern part of the Dalby Sheet area by Bell (1962) defined the general structure and preceded seismic surveys. Between January 1961 and January 1965 Phillips Petroleum conducted a number of reflection seismic surveys (Table 1) and in 1963 commenced stratigraphic drilling. Up to 1966 they had drilled 20 dry wells (Table 2).

Reviews of the petroleum-bearing reservoir rocks in the Surat Basin and elsewhere in Queensland were produced by Hogetoorn (1968) and Allen & Hogetoorn (1970).

In 1970 a seismic survey by Amalgamated Petroleum in the Cecil Plains area (Haskett & Buckley, 1970) was followed by drilling of Horrane 1 (Mellins, 1971).

In 1970 a number of water bores and converted oil exploration wells in the area were wireline-logged under contracts let by the BMR. The bores logged are listed in Tables 4 and 5, and the original data are held by the BMR, Canberra.

PHYSIOGRAPHY

Drainage in the area (Fig. 2) is to the Condamine, Moonie, and Dumaresq-Macintyre river systems, all of which join the Darling system. Elevations range from around 700 m in the southeast to as little as 200 m on the western alluvial plains. The western plains are separated from the plains of the Condamine river system by elevated country extending north-northwest from the southeast corner, which corresponds to the Texas High and the Kumbarilla Ridge (Fig. 1). The physiographic units (Fig. 2) are:

(1) Western alluvial plains, which vary in elevation from 200 to 250 m and drain generally westward. They are underlain by Quaternary and Tertiary alluvium.

(2) Plains of the Condamine River system, which decline northward from around 380 m south of Millmerran to around 320 m in the north. They also are underlain by Quaternary and Tertiary alluvium.

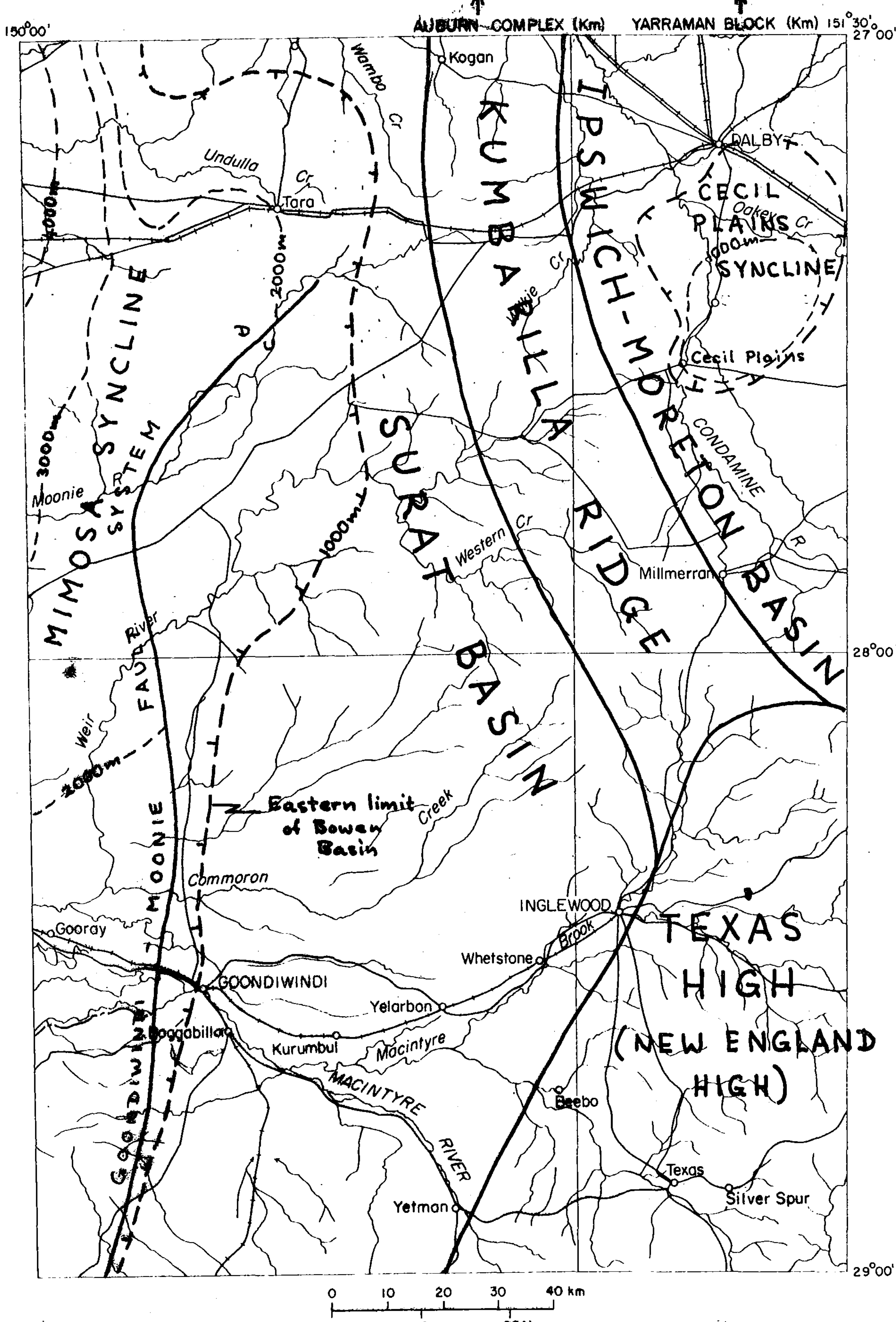
(3) Dissected plateaux: Sandy areas where the deeply weathered older Tertiary capping is partly preserved. Elevations generally decrease northward from around 400 m near the Texas High to around 330 m in the far north. Local relief amounts to a few tens of metres.

(4) Undulating sandy country rises up to the dissected plateaux areas (3 above), and occurs where the deeply weathered profile has been removed.

(5) Elevated sandy country with numerous cuestas: Around the flanks of the Texas High the moderately resistant Marburg Sandstone has been dissected, leaving cuestas which dip gently basinward.

(6) Elevated deeply dissected hilly country: The resistant, strongly deformed Palaeozoic rocks of the Texas High are deeply dissected. Strike ridges are common. The basalts northeast of Dalby, which form the foothills of the Bunya Mountains, have been eroded to form dissected mesas rising to around 600 m.

(7) Undulating to hilly country with prominent strike ridges: At the northern end of the Texas High a less extreme version of unit 6 (above) is developed.

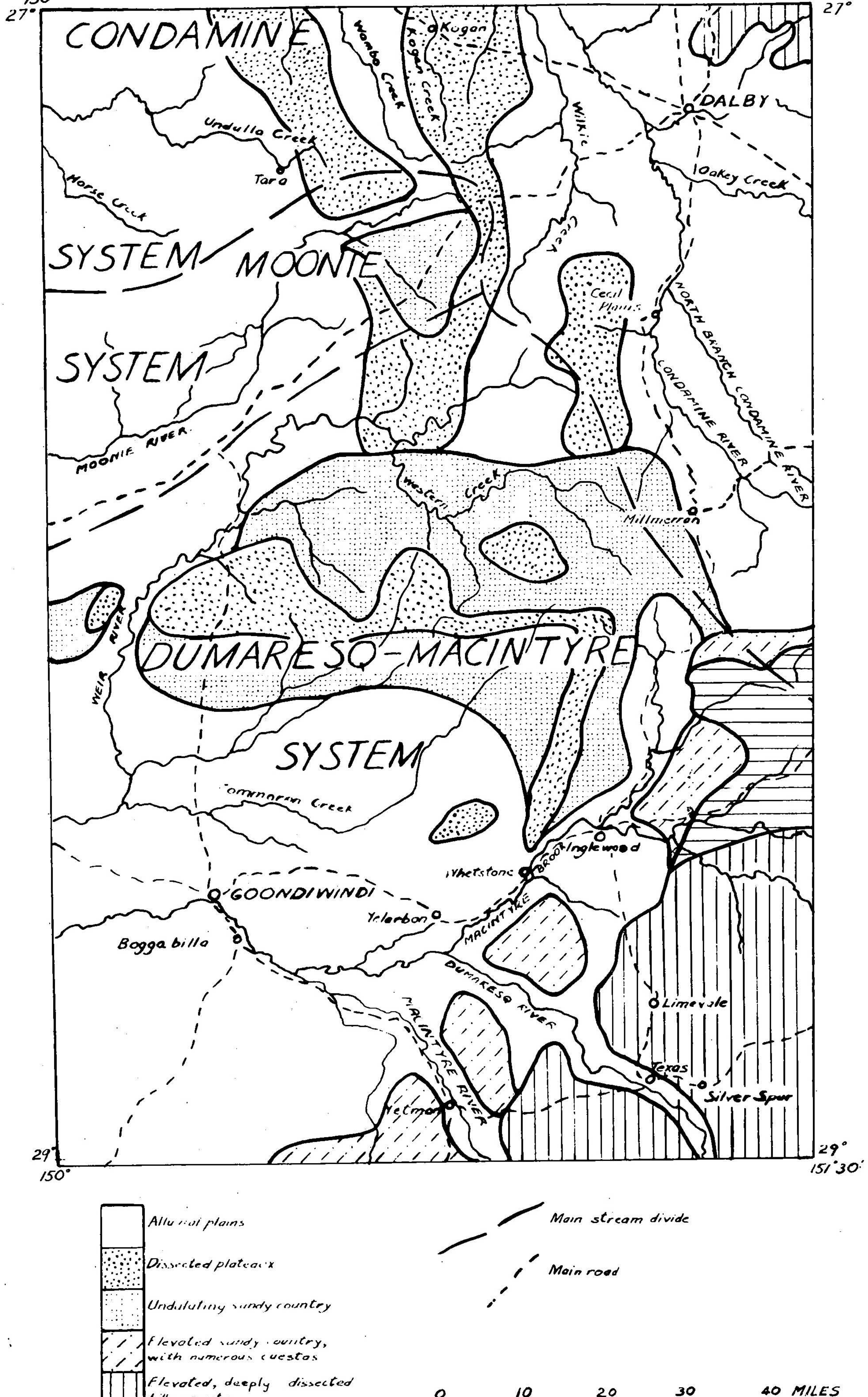


STRUCTURAL SKETCH MAP

Major structural division	Edge of syncline
Fault	Basement contour (metres below m.s.l.)

to accompany Record 1972/53 FIG. 1.

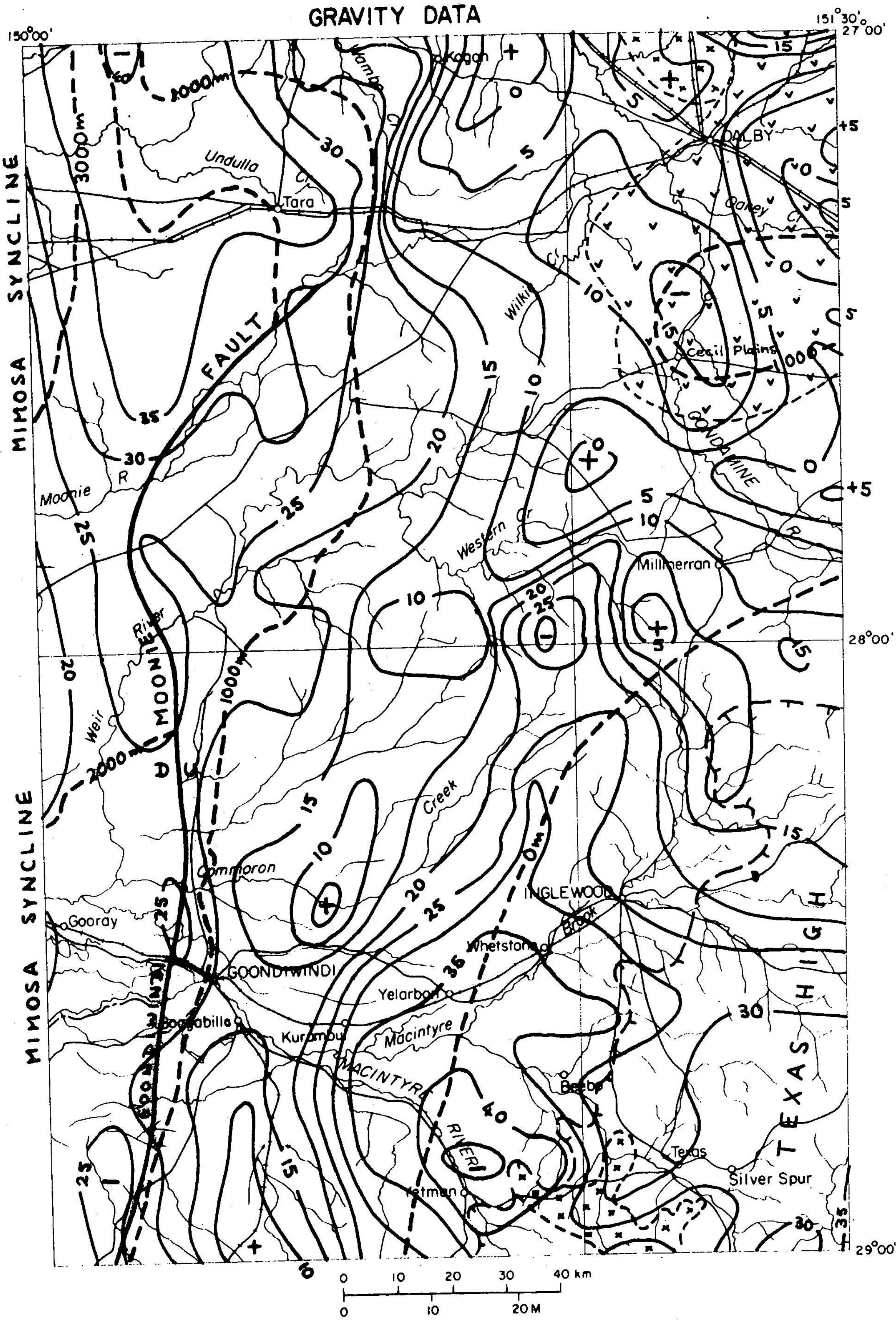
PHYSIOGRAPHY



Q/A/395 to accompany Record 1972/53

FIG. 2.

GRAVITY DATA



—25— Bouguer isogal (BMR regional surveys)

\+ — "High" and "Low" anomalies

Major fault

"Basement" structure from seismic data (metres below m.s.l.)

Western limit of basement outcrop

"Basement" granite

Triassic volcanic sequence in the Cecil Plains Syncline

FIG. 3.

Q/A/396 to accompany Record 1972/53

CARBONIFEROUS STRATIGRAPHY

The Kumbarilla Ridge, Texas High and the shelf areas on either side of them (Fig. 1) are composed largely of mainly Carboniferous sediments and volcanics overlain by less than 1250 m of younger sediment. Gravity data (Fig. 3) show most of this relatively shallow basement to be dense, apart from the Texas High. This suggests that most of the basement is a thick sequence of sediments and volcanics, but that the Texas High itself is an area of shallow granite (the gravity values are lowest over the limited area of granite outcrop near Yetman). Local rises in the basement include those underlying the Kogan and Durabilla Anticlines and the fault-bounded Undulla Nose (Fig. 13).

The Carboniferous units are the Texas Beds, which crop out on the Texas High, and the Kuttung Formation subsurface. The units are lithologically similar and are at least partly equivalent. The Kuttung Formation probably includes a lower Permian unit in the north, and both Kuttung Formation and Texas Beds may extend into the Upper Devonian.

Kuttung Formation

All non-granitic basement rocks in the subsurface of this area are included in the Kuttung Formation.

In outcrop in the Warialda-Narrabri district of New South Wales the Kuttung Formation consists of tuffaceous sandstone, volcanic conglomerate, breccia, tuff and flows. Union Oil Development Corporation introduced this name for the pre-Permian basement rocks in the subsurface in the western part of this area. The Kuttung Formation as described here consists mainly of volcanic rocks and includes sequences assigned to the Cracow Formation in some wells. Mack (1963) considered the Cracow Formation to be equivalent to the Kuttung Formation, and relationships are too obscure to allow real separation of the two units, if they are in fact different. Fossils of early Carboniferous to late Carboniferous or Permian age occur (Mack, 1963). The Permian Camboon Andesite, which crops out north of this area, contains similar rock types and may also be present with the Kuttung Formation in the subsurface.

Thus all subsurface basement rocks of volcanic aspect and of Carboniferous (and early Permian) age are here arbitrarily assigned to one unit. Like the Texas Beds the Kuttung Formation may extend into the Upper Devonian. Its outcrop equivalent in this area is the Carboniferous Texas Beds.

Texas Beds

The Texas Beds of this area (see Olgers & Flood, 1970) consist dominantly of volcanically derived sandstone and mudstone with minor slate, jasper, chert, intraformational conglomerate, limestone and andesite volcanics. The sandstone is commonly graded, and according to Olgers & Flood (1970) the sequence is 'flysch-like', but of shallow marine depositional environment.

The Texas Beds are intensely deformed; dips are generally steep to vertical and some beds are overturned. Corals, brachiopods, and Radiolaria are present. According to Olgers & Flood the age of this sequence is mainly Lower Carboniferous, possibly extending into the Upper Devonian and Upper Carboniferous.

PERMIAN STRATIGRAPHY

Regional Setting

In Permian times a sedimentary sequence was deposited throughout much of this area, in the Bowen Basin. The basin shallowed with time, as evidenced by the change from the marine Back Creek Group to the freshwater coal-measure sequence of the Blackwater Group.

West of the Goondiwindi-Moonie Fault much of the sequence is preserved, but in the central and eastern part of the area uplift has led to the removal of most Permian sediments, with the exception of two outliers on the Texas High, preserved by faulting (Fig. 4). The limits of the Permian sequence are related to the regional structure in Figure 4. No equivalents of the Blackwater Group are present on the Texas High, and they may not have been deposited there. Granites which are intrusive into the Carboniferous sequence of the Texas High are of Permian to Lower Triassic age (Olgers & Flood, 1970), and similar granite occurs beneath the Mesozoic sequence south of the Cecil Plains Syncline in Phillips-Sunray Millmerran No. 1 well.

Lower Permian sediments of the Texas High

Permian rocks rest on the Carboniferous Texas Beds in the southeast of the Goondiwindi Sheet in two areas (Olgers & Flood, 1970, pp. 51-53). In both they are steeply dipping marine sediments and are partly fault-bounded. At Glenlyon homestead, and also around Silver Spur, the major rock types are conglomerate, lithic sandstone, pebbly mudstone, and minor poorly fossiliferous limestone with a Lower Permian fauna. At Silver Spur some pebbly mudstones are tuffaceous. The fossils and rock types indicate that these sediments are contemporaneous with, and similar to, the Back Creek Group sequence in the subsurface. They were, in all probability, deposited in a continuous basin.

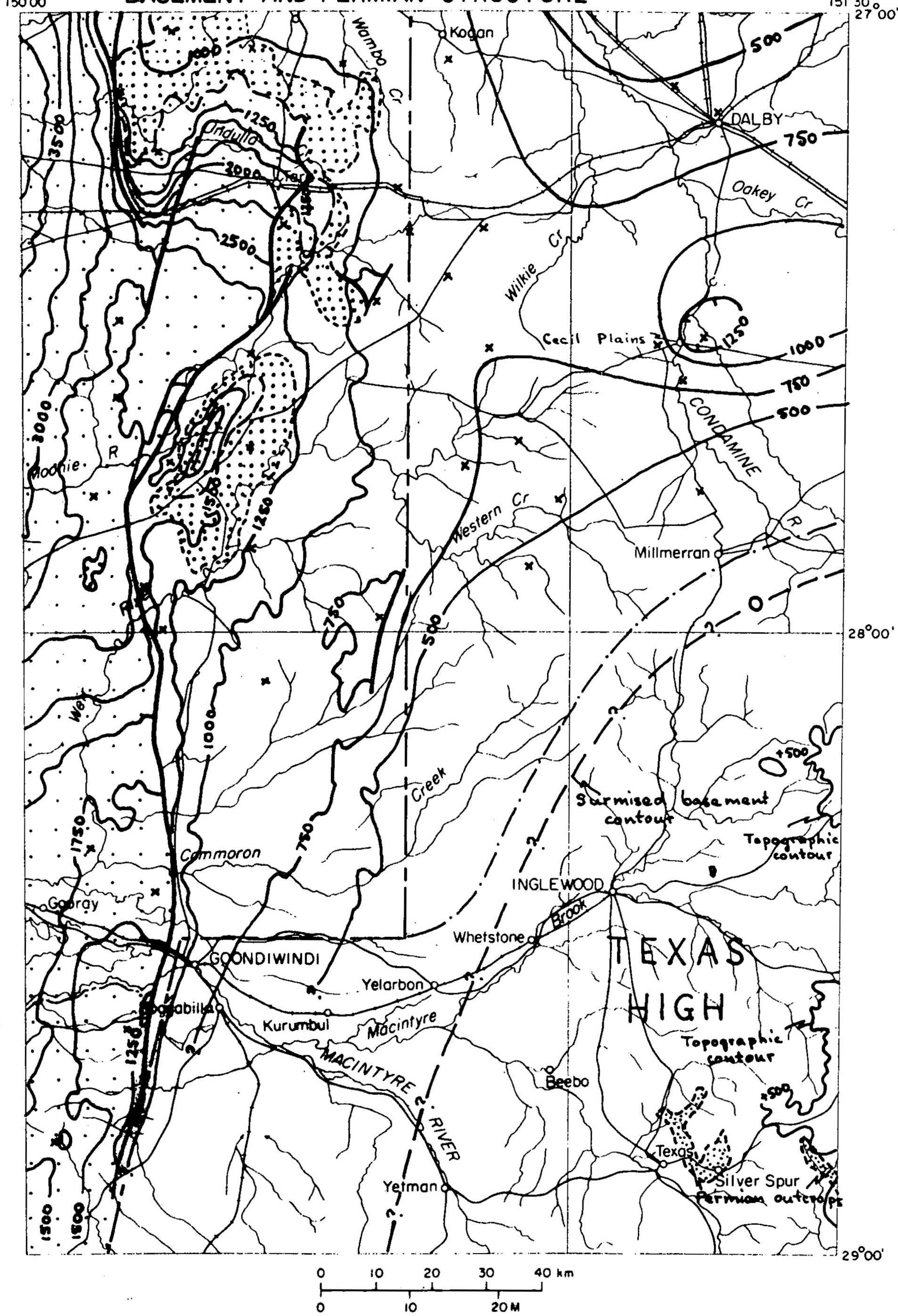
Back Creek Group

The Back Creek Group does not crop out; it consists of sandstone, siltstone, and shale, largely of volcanic origin.

Schneeberger (1951) proposed the name 'Back Creek Series' for about 1740 m of tuffaceous, partly fossiliferous clastics with basal limestone beds, exposed in Back Creek near Cracow, north of this area. On the basis of megafossils, the 'Series' was assigned a Permian age. The name was formally defined by Derrington, Glover, & Morgan (1959) as Back Creek Group, but was later downgraded by Mack (1963) to a formation. Mack suggested that the Back Creek Formation in UKA Cabawin 1 represents only the upper part of the unit as seen in the type area near Cracow. Union Oil Corporation Development follows Mack's usage.

The name Back Creek Group has been extensively used in the subsurface of the Bowen-Surat Basin for marine Permian sediments, although they may or may not be entirely equivalent to the group in outcrop (Jensen, Gregory & Forbes, 1964; Thomas & Reiser, 1968; Exon et al., 1968). In this area the group is virtually restricted to the Mimosa Syncline on the west side of the Moonie-Goondiwindi Fault, where it unconformably overlies the Kuttung Formation. Its approximate easterly limit is shown in Figure 4.

BASEMENT AND PERMIAN STRUCTURE



Blackwater Group reflector (Upper Permian)

Back Creek Group reflector (Lower Permian)

Basement reflector, and basement from oil wells and outcrop information

× Oil well

Fault

Contour (metres below m.s.l.) on basement in E, Permian in W.

Limit of Blackwater reflector eastward

Limit of Back Creek reflector eastward

Eastern limit of U.K.A. seismic data

Southeastern limit of Phillips seismic data

Q/A/397

To accompany Record 1972/53

Based on seismic and oil well data

FIG. 4.

The sequence in UKA Cabawin No. 1, where it consists of 396 m of shallow marine deposits, is typical of the group. The lower part consists of dark-grey, pyritic, silty shale, silicified tuffaceous sandstone, and siltstone, with some coaly partings. In the upper part blue-grey calcareous siltstone is interbedded with calcareous shale and sandstone. The abundant fossil fauna consists predominantly of brachiopods and crinoids.

Farther south, in UKA Goondiwindi No. 1, it is difficult to distinguish the Back Creek Group from the overlying Blackwater Group because the typical outcrop rocks are no longer present. Instead of the typical shale and coal, the local facies of the Back Creek Group is mostly tuffaceous sandstone and conglomerate.

The environment of deposition varied from marine to coastal plain or deltaic. The presence of carbonaceous matter throughout suggests that deposition was in shallow water (Bastian, 1965). The water may have been shallower towards the south, where land perhaps lay. Between UKA Cabawin No. 1 and UKA Minima No. 1 (i.e. southward) the Permian marine section thins, suggesting that Minima is closer to the shoreline of the Back Creek sea. Contemporaneous volcanism was a source of tuffaceous material throughout deposition.

Animal and plant macrofossils, and microfossils (e.g. Cabawin No. 1) all indicate a Permian age for the Back Creek Group.

Blackwater Group

Malone, Olgers, & Kirkegaard (1969) named the coaly, non-marine Blackwater Group after Blackwater in Central Queensland, where the formation is about 530 m thick and consists of sandstone, siltstone, mudstone, and coal. The name Kianga Formation (Mack, 1963) established by Union Oil Development Corporation in the Cracow-Theodore-Banana area to the north, and used in their reports on the subsurface of the Surat Basin, appears to be synonymous with Blackwater Group. The group is widespread in the Bowen-Surat Basin and is everywhere present in the Mimosa Syncline in this area. It conformably overlies the Back Creek Group but is not quite as widely preserved (Fig. 4).

The Blackwater Group in this area does not crop out; it consists of interbedded tuff, coal, shale, sandstone, and conglomerate. The tuffs are bedded, micaceous and carbonaceous. Many of the coaly beds contain some volcanic ash. Sandstones are locally quartzose but generally they contain abundant volcanic detritus. Conglomerates are present mainly in the southernmost area (UKA Goondiwindi No. 1) where tuffaceous sandstone and conglomerate predominate.

These markedly variable and generally fine-grained sediments were deposited in swampy lowlands, in which plant remains accumulated (Bastian, 1965). Some of the detritus was provided by contemporaneous volcanism, and primary tuffs are common.

In the axial part of the basin the unit is over 300 m thick; however, at UKA Minima No. 1 it is only 34 m thick and the upper part is missing, probably because of depositional thinning, overlap, and erosion.

De Jersey (in UKA Cabawin No. 1 and UKA Minima No. 1 Completion Reports) reports spores of Permian age and suggests an Upper Permian age, and Evans has found an Upper Permian microflora in UKA Cabawin No. 1 (division P4 of Evans, 1964b).

TRIASSIC SEQUENCE IN THE BOWEN BASIN

Regional setting

In Triassic times the Bowen Basin in the west was apparently completely cut off from the Ipswich-Moreton Basin in the east by the newly-uplifted Kumbarilla Ridge connecting the Yarraman Block in the north to the Texas High in the south. Sedimentation in the two basins was non-marine, but otherwise basically dissimilar.

The Bowen Basin Triassic sequence conformably overlies the Upper Permian Blackwater Group. It consists of the Lower Triassic Rewan Formation, the Lower to Middle Triassic Clematis Sandstone and the Middle to Upper Triassic Moolayember Formation. (The latter two units are not readily differentiated in some areas and are then called Wandoan Formation). This Triassic sequence is confined to the Taroom Trough (Mimosa Syncline) west of the Goondiwindi-Moonie Fault, and its original extent was probably not much greater. In the north the trough subsided rapidly during Rewan times, with deposition in the axial region of about 1000 m of sediment, but then slowed, and the younger Triassic sediments thicken relatively little basinward. In the south the syncline sank only slowly throughout the Triassic, and basinward thickening is slight.

Rewan Formation

The type area of the Rewan Formation (Isbell, 1955; Hill, 1957) is near Rewan Homestead on the Springsure Sheet area, where it is 490 m thick (Mollan, Dickins, Exon, & Kirkegaard, 1969). Palynological and petrographic data from outcrops and various wells suggest that the Cabawin Formation of Mack (1963) correlates with the outcropping Rewan Formation (Bastian & Arman, 1965) and the older name Rewan Formation is preferable. In places palynological studies did not support correlations proposed by Union Oil Development Corporation and detailed petrological investigations were made to study alternative correlations (Tissot, 1963; Febr, 1965; Bastian, 1965).

In this area the Rewan Formation is confined to the northwest in the subsurface and is well developed in UKA Cabawin No. 1, where it is 670 m thick. It consists of interbedded conglomerate and pebbly sandstone with a few distinctive intercalations of reddish-brown claystones (Bastian, 1965, p.25). The formation is unconformable on the Permian Blackwater Group.

The environment of deposition was non-marine and strongly oxidizing, and the unit was probably laid down by streams and in lakes in a continually subsiding shallow basin. The thick conglomerates point to vigorous erosion of high land east of the Moonie Fault. Initially tuffaceous material was derived from the sediments of the Blackwater Group and later, as erosion went deeper, from older volcanics.

The unit contains probable Triassic plant remains and Lower Triassic spores (Evans, 1964b; de Jersey, 1970b).

Wandoan Formation

The section from 3530 to 4817 feet (1 076-1 468 m) in UKA Wandoan No. 1 was defined as the Wandoan Formation (Union, 1964d). Detailed palynological and petrological studies of outcrops and other wells by Fehr (1965), Bastian (1965), and Bastian & Arman (1965) have shown that the Wandoan Formation should be correlated with the Middle to Upper Triassic Clematis Sandstone and Moolayember Formation. On the basis of palynology, lithology, and electrical log character they subdivided this Middle to Upper Triassic unit into four sub-units (T_1 - T_4). Units T_1 and T_2 are regarded as probably equivalent to the Clematis Sandstone and T_3 and T_4 to the Moolayember Formation (Bastian, 1965).

Even in the few wells in this area on which detailed petrological work has been done, interpretation is difficult, but following Bastian (1965), and Bastian & Arman (1965), we have split the Wandoan Formation into Clematis Sandstone and Moolayember Formation.

Clematis Sandstone

The Clematis Sandstone (Jensen, 1926) is named after Clematis Creek in the Expedition Range north of this area, where it consists mainly of quartzose sandstone, with minor siltstone toward the top. In the Dalby-Goondiwindi area it is the lower part of the Wandoan Formation of UKA. The lower part of our Clematis Sandstone is the Showgrounds Sandstone of the Roma Shelf. In this area the Clematis Sandstone is confined to the subsurface of the Mimosa Syncline.

The sequence in UKA Cabawin No. 1, described in detail by Bastian (1965), is typical of the Clematis Sandstone of this area. This 132 m sequence (7 208 to 7 640 feet) consists of three parts. The lowermost 59 m is pebbly sandstone, with white chert (?devitrified tuff) pebbles, and poorly sorted sandstone rich in chert clasts. The poorer sorting as compared to the type area is believed to be due to the proximity of a volcanic source area. Above the sandstone unit is 13 m of dark grey claystone which serves as a useful regional marker bed. It contains carbonaceous material, siderite spherules, and some glauconite. The uppermost 60 m consists of thinly interbedded sandstone, siltstone, and claystone. The sandstone is greenish, volcanic lithic, strongly cemented, and some beds may be of primary tuffaceous origin.

The Clematis Sandstone overlies the Rewan Formation disconformably. The environment of deposition of the lower part of the Clematis Sandstone is fluviatile, of the middle part consisting of brown pelletal claystone it is probably largely shallow marine, and of the upper part is probably deltaic and flood-plain.

The sequence is more than 120 m thick in the northwest, but thins southwards down the Mimosa Syncline, and pinches out eastwards near the Moonie-Goondiwindi Fault.

Spore evidence suggests a Middle Triassic age for the formation (de Jersey, 1968).

Moolayember Formation

The formation was named the 'Moolayember Shale' by Reeves (1947) after Moolayember Creek in the Carnarvon Ranges. It was renamed 'Moolayember Formation' by Mollan, Forbes, Jensen, Exon, & Gregory (1972), who presented the type section. In this area the Moolayember Formation is confined to the subsurface of the Mimosa Syncline. It is the upper part of UKA's Wandoan Formation.

The sequence in UKA Cabawin No. 1, described in detail by Bastian (1965), is fairly representative of the formation in this area. It is 56 m thick (7 025 to 7 208 feet) and is largely conglomeratic lithic sublabile to lithic sandstone, with devitrified glass present as pebbles and matrix.

The Moolayember Formation conformably overlies the Clematis Sandstone. It is confined to the Mimosa Syncline, pinching out eastward near the Goondiwindi-Moonie Fault, and it is less than 60 m thick.

Absence of marine fossils suggests non-marine conditions, but rare glauconitic and chamositic horizons (Bastian, 1965) indicate marine or brackish periods, as do the scattered horizons containing acritarchs in various wells in the Mimosa Syncline (P.R. Evans, pers. comm.). The angular volcanic clasts suggest rapid deposition, and other evidence points to deposition on a coastal plain and in deltas.

Spores in the formation are of Middle Triassic age (de Jersey & Hamilton, 1967) but the unit may range into the Upper Triassic.

TRIASSIC SEQUENCE IN THE IPSWICH-MORETON BASIN

Regional Setting

A Triassic sequence is present in the subsurface in the Cecil Plains Syncline, which lies east of the Kumbarilla Ridge and is an embayment of the Ipswich-Moreton Basin. In this area the Upper Triassic Raceview Formation (Staines, 1964) generally lies directly on pre-Triassic basement rocks, but in a small area east of Cecil Plains township there is a depression containing faulted sediments of the Upper Triassic Aberdare Conglomerate (see Staines, 1964, for formal discussion) and volcanics which may be equivalents of the Middle Triassic Neara Volcanics (Mellins, 1971). The Triassic sequences penetrated were 380 m thick in Phillips Cecil Plains No. 1 and 257 m thick in A.P. Horrane No. 1 well, and in neither well was basement reached. Seismic data (see Mellins, 1971) suggest that more than 900 m of Triassic rocks occur in the middle of the Cecil Plains Syncline.

Triassic volcanics

The oldest Triassic rocks yet penetrated in the Cecil Plains Syncline are the volcanics in A.P. Horrane No. 1 (Mellins, 1971), which are regarded as probable equivalents of the Neara Volcanics of the Esk Rift. They are a series of interbedded relatively flat-lying acid lavas and tuffs, which are greenish, massive, crystalline, siliceous, dense and hard. The thickness penetrated in A.P. Horrane No. 1 was 257 m (3 518-4 362 feet), but seismic data (see Mellins, 1971) suggest that there is more than 750 m of Triassic volcanics in the Horrane area, unconformably overlying Permo-Carboniferous basement.

If these volcanics are, in fact, Neara Volcanics equivalents, they are older than the Ipswich Coal Measures and are of Middle Triassic age.

Aberdare Conglomerate

The Aberdare Conglomerate is named after Aberdare Colliery in the Ipswich Sheet area (see Staines, 1965) where it consists largely of polymictic cobble and pebble conglomerates, sandstone, siltstone, and thin carbonaceous shale. Ferruginous shale beds are a distinctive feature of the formation in the type area.

The Triassic sequence in Phillips Cecil Plains No. 1 well was subdivided by Hogetoorn (Appendix 1 in Meyers, 1970) as 49 m (4 090-4 252 feet) of Raceview Formation overlying 380 m (4 252-5 501 feet) of possible Ipswich Coal Measures. The lower sequence was regarded by Mellins (1971) as probable Aberdare Conglomerate, and this interpretation is preferred here.

The Aberdare Conglomerate which, in this area, has so far been penetrated only in Cecil Plains No. 1, consists largely of conglomerate with some shale. The conglomerate contains pebbles of shale, siltstone, sandstone, quartz, and quartzite. The shale is predominantly grey or green above 5 216 feet (1 590 m) but reddish hematitic shale is present below that level. Minor thin bands of coal are present in places.

Seismic and other evidence (see Mellins, 1971) shows that the formation is at least partly fault-bounded in this area, and that it extends from Phillips Cecil Plains No. 1 only a few kilometres in any direction except perhaps to the east. It probably disconformably overlies the Triassic volcanics at depth, as there is a considerable time-break between the two units if the preferred age relationships are correct. Its maximum thickness in the Cecil Plains Syncline may be as much as 1 000 m.

Spores from cores in the well (de Jersey, Paten & Hamilton, 1964) suggest a late Upper Triassic age, which makes it unlikely that this sequence equates with the Ipswich Coal Measures which are of Middle Triassic age.

Raceview Formation

The Raceview Formation (Staines, 1965) is named after Raceview on the Ipswich Sheet area, where it consists of interbedded sandstone, siltstone, shale (some carbonaceous) and a few thin coal seams.

In this area, east of the Kumbarilla Ridge, a sequence of relatively impermeable sandstone, siltstone, and shale, which is commonly found below the Helidon Sandstone, contains spore assemblages transitional between typical Triassic and typical Jurassic assemblages. Recent lithological correlation (Hogetoorn in Meyers, 1970), and increasing knowledge of the spore assemblage in the type area, has led various workers (e.g. Mellins, 1971) to call this sequence the Raceview Formation.

The Raceview Formation pinches out against the Kumbarilla Ridge in the west, and the Texas High in the south. Mostly, it unconformably overlies the Permo-Carboniferous basement rocks, but in the central part of the Cecil Plains Syncline it rests conformably on the Aberdare Conglomerate, or disconformably on Triassic volcanics. It is apparently unaffected by the faulting which has displaced the underlying Triassic sequences.

The formation was deposited in quiet conditions, perhaps in lakes and backswamps. Its thickness reaches 67 m in ARO 20 (Dalby) and 49 m in Phillips Cecil Plains No. 1. Spore data suggests an Upper Triassic, probably late Upper Triassic, age (de Jersey, 1970).

JURASSIC TO LOWERMOST CRETACEOUS (NEOCOMIAN) STRATIGRAPHY

Regional Setting

The structure of the lower Jurassic sequence and a pre Jurassic palaeogeology map is shown in Figure 5. The differences between the Bowen-Surat Basin and Ipswich-Moreton Basin sequences, which were marked during the Triassic, diminished during the Jurassic as the Kumbarilla Ridge (uplifted in early Triassic times) was gradually eroded, and the initial deep basins were filled in. The unconformity surface below the Jurassic sequence was relatively even. By mid-Jurassic time the ridge was no longer an effective barrier, and the Surat and Moreton Basins could then be regarded as essentially one.

Jurassic sediments occur in both basins, but Cretaceous sediments are now confined to the Surat Basin. Cretaceous rocks probably once covered the whole area, but stream erosion removed them from the Moreton Basin.

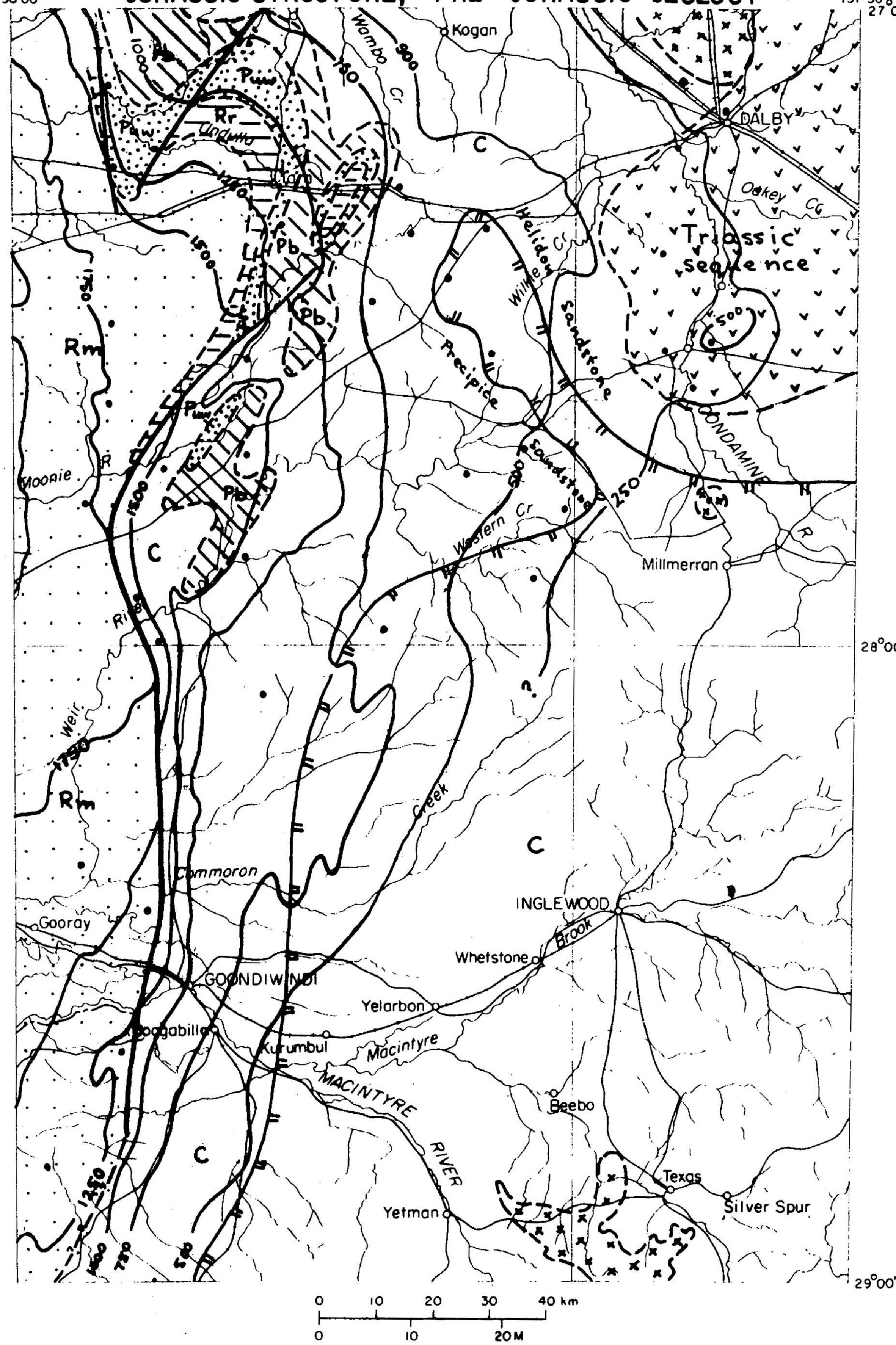
In earliest Jurassic time Surat Basin deposition began when the Precipice Sandstone was laid down disconformably on the Moolayember Formation and unconformably on the older rocks whose distribution is shown in Figure 5. At the same time Moreton Basin deposition continued with the deposition of the Helidon Sandstone, disconformably on the Raceview Formation and unconformably on the basement rocks. In most of the Surat Basin, and in the Cecil Plains Syncline, deposition of the silty Evergreen Formation and the quartzose Hutton Sandstone followed, but around the margins of the eastern Surat Basin and western Moreton Basin the Marburg Sandstone was laid down. This marginal facies of the Evergreen-Hutton sequence comprises a lower silty part and an upper sandy part characterized by clayey sublabile sandstone.

The Moreton Basin sequence in this area ends with the Walloon Coal Measures, which cross the Kumbarilla Ridge virtually unchanged. The maximum thickness of the sequence is about 1 200 m.

In the Surat Basin, throughout the Jurassic and into the lowermost Cretaceous, deposition of clayey sand with abundant quartz grains alternated with that of calcareous labile sand, silt, mud, and a little coal. Each sequence (formation) is generally about 100 m thick. The sand sequences, with high-angled cross-bedding and no marine fossils, are regarded as stream deposits, and the intervening sequences, on account of their bulk lithology and sporadic marine microfossils, are regarded as paralic, largely deltaic, deposits.

It is possible that the mineralogical differences between the two facies resulted purely from weathering in the basin in the zone of transportation and immediately after deposition. Sediments deposited in continental environments were subjected to weathering, which reduced the labile grains to clay. Paralic sediments were largely deposited in subaqueous conditions, and were buried rapidly, so that they remained virtually unaffected by weathering. If this is the case the mineralogical differences do not reflect original differences in source material or in sediment load. The regularity of the marine transgressions and regressions, which caused the fluctuations in depositional environment, are not explained.

JURASSIC STRUCTURE; PRE-JURASSIC GEOLOGY



Rm		Moolayember Formation
Rr		Rewan Formation
Puw		Blackwater Group
Pb		Back Creek Group
		Moreton Basin Triassic
		Permo-Triassic granite
C		Kuttung Fm + Texas Beds

- Fault
- Geological boundary
- Oil well
- Contour on upper Evergreen Fm (metres below m.s.l.)
- Limits of Helidon and Precipice Sandstones

Based on seismic and well data

QA/398 to accompany Record 1972/53

FIG. 5.

The source material for the Jurassic to lowermost Cretaceous sediments was largely Permian and Triassic granites and Palaeozoic sediments and metamorphics of the Texas High and Kumbarilla Ridge, with an admixture of acid volcanics which may have been contemporaneous.

Precipice Sandstone

The Precipice Sandstone, as the main producer of hydrocarbons in the Surat Basin, is of great interest both academically and economically. In this area it consists of quartzose to sublabile sandstone and siltstone.

The name Precipice Sandstone was first used by Whitehouse (1952). He defined the type area (Whitehouse, 1954) as 'the sandstone cliffs in the gorge of Precipice Creek, a tributary of the Dawson River' (Taroom Sheet area), and the type section is figured in Mollan et al. (1972). The formation is widespread in the Surat Basin.

Bastian (1965) and Fehr (1965) showed that there is no marked change in lithology from subsurface to outcrop, where the unit consists of white to light coloured, non-calcareous, quartzose sandstone, strongly cross-bedded. In outcrop it is commonly coarse-grained in the lower part, but medium to fine-grained sandstone and siltstone are dominant in the upper part. The Precipice Sandstone is present in the subsurface of the western part of the area and is divisible into a lower, coarse, crossbedded, fluviatile sandstone and an upper lacustrine fine-grained sandstone and siltstone sequence (Bastian, 1965).

In UKA Cabawin No. 1 (Bastian, 1965) the lower part consists of medium to coarse-grained locally conglomeratic sandstone that becomes finer towards the top. The sandstone is mainly light to medium grey, fine-grained to conglomeratic, very porous, massive, fairly well sorted, and quartzose. The matrix is white to very pale brown kaolinite, with some muscovite. Tourmaline and zircon are accessory minerals.

The upper part contains more compact and less permeable fine-grained sandstone with increasing clay matrix and many microstylolites, and subordinate siltstone and shale. The sandstone is composed of about 60% to 80% quartz, with glass fragments and some K-feldspar. Accessories include abundant zircon, tourmaline, and apatite, and sporadic garnet at the top. The matrix is kaolinite and muscovite.

The Precipice Sandstone overlies a basin-wide unconformity and is regarded as the basal unit of the Surat Basin. Compared to the underlying Triassic sandstone, Fehr (1965) found that in the Precipice Sandstone the quartz content is high, sorting is poor, and there is an increase of the coarse sand and conglomerate fractions. Porosity and permeability are moderate partly because grains are rounded and the kaolinitic cement is sparse. Feldspar, mainly K-feldspar, is generally less than 10 percent. Rounded tourmaline, zircon, and angular garnet are the main accessory minerals.

The formation thins eastward against the Kumbarilla Ridge, extending little beyond the Mimosa Syncline except in the far north (Fig. 5), where it intertongues with the Helidon Sandstone of the Ipswich Basin (see 'Helidon Sandstone'). It also thins southward. In the north, typical thicknesses are 200 m in UKA Cabawin No. 1 and 120 m in Toombilla No. 1 east of the Moonie Fault. In the south typical thicknesses are 92 m in Tingan No. 1 and 52 m in Goondiwindi No. 1, with no Precipice in Yarril Creek No. 1 east of the Goondiwindi Fault.

Spores belong to Evan's (1964a) division J1 of Lower Jurassic age.

Evergreen Formation

Whitehouse (1952; 1955) applied the name 'Evergreen Shales' to shale sections below the Boxvale Sandstone, in the valley of the Dawson River immediately below Evergreen Homestead (northeast of Injune). The shales are clayey, commonly micaceous, and white to yellowish. In weathered exposures, they are commonly thin, reddish, and ferruginous. Later studies (Jensen et al., 1964; Mollan, Exon, & Kirkegaard, 1964) showed that even in the type area there is also a shaly sequence above the Boxvale Sandstone. (The Boxvale Sandstone lenses out towards the centre of the Mimosa Syncline and is not present in the Dalby-Goondiwindi area). Jensen et al. (1964) included the 'Evergreen Shales' and 'Boxvale Sandstones' of Whitehouse, together with the oolite member, and the shaly sequence about it, into one unit and called it the 'Evergreen Formation'.

The Evergreen Formation is present in the subsurface in most of the Surat Basin and in most of the Goondiwindi-Dalby area, where it is characterized by a predominance of light brown, dark brown and grey clayey or sandy carbonaceous siltstone. The base is transitional to the Precipice Sandstone. Two subunits with similar rock types, but different bulk lithologies, were recognized and described by Fehr (1965) and Bastian (1965). The lower one, predominantly silty, consists of dark grey siltstone with fine coaly debris, fine-grained sandstone, and thin coal seams. Tuffaceous sandstone and brown and grey siltstone and shale alternate (Fehr, 1965). The sandstone is greenish grey to grey and is generally similar to the Precipice Sandstone, except that tuffaceous components are more abundant. Accessories include angular garnet, in places abundant, and glauconite which appears sporadically in UKA Cabawin No. 1 (Bastian, 1965).

The upper, predominantly shaly, subunit is of more uniform thickness than the lower one, and averages about 60 m. The base is marked by a thin, basinwide pelletal claystone with distinctive petrological features (Fehr, 1965) and is easily recognized on the electric logs (Bastian, 1965). The sandstone is porous and quartzose; the quartz grains are variably rounded but appear, on average, to be somewhat less rounded than those of the Precipice Sandstone. The feldspar content is commonly less than in the Precipice Sandstone. The pellets are probably glauconite, rather than the chamosite of the type area, and are most commonly translucent brown; they probably formed during or slightly after deposition. Above the basal bed the upper subunit is almost entirely shaly mudstone with subordinate siltstone, and some very fine-grained sandstone near the top. In UKA Minima No. 1 the upper interval is more sandy, but the basal sandstone is still easily identified.

The Evergreen Formation conformably overlies the Precipice Sandstone in the Mimosa Syncline, but overlaps it and rests directly on the Carboniferous basement on much of the Kumbarilla Ridge and Texas High. In the central part of the Cecil Plains Syncline it rests conformably on the Helidon Sandstone, and passes laterally into the lower part of the Marburg Sandstone around the margins both of the syncline and of the Surat Basin around the Yarraman Block and the Texas High (Fig. 1).

The Evergreen Formation was deposited on and near a coastal plain. The absence of coarse clastic material is probably caused by lack of relief in the hinterland. Most of the formation was deposited on floodplains and in deltas. The presence of oolites, glauconite, and acritarchs at the base of the upper subunit points to a period of marine deposition, and Jensen et al. (1964) concluded that conditions at that time must have been slightly reducing, with gentle wave or tidal action. Terpstra (Appendix 2 <u>in</u> Evans, 1962) reported the presence of four genera of arenaceous foraminifera, and

Evans (1962) of hystrichospheres, at 5 354 feet (1 632 m) in Core 4 of UKA Moonie No. 1. The spore assemblage at this level includes Tsugaepollenites segmentatus which characterizes Evans' (1966) spore division J2. This horizon appears to be just below the oolitic (pelletal) horizon in the well.

The formation is thickest in the central parts of the Mimosa and Cecil Plains Synclines - 260 m in Phillips Cecil Plains No. 1 - but seldom thins to less than 180 m except where it rests on basement.

Spores, pollen, and microplankton are common and a Liassic palynological assemblage was described by de Jersey & Paten (1964) from Moonie No. 1. Basinwide work by Evans (1966) showed that the sequence below the oolitic (pelletal horizon belonged to his division J1, and within and above the oolitic horizon to his division J2, both of Lower Jurassic age.

Hutton Sandstone

The name Hutton Sandstone was first used by Reeves (1947) for sandstone in the vicinity of Westgrove Station on Eddystone Sheet area. The type section was measured near Hutton Creek, east-northeast of Injune (Mollan et al., 1972). In the type area the formation is almost entirely friable fine to medium-grained, thick-bedded, crossbedded quartzose to sublabile sandstone. The unit is very widespread in the Surat Basin, and over most of this area is present in the subsurface.

In the subsurface it is a friable, porous sandstone which contains more siltstone and mudstone interbeds than in the type area. Detailed petrological examination was carried out by Fehr (1965) and Bastian (1965). In general the base of the unit is clearly marked by thick beds of white quartz sandstone (Fehr, 1965). Quartz grains are less rounded than in the Precipice Sandstone, and feldspar and tuffaceous fragments are almost absent from the fine fraction, although rare fragments of metamorphic rock are present. This, and the presence of coarse flakes of muscovite, sporadic biotite, and very minor garnet, suggest a metamorphic source for the sandstone. Streaks of calcite cement are common throughout and glauconite occurs sporadically.

Bastian (1965) subdivided the formation into two subunits. The lower subunit consists of numerous beds of white or very light grey, fine to very fine-grained sandstone, interbedded with claystone, shale, and brown siltstone, and minor coal. It grades into the upper subunit of light grey sandstone and thin intercalations of dark shale. The sandstone is generally fine-grained, in places medium to coarse-grained, and well sorted. It contains up to 85% quartz, mostly subrounded, and up to 15% feldspar, predominantly orthoclase and microcline. Zircon and angular garnet are common accessories. The matrix is sparse, but compaction and quartz overgrowths have greatly reduced porosity.

The Hutton Sandstone conformably overlies the Evergreen Formation, and in this area grades laterally into the more labile upper part of the Marburg Sandstone around the basin margins.

It was laid down by streams on coastal plains. Plentiful garnet suggests a similar source to that of the Precipice Sandstone (Bastian, 1965), and the much higher feldspar content is probably due to lower maturity rather than difference in source.

The Hutton Sandstone is generally 170 to 210 m thick throughout most of the area. It has a maximum thickness of 243 m in Cecil Plains No. 1, and it thins southward. It contains spores of Evan's (1966) divisions J2-J3, of Lower Jurassic age.

Helidon Sandstone

The name 'Helidon Series' was used by Dunstan (1915) and 'Helidon Sandstone' by Richards (1918), in discussing the building stones near Helidon, east of Toowoomba. McTaggart (1963a) accurately mapped and defined the formation in the type area. The Helidon Sandstone is confined to the Moreton Basin, cropping out as far west as White Mountain (15 km NNE of Helidon) and as far east as Lowood.

Near Helidon it consists of 250 m of medium to very thickly bedded, commonly cross-bedded, white, weathering to brown, feldspathic sublabile sandstone and lesser siltstone. The sandstone contains yellowish clayey rock fragments and considerable clay matrix. McTaggart (1963a) reports a persistent basal conglomerate, and that the sandstone becomes finer grained, more massive and less coloured, upward.

In the Dalby Sheet area the formation is present in the subsurface east of the Kumbarilla Ridge and north of Millmerran, where the name Helidon Sandstone is preferable to the name Precipice Sandstone commonly used by oil exploration companies. Meyers (1970) has shown that the lower parts of the Helidon Sandstone (most of Meyers 'Lower Precipice') and Precipice Sandstone do not link up across the Kumbarilla Ridge, and that the upper parts join only north of Kumbarilla.

According to Meyers (1970), who made a detailed study of well information, the formation is divisible into a lower shaly part, a middle sandstone part, and an upper sandstone-shale part. The lower shaly part is interpreted by Hogetoorn (in Meyers, 1970), and the authors, as Raceview Formation. This interpretation agrees with the spore evidence (e.g. de Jersey, Paten & Hamilton, 1964) and means that Helidon deposition begins with sand, as in the type area.

Thus there is a lower sandstone sequence and an upper sandstone-shale sequence in this area. The lower sequence consists (see Meyers, 1970) largely of porous, generally coarse-grained, quartzose to sublabile sandstone, with a few grey shaly interbeds. The sandstone contains subangular quartz grains and some quartz pebbles, and generally has a siliceous cement and a clay matrix. The upper sequence consists of sandstone and shale in roughly equal proportions. The sandstone is sublabile, light grey, generally fine to medium-grained, and the clasts are subrounded quartz, minor lithic grains and feldspar, and rare red garnet. It is generally non-porous, with a clay matrix, and is characterized (as in the type area) by abundant orange to yellow weathered grains. The greyish shaly beds contain 'black oolites' in Phillips Wilkie No. 1 and Cecil Plains No. 1.

The Helidon Sandstone disconformably overlies the Raceview Formation in much of this area, and unconformably overlies the Permo-Carboniferous basement rocks on the Kumbarilla Ridge. It gives way westward to the Precipice Sandstone, and eastward to the Ripley Road Sandstone at the West Ipswich Disturbance.

The formation is thickest in the Cecil Plains Syncline (146 m in Phillips Cecil Plains No. 1). Meyers (1970) suggests that the major source area, consisting of metamorphic and possibly igneous rocks, lay to the east. Deposition was largely fluviatile, with initial energetic deposition of point bar and channel sands giving way to lower energy deposition later. The oolites high in the sequence indicate periods of shallow marine conditions.

Miospore assemblages (de Jersey, 1971) give a Liassic (lowermost Jurassic) age to the formation, whereas the apparently laterally continuous Riplay Road Sandstone is largely of Rhaetic (uppermost Triassic) age. Thus Ripley Road deposition in the east started earlier than deposition of the Helidon and Precipice Sandstones in the west.

Marburg Sandstone

Reid (1921) subdivided the Walloon Coal Measures into the Marburg Stage and the overlying Rosewood Stage. In the type area near Marburg, the formation consists of torrentially cross-bedded calcareous sandstone and some shale, silty sandstone, grit, and conglomerate. Swindon (1956, 1960) used the term Marburg Sandstone in his description of the sandstones in the type area. McTaggart (1963a) mapped the Marburg Formation in the Lockyer-Marburg area and divided it into two parts. The lower part consists of calcareous lithic sandstone, siltstone, and mudstone, with lesser conglomerate. The upper part (Heifer Creek Sandstone) was described as 200 m of 'coarse ferruginous siliceous sandstone with minor shale and flaggy sandstone beds'. McTaggart correlated the formation with the Evergreen Formation and Hutton Sandstone of the Surat Basin. Jorgenson & Barton (1966) in a photogeological survey supported McTaggart's interpretation. They equated the Heifer Creek Sandstone Member with the Hutton Sandstone, and the lower Marburg Formation with the Evergreen Formation. Regional mapping of the Chinchilla 1:250 000 Sheet area (Exon et al., 1968) showed that this was likely interpretation. Casey, Gray, & Reiser (1968) suggested that the subdivision of the Marburg Sandstone cannot be maintained regionally and that precise correlation was not possible, at that stage. Recent work in the Ipswich-Moreton Basin shows that even in the type area of the Marburg Sandstone it is difficult to distinguish individual members. In the Cecil Plains Syncline we regard the Marburg Sandstone as a marginal equivalent of the basinal Hutton Sandstone and Evergreen Formation.

The Marburg Sandstone crops out in the Goondiwindi Sheet area and in the northeastern Dalby Sheet area. In outcrop in the south it consists of pale yellow to white quartzose to sublabile sandstone. The sandstone is medium-grained, angular to subangular, poorly to moderately sorted, porous, with small quartz pebbles, garnet grains, and in some places feldspar. Some white fine to medium-grained silty and clayey sandstone, together with thin bedded siltstone and mudstone, often containing unidentifiable plant debris, occur higher in the sequence. Thin beds of coarse clastics and breccia are present throughout the sequence.

In northeast Goondiwindi Sheet the sandstone is coarser and basal conglomerates and breccias rest on basement. The breccias consist mostly of quartz fragments, but in places fragments similar to the underlying Palaeozoic rocks are common. These thin basal beds grade upwards gradually into coarse and medium-grained labile, sublabile, and quartzose sandstone. These sandstones are generally poorly sorted, angular to subrounded, and consist essentially of 30-45% quartz, 15% feldspar, predominantly orthoclase, 40-50% matrix and 5-10% rock fragments. Muscovite and biotite and minor zircon and tourmaline are also present. Iron staining is common and, especially in outcrop, the sandstones are commonly ferruginized.

The shallow hole BMR Goondiwindi No. 3 (Fig. 6) encountered grey, grey-brown, and brown, feldspathic, clayey sandstone with minor siltstone and mudstone. In the northeast of Dalby Sheet the unit consists of labile to sublabile sandstone, pebbly in places. Fifty kilometres north of this area, in shallow hole BMR Chinchilla No. 9 (Fig. 7) there are 100 m of mostly white and grey, feldspathic to sublabile sandstone, with minor siltstone, carbonaceous fragments, fossil plant debris, and also some large chert fragments in the lower part of the section. In BMR Goondiwindi No. 4 (Fig. 8) there is a general decrease in grainsize and increase in resistant lithic grains up the sequence. The sandstones consist essentially of subangular quartz and clay in roughly equal portions, suggesting that labile constituents broke down to clay soon after deposition.

The thickness of the Marburg Sandstone increases from 250-330 m in the south to 500 m near Dalby. In the Goondiwindi Sheet area the unit rests unconformably on Permian granite and Carboniferous basement rocks. In the Dalby Sheet area it is conformable on the Helidon Sandstone.

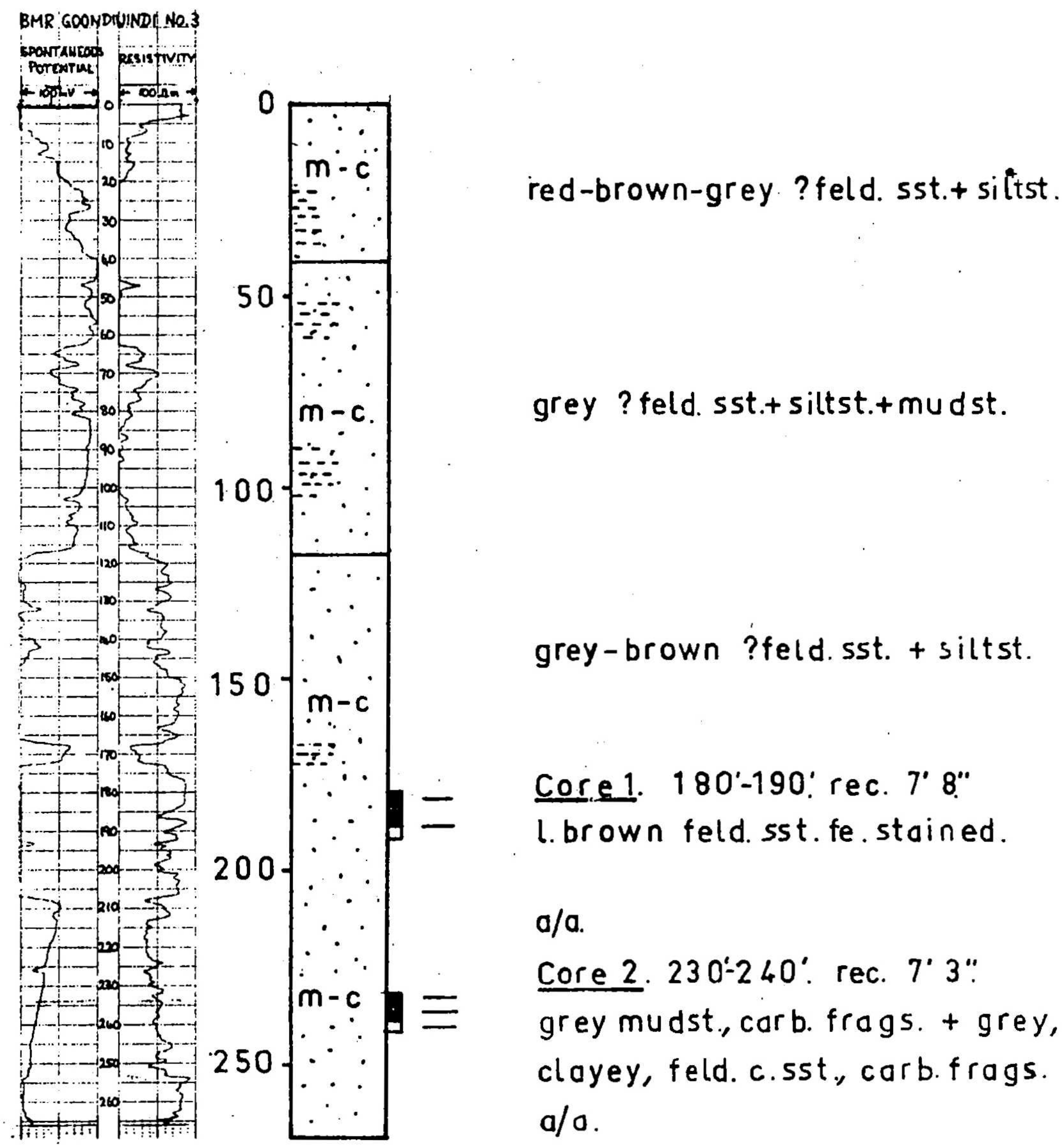
The formation was deposited by rapid streams draining the Texas High and Yarraman Block. The very coarse basal polymictic conglomerates near the Texas High were probably laid down during major floods, and in general they filled stream valleys not very far from the source areas. Deposition of progressively finer grained, poorly sorted labile, sublabile, and quartzose sandstones, with some siltstone followed, as gradients decreased. Measurements of cross-bedding indicate north to northwesterly flowing streams near the Texas High.

Fossils are rare apart from plant impressions preserved in beds of red sandstone. Most are unidentifiable and the only plant fossils identified in proven Marburg Sandstone are the long-ranging Taeniopteris spatulata and Cladophlebis australis in the type area (Reid, 1922). Reid also recorded the freshwater bivalves Unio and Unionella? A jaw fragment of a labyrinthodont, Austropelor wadleyi, was collected from the uppermost Marburg Sandstone at Lowood (Longman, 1941). Whitehouse (1954) suggested on this evidence that the sandstones at Lowood are Upper Triassic, but later workers (e.g. de Jersey, 1960), have suggested that the labyrinthodont fragment is reworked.

The microflora and the conformable relationship with the overlying Walloon Coal Measures (de Jersey, 1963) provide strong evidence that the whole of the Marburg Sandstone is Jurassic. Classopollis occurs down to the lowest known outcrop of the formation at Lowood and forms such as Ischyosporites, Taurocusporites, Lycopodiumsporites rosewoodensis, and Laricoidites turbatus are known from Jurassic sediments elsewhere, but have not been found in the Triassic. Comparison with Jurassic microfloras from Western Australia by de Jersey (1963) suggests a Liassic age (possibly extending into the Bajocian) for the formation.

DRILL HOLE B.M.R. GOONDIWINDI No 3.

MARBURG SANDSTONE.



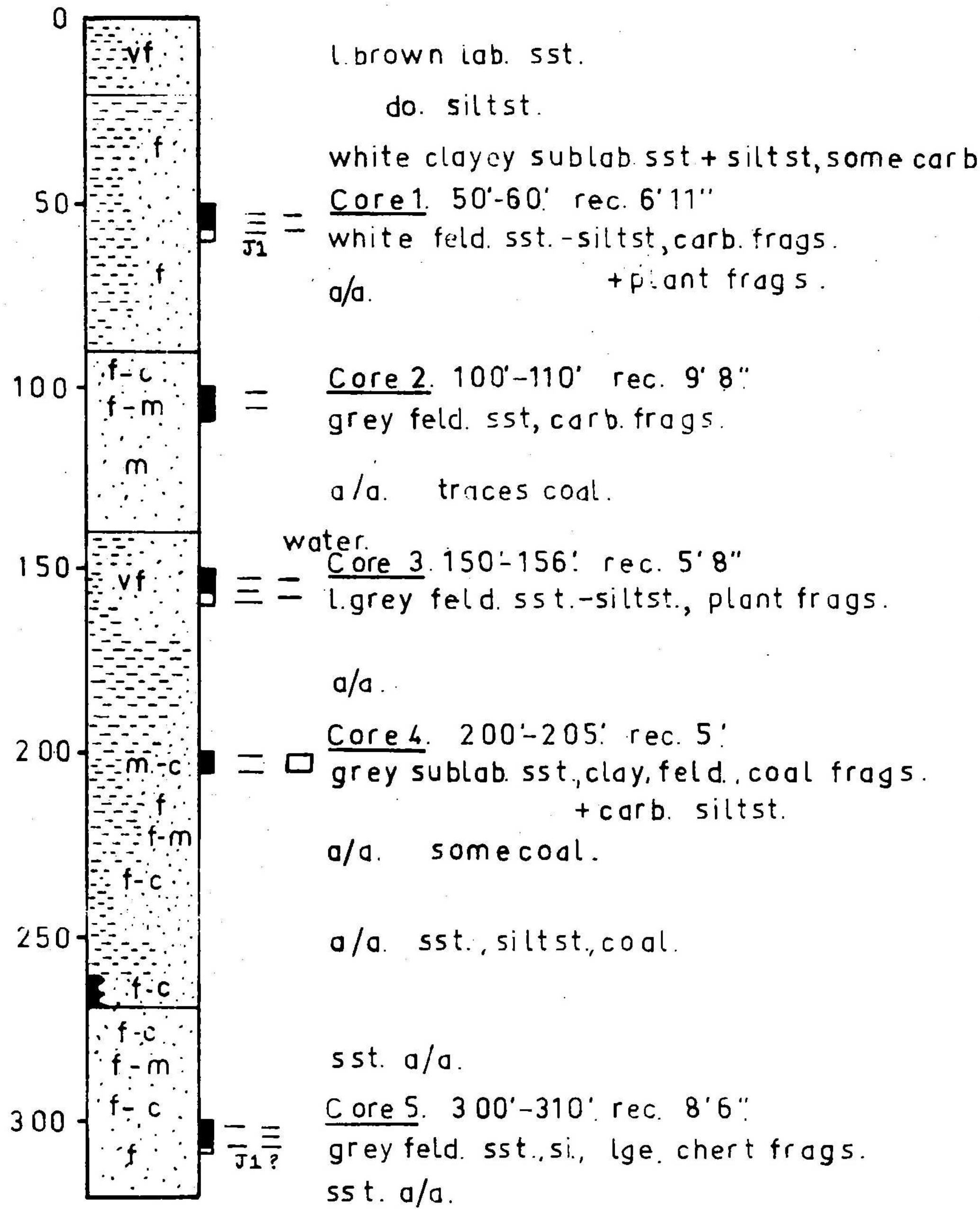
Depths in feet

H56/A1/2 to accompany Record 1972/53

FIG. 6

DRILL HOLE B.M.R. CHINCHILLA No. 9.

MARBURG SANDSTONE.



Depths in feet

Walloon Coal Measures

The 'Walloon Beds' were first named by Cameron (1907) in the Walloon-Rosewood area in the Moreton Basin. Reid (1921) renamed them Walloon Coal Measures. Whitehouse (1954) designated a type area near the town of Walloon. Gould (1968) states 'the name is now applied to the coal measures conformably resting on the .... Marburg Formation in the Clarence-Moreton basin'. The poorly outcropping coal measures are about 200 m thick in the type area, where drilling shows them to consist of light grey mudstone, siltstone, fine-grained clayey lithic sandstone, and thin coal seams. When exposed to the weather, the sandstone, which has a montmorillonitic matrix, disintegrates rapidly, and sandstone is rare in outcrop. In the subsurface the proportion of sandstone varies greatly.

The Walloon Coal Measures crop out extensively in the Moreton Basin, and extend over the Kumbarilla Ridge into the Surat Basin, where they can be traced in the subsurface to the western side of the Mimosa Syncline. They are very widespread in this area in the subsurface, although outcrop is rare and poor.

In the subsurface the formation consists of lithic sublabile and lithic sandstone, siltstone, carbonaceous mudstone, and coal. The sandstone is generally fine-grained, calcareous in part, and the clasts are largely intermediate volcanics. The formation is readily identified on electric logs by the high narrow peaks associated with coal seams.

Most outcrops are fine-grained calcareous lithic sandstone and siltstone. In northeastern Dalby Sheet, in places where it is not covered by alluvium, thinly interbedded calcareous labile sandstone, siltstone and mudstone predominate. South of Millmerran light brown or grey, cross-bedded very fine to medium-grained feldspathic sandstone predominates. When fresh the sandstone is calcareous, but weathering has concentrated the calcite in concretions in some beds, leaving friable sandstone outside the concretions.

In the south, brown, thinly bedded, feldspathic to feldspathic sublabile sandstone crops out. This is fine to medium-grained and well sorted, and the grains are angular. Typical sandstones (Appendix 1) consist essentially of 25-30% quartz, 10-30% feldspar, (mostly orthoclase), 2% rock fragments, and 50% clayey or calcitic ferruginous matrix. Accessory minerals include muscovite, biotite, tourmaline, and rutile.

The Walloon Coal Measures rest with a gradational contact on the Marburg Sandstone. In outcrop, in places, the fine to medium-grained, medium-bedded, sublabile porous Marburg Sandstone grades upwards over 10 to 20 m into fine to very fine-grained labile sandstone and mudstone, with lesser siltstone (the Walloon Coal Measures). In BMR Goondiwindi No. 4 (Fig. 8) the fine-grained sandstone and siltstone of the uppermost Marburg Sandstone grade upward into the mudstone and siltstone of the Walloon Coal Measures; the lowest Walloon coal seam is about 15 m above the lowest mudstone. West of the Dalby and Goondiwindi Sheet areas, on the western flank of the Mimosa Syncline, the coal measures grade laterally into the thinner, more sandy and less coaly sediments of the Birkhead Formation.

The Walloon Coal Measures were deposited largely in swamps and lakes, with meandering streams laying down sand. The andesitic volcanic debris was probably provided by contemporary volcanism; that this was so is suggested by the freshness of the lithic grains, and the presence of montmorillonite (normally a volcanic derivative). The Jurassic feeders may have lain to the east in areas which have since drifted away from Australia.

The unit is generally 350 to 450 m thick on Dalby Sheet, and retains its thickness across the Kumbarilla Ridge, but thins to less than 120 m in the southern part of Goondiwindi Sheet. Plant leaves and stems are abundant, but the plants are long-ranging. De Jersey & Paten (1964), working on the microflora, assigned a Middle Jurassic age to the unit in the type area, and a similar age is assumed for the unit in this area.

Kumbarilla Beds

'Kumbarilla Beds' is a term used for mapping the combined Springbok Sandstone to Bungil Formation units where they could not be distinguished at the surface owing to poor outcrop and deep weathering (Exon & Vine, 1970). The unit was named after Kumbarilla township west of Dalby and the type area is from a few kilometres west of Cecil Plains through Kumbarilla to a few kilometres east of Tara. Fresh sediments are exposed along the road west from Kumbarilla south of the Moonie River, and in the river. Deeply weathered material is well exposed along the Glenmorgan branch railway line through Kumbarilla. Sandstone, siltstone, and mudstone, with some conglomerate, typify the unit in the type area. The sandstone varies from very fine to coarse, and from quartzose to lithic and calcareous. The siltstone and mudstone varies from laminated to massive but fairly well bedded. The conglomerate is polymictic.

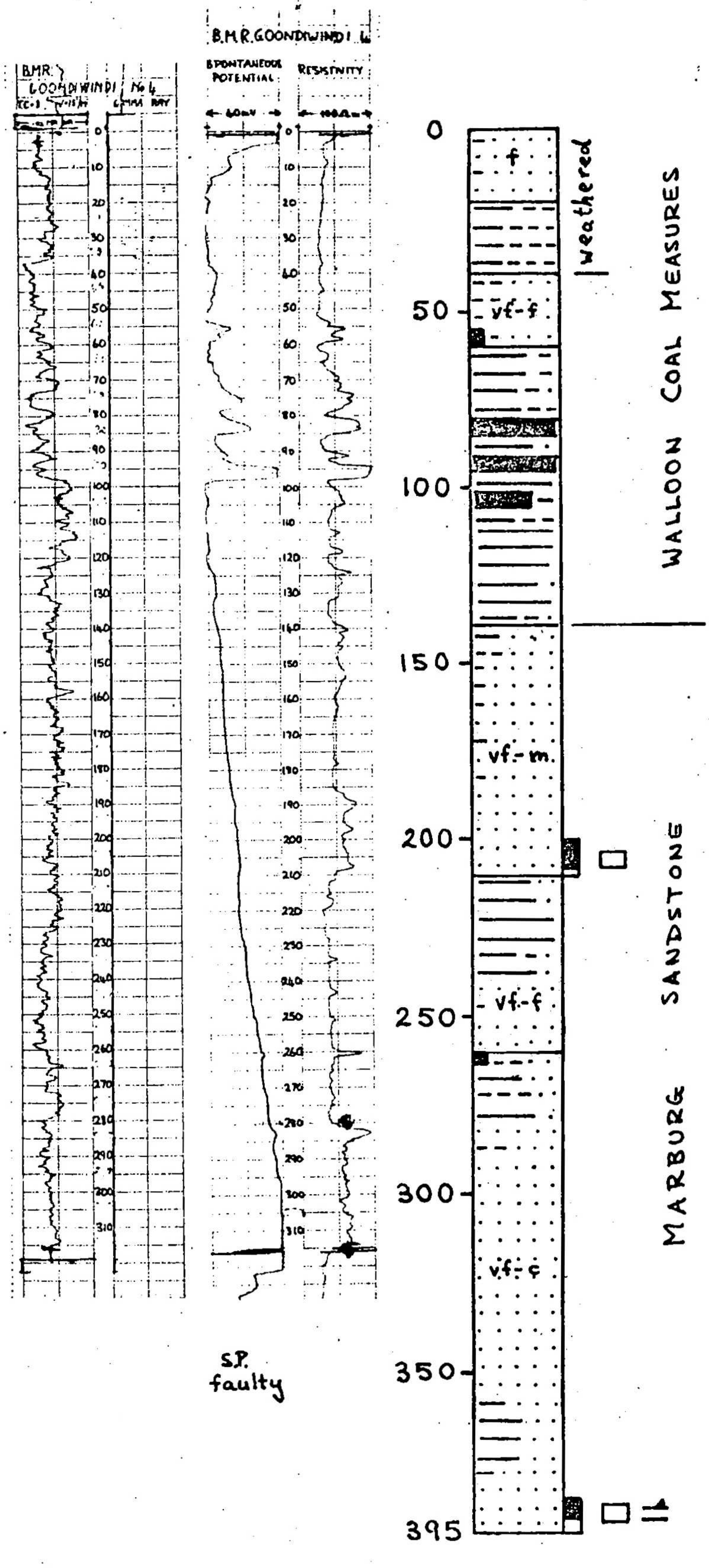
The sandstones (Appendix 1) are very similar throughout the section in the Dalby and Goondiwindi Sheet areas. They are white to pale grey, thickly cross-bedded, very clayey and lithic, with less than 50% quartz. Almandine garnet is common. In most places the sandstone is deeply weathered, and leaching of labile rock fragments and cement gives the impression that the sandstones are more quartzose and porous than their equivalents in the subsurface.

The units recognizable in the subsurface (e.g. UKA Cabawin No. 1) can in places be identified in outcrop, although they cannot be readily mapped (see sections on Springbok, Gubberamunda, Orallo, Mooga, and Bungil Formations below). For example, Springbok sediments are recognizable immediately west of Cecil Plains and Gubberamunda sediments in a meridional strip starting 15 km west of Cecil Plains; the calcareous sandstones and siltstones around Kumbarilla are typical of the Orallo Formation.

The Kumbarilla Beds crop out as a broad arc of sandy country, as far south as Inglewood on the Goondiwindi Sheet, where they are obscured by the alluvial plains of the Dumaresq-Macintyre River system. They conformably overlie the Birkhead Formation. Where it could be mapped, on northern Dalby Sheet, the Bungil Formation was separated from the Kumbarilla Beds, but on the southern part of Dalby Sheet and on Goondiwindi Sheet its equivalent has been included in the Beds.

DRILL HOLE BMR GOONDIWINDI 4

WALLOON COAL MEASURES AND MARBURG SANDSTONE



yellowish to pale brn v. clayey sst.

pale grey or brn clayey siltst and mudst, some carbonaceous.

v. clayey sst and siltst.

grey clayey siltst; mudst, some carbonaceous; white v.f. clayey sst, some calcareous; coal

white to pale gry v. clayey sst c̄ subangular quartz grains, some dark rock fragments. Slightly calcareous at some levels

Core 1 200 - 210'. Recovery 8'3½"
v. clayey sst c̄ some carbonaceous parting. Subangular quartz 50%, minor dark rock fragments, v. minor biotite.

medium grey slightly carbonaceous mudstone, v. clayey sst.

white to pale grey v. clayey sst, some calcareous. Quartz grainsize increases, rock fragment content decreases, downward.

Core 2 385 - 395'. Recovery 6'2"
white v. clayey sst, c̄ subangular quartz grains. Clay leached in places, leaving good porosity.

Depths are in feet

H56/A1/3 to accompany Record 1972/53

FIGURE 8

The subsurface equivalents of the Kumbarilla Beds are thickest in the deepest parts of the Mimosa Syncline, and thin southward and eastward (e.g. 708 m in Cabawin No. 1, 576 m in Tingan No. 1, and 525 m in Goondiwindi No. 1). The unit probably continues to thin eastward, with reduced outcrop thicknesses.

The Kumbarilla Beds are probably mainly freshwater, apart from the uppermost beds, which are comparable with the marine Minmi Member of the Bungil Formation in the Roma area. Deposition was mainly from currents, either in streams or on lake bottoms. Well bedded siltstone and mudstone are overbank and lake deposits. In the type area palaeocurrent directions are to the northwest near the Texas High and to the east farther west.

Long-ranging plant species have been collected from several localities (White, 1969). Spores from high in the beds in BMR Dalby No. 4 (Kemp, Appendix 5) are assigned to Evans' (1966) division K1a of presumed Neocomian to Aptian age. As the beds are equivalent to the sequence from the Springbok Sandstone to the Bungil Formation, their age is probably Middle Jurassic to Lower Cretaceous.

Springbok Sandstone

The Springbok Sandstone was named and defined as the Springbok Sandstone Lens by Exon (1966), after the Parish of Springbok (Roma Sheet area). It was renamed the Springbok Sandstone Member (Exon, Milligan, Casey & Galloway, 1967) and later revised by Power & Devine (1968) to Springbok Sandstone. It is largely sandstone with some interbedded siltstone and mudstone. The sandstone is generally labile, but ranges from feldspathic to lithic, and is generally calcareous. The formation is widespread in the Surat Basin and in this area.

In the subsurface in this area the unit consists of white to light grey lithic sandstone, interbedded with siltstone and mudstone. In the lower part the sandstone is medium to coarse-grained and pebbly, lithic, calcareous, very porous or cemented with clayey matrix. The interbedded siltstone and mudstone are grey to brown, soft, carbonaceous, and micaceous. Cores from UKA Cabawin No. 1 and BMR Dalby No. 1 (Appendix 1) show typical sandstones to be essentially 35-45% quartz, 5% feldspar, 15-20% rock fragments and 30% matrix, with up to 5% garnet. The sequence in BMR Dalby No. 1 (Fig. 9), which by comparison with Phillips Cecil Plains West No. 1 must be lowermost Springbok Sandstone, is a monotonous sequence of clayey, fine to medium-grained, lithic to lithic sublabile sandstone, with minor coal. In outcrop in the same area it is strongly leached and very friable.

The Springbok Sandstone rests conformably on the Walloon Coal Measures and is the lowermost part of the sandy Kumbarilla Beds in outcrop. In the subsurface, especially in the southern part of this area, it is often hard to distinguish from the overlying Gubberamunda Sandstone. Study of cores in UKA Cabawin No. 1 (Exon & Vine, 1970) has shown that the abundant clay in the Springbok Sandstone was derived from weathered volcanic rock fragments, indicating that the sandstone was highly labile - much more so than that of the Gubberamunda Sandstone. The Springbok Sandstone was deposited by streams and in deltas and lakes.

The Springbok Sandstone is 260 m thick in UKA Cabawin No. 1 and thins towards the eastern edge of the Surat Basin. In UKA Minima No. 1 further south, it is 175 m thick. No fossils have been found in this area but, on stratigraphic grounds and by correlation with other parts of the Surat Basin, it is probably late Middle Jurassic.

Gubberamunda Sandstone

The name 'Gubberamunda Sandstone' was first used by Reeves (1947). Day (1964) nominated the type area near Roma, where he described the formation as being medium to coarse-grained poorly cemented sandstone. In the general Roma area, in outcrop, it consists of quartzose to sublabile sandstone and lesser conglomerate, siltstone, mudstone and claystone (Exon et al., 1967). The unit is widespread in the Surat Basin, and in this area.

In the subsurface the unit is dominantly very clayey sandstone, which is apparently quartzose. However, examination of these sandstones in thin section (e.g. Exon & Vine, 1970) shows that much of the 'clay matrix' is actually weathered volcanic rock fragments, and hence the original rock type was a sublabile or labile sandstone. A typical sandstone is around 50% quartz, 5% feldspar, 10% identifiable rock fragments, and 30% clay matrix which is probably largely altered rock fragments, and contains accessory garnet and iron minerals. Pebbly sandstone, and some siltstone in the upper part of the sequence, are the only other rock types present.

Although the Gubberamunda Sandstone has not been mapped in this area, it can be identified in places. Thus the meridional strip of scarp-forming sandstone some 15 km west of Cecil Plains is similar to the Gubberamunda Sandstone of the type area. Outcrops on the Cecil Plains/Dunmore homestead road consist of medium to coarse-grained leached and ironstained quartzose sandstone. Beds are generally thick and display both planar and scour cross-bedding, but some thinner beds with climbing ripple marks (Conybeare & Crook, 1968) are also present.

The Gubberamunda Sandstone is limited today to the Mimosa Syncline and Kumbarilla Ridge, but was almost certainly also deposited in the Cecil Plains Syncline. It conformably overlies the Springbok Sandstone, and in the north is readily differentiated from it on electric logs of petroleum exploration wells, in that it contains more porous beds saturated with fresh water and thus resistivity values are higher. However, farther south differentiation is very difficult. Lithologically it contains more sandstone than the Springbok Sandstone, is less labile, and is seldom calcareous.

The formation was largely laid down by streams, whose gradients decreased with time. It is generally about 150 m thick in this area. Spores of Evan's (1966) division J6, of Upper Jurassic age, were found in the unit on the Surat Sheet area (Thomas & Reiser, 1968).

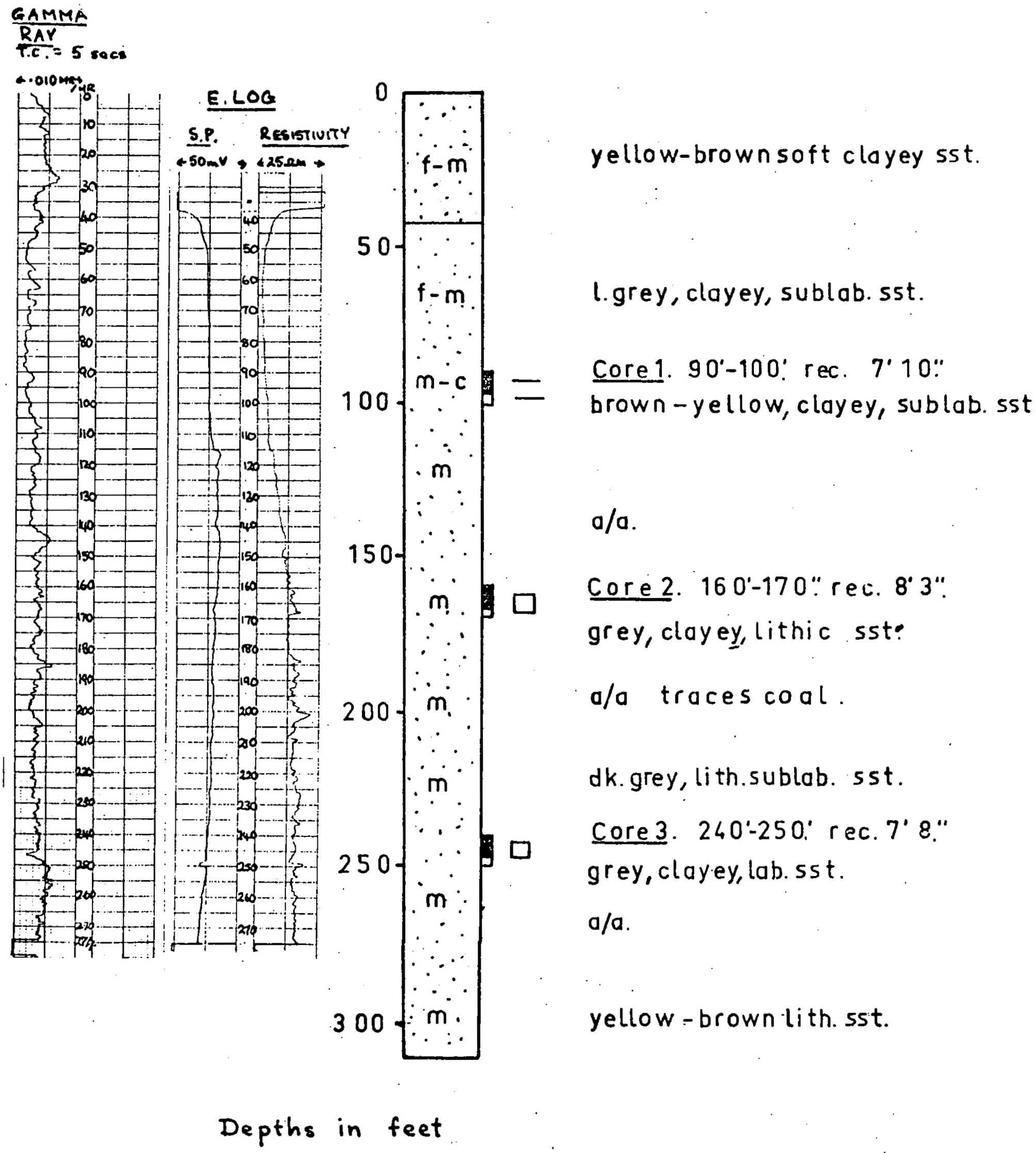
Orallo Formation

Day (1964) formally used the name 'Orallo Formation' to replace the 'Orallo Coal Measures' of Jensen (1960), as the sequence has no known workable coal. The Orallo Formation is the 'Fossil Wood Stage' of Reeves (1947) and the 'Fossil Wood Beds' of Whitehouse (1954). Typical rock types in the type area near Orallo (Exon et al., 1967) are thin-bedded siltstone and friable, medium to coarse-grained, calcareous lithic sandstone; fossil wood is abundant. Minor constituents are bentonite and coal. The formation is widespread in the Surat Basin and, in this area, is present in the subsurface

DRILL HOLE B.M.R. DALBY No. 1.

KUMBARILLA BEDS.

(SPRINGBOK SANDSTONE).



G56/A13/14 to accompany Record 1972/53

FIG. 9.

in the Mimosa Syncline, and can, in some places, be recognized in outcrop within the Kumbarilla Beds on the Kumbarilla Ridge.

In the subsurface it consists of lithic sandstone and siltstone in roughly equal proportions. The sandstone is white to light grey, fine to medium-grained, and the grains are subangular. In hand specimen, the sandstone consists largely of quartz grains set in an abundant clay matrix. Thin section examination has shown that most of the clay is altered volcanic rock fragments. Typical sandstones in UKA Cabawin No. 1 (Exon & Vine, 1970) contain 40% quartz, 5% feldspar, 20-25% easily identified rock fragments, 25-30% clay (largely from rock fragments), 5% iron minerals, and minor biotite and almandine garnet. Pebbly sandstone is common low in the formation.

Typical Orallo sediments are particularly well exposed in the area east of Kumbarilla and south of Weranga, especially along the Moonie River (e.g. at locations of cross-bedding symbols on map). Here they include both thickly cross-bedded medium to coarse-grained sandstone (lateral accretion deposits) and thinly bedded fine-grained sandstone and siltstone (vertical accretion deposits). The cross-bedded sandstone is leached and friable, with very little of the original clayey and calcareous matrix remaining. It contains some granules and fossil wood (ferruginized or clayey) layers, and polymictic pebble and cobble beds. Centimetre-thick bentonite seams occur in the Weranga area. Thin-section examination of outcrop sandstones (Appendix 1) shows them to be essentially similar to their subsurface equivalents, although leached. Volcanic rock fragments generally, but not always, greatly predominate over feldspar.

The Orallo Formation conformably overlies the Gubberamunda Sandstone; the boundary is commonly not clearly expressed in well logs. The situation is similar to that on Surat Sheet, where Thomas & Reiser (1968) suggested that the boundary was gradational and that both it and the upper boundary of the Orallo Formation were strongly time transgressive. In outcrop, because of lack of exposure and widespread deep weathering, the unit has been mapped as Kumbarilla Beds.

The formation was largely deposited by streams which, in the Kogan-Kumbarilla area at least, flowed in an easterly direction. Coarser sand and gravel was deposited in stream channels, and fine sand and silt in overbank deposits. The source material was largely volcanic, and the bentonite horizons point to some contemporaneous explosive volcanism. The sequence was weathered before burial, causing the breakdown of rock fragments to clay.

The formation is about 210 m thick in UKA Cabawin No. 1 and Minima No. 1, and thickens southward to roughly 290 m in Goondiwindi No. 1 and 305 m in Tingan No. 1. Plant fossils are common but the species are long-ranging. Spores of Evans' (1966) division J6 of Upper Jurassic age have been found in the adjacent Surat Sheet area (Thomas & Reiser, 1968).

Mooga Sandstone

The Mooga Sandstone was named by Reeves (1947) and its type area was defined by Day (1964). The type area was later redefined by Exon & Vine (1970) as 'Parish of Mooga in the area near the junction of Bungil and Mooga Creeks, extending from where the Carnarvon Highway crosses Bungil Creek to a point about 1 mile south of this crossing'. The lithology in the type area is very uniform, consisting of over 30 m of quartzose to sublabile sandstone with only minor amounts of clayey sandstone, siltstone, and mudstone. The sandstone is dominantly grey to yellowish brown, moderately resistant and fine-grained. The formation is widespread in the Surat Basin and in this area.

In the subsurface of the Dalby-Goondiwindi area, the Mooga Sandstone consists of clayey quartzose to sublabile sandstone, interbedded with carbonaceous siltstone and mudstone. The sandstone is light to dark grey, very fine to medium-grained, subangular to subrounded, soft, with white clay matrix. In UKA Cabawin No. 1 the formation consists largely of sandstone but in UKA Tingan No. 1 mudstone and siltstone predominate. In Tingan No. 1 light grey to dark brown carbonaceous mudstone is intercalated with light to dark brown argillaceous siltstone containing laminae of carbonaceous material. A few medium to thick beds of light to medium grey, medium to coarse-grained, poorly sorted, friable, lithic sandstone, loosely cemented with soft white clayey matrix, are interbedded in the argillaceous sequence.

The Mooga Sandstone is conformable on the Orallo Formation, from which it is relatively easily separated in exploration well logs in much of the area, because its common porous sandstone beds saturated in fresh water give high resistivity values. Undoubted Mooga Sandstone is rare in outcrop and the formation has been included in the Kumbarilla Beds. In BMR Dalby No. 4 (Fig. 10) it consists of clayey labile sandstone and carbonaceous siltstone, with minor coal.

The Mooga Sandstone is a dominantly stream-deposited sequence, with point bar and channel sands at the base (Exon et al., 1967). Towards the top of the sequence it is interbedded with muddy horizons probably representing back swamp conditions. The sequence is generally 50 to 60 m thick in this area.

Fossil plant remains found in various parts of the Surat Basin are of little value in age determination. Spores from cores in BMR Roma No. 1 belong to Evans' (1966) division K1a of Neocomian (Lower Cretaceous) age (Burger, 1972).

LOWER CRETACEOUS (LATE NEOCOMIAN TO ALBIAN) STRATIGRAPHY

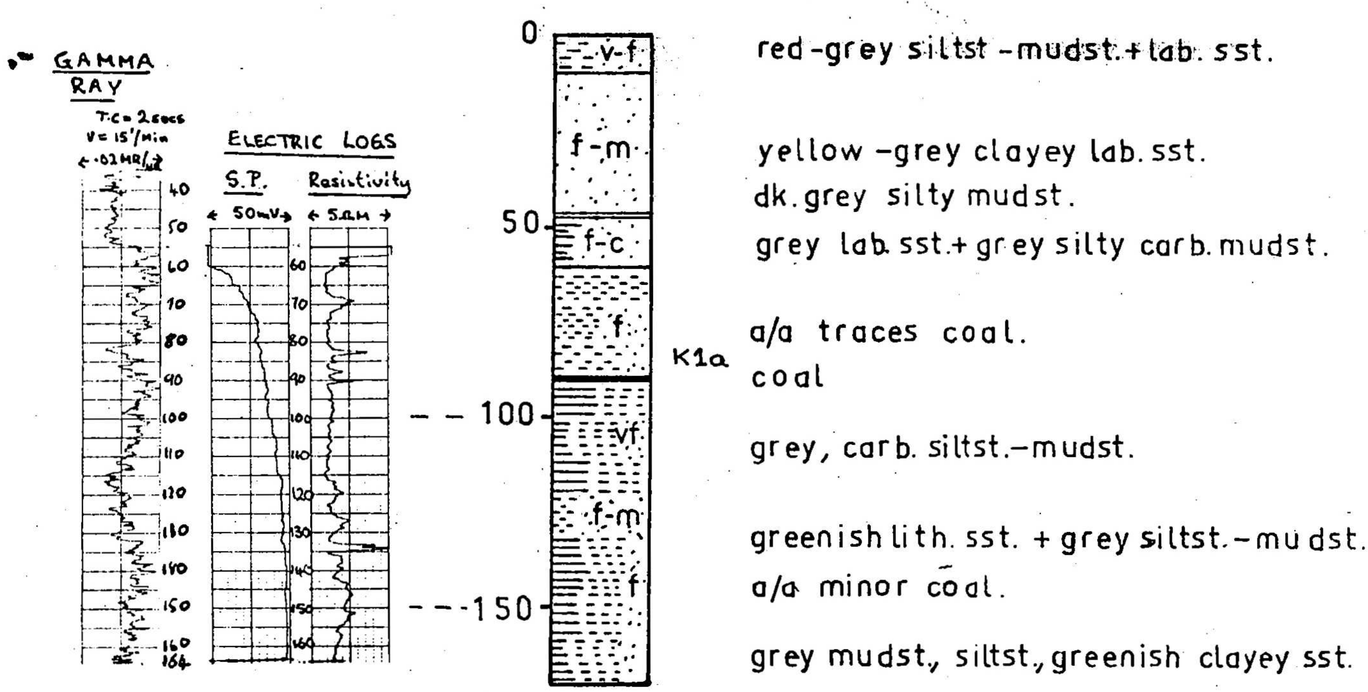
Regional Setting

The Neocomian to Aptian Bungil Formation is transitional in character between the earlier sequence and the Aptian-Albian Rolling Downs Group sediments. The Bungil Formation contains considerable fluviatile sandstone in the lower part, but marine sediments predominate higher in the sequence.

The Rolling Downs Group as a whole consists of calcareous labile sandstone, siltstone, and mudstone, deposited largely in shallow marine and deltaic environments. Non-marine beds became more common with time. The Rolling Downs Group sandstones, unlike many of the older Cretaceous sandstones, are dominated by andesitic volcanic debris, suggesting contemporary volcanism, but this could be due to changes in environment of deposition rather than provenance (see also introduction to JURASSIC - LOWERMOST CRETACEOUS).

DRILL HOLE B.M.R. DALBY No. 4.

UPPER PART OF KUMBARILLA BEDS (MOOGA SANDSTONE)



Depths in feet

G56/A13/15 to accompany Record 1972/53

FIG. 10.

Bungil Formation

The Bungil Formation consists of fine-grained sandstone, siltstone, and mudstone. It was named by Exon & Vine (1970) after Bungil Creek, north of Roma, and is the Transition Beds of Whitehouse (1954). The type area is in the valley of Bungil Creek, where the formation consists of fine-grained lithic sandstone, siltstone, and mudstone, with subordinate sublabile and quartzose sandstone. The sandstone is commonly glauconitic, and calcareous beds and concretions are common in the upper part. The siltstone and mudstone are commonly carbonaceous, and contain identifiable plant remains. Bedding varies from laminated to thickly cross-bedded. In the type area the formation consists of the essentially non-marine Kingull and Nullawurt Sandstone Members and the overlying marine Minmi Member, which are not distinguishable on the Dalby-Goondiwindi area. The unit is widespread in the Surat Basin.

In this area outcrop is poor, with clayey sandy soil characteristic, and is confined to northern Dalby Sheet. Typical rock types are light grey or white, weathered, fine-grained clayey sandstone, siltstone, and mudstone. The sandstone contains weathered ?glauconite. In BMR Dalby No. 3 (Fig. 11) the sequence is dominated by fine-grained, greyish, glauconitic labile sandstone and grey carbonaceous siltstone. Mudstone is common and coal seams occur.

In the subsurface the lithology of the Bungil Formation varies. In the north (UKA Cabawin No. 1), the predominant rock type is carbonaceous lithic sandstone, with around 30% quartz, minor feldspar, 30% igneous? rock fragments and 40% matrix (degraded rock fragments). In the south (UKA Minima No. 1 and Tingan No. 1), interbedded siltstone and mudstone predominate, and sandstone is relatively minor. Light grey to dark brown, carbonaceous mudstone is intercalated with brown argillaceous sandstone containing carbonaceous laminae. The sandstone is grey or brown, fine to medium-grained, poorly sorted and calcareous. Towards the margin of the basin (UKA Tingan No. 1) it becomes medium to coarse-grained, friable, and loosely cemented and has a soft, white clayey matrix.

The Bungil Formation conformably overlies the Mooga Sandstone and is included in the Kumbarilla Beds in this area, where it is not mappable.

In the Roma area the unit is possibly non-marine lower in the sequence, but the upper part consists of shallow marine sediments. In the Dalby-Goondiwindi area the sequence is poorly known, but BMR Dalby No. 3 (Fig. 11) suggests that the same situation applies, with coal seams low in the sequence, overlain by glauconitic sandstone. Dinoflagellates from 200-210 feet (61-64 m) in this hole suggest a near-shore marine environment, and acritarchs from 80-90 feet (24-27 m) suggest, at least, brackish conditions (Kemp, Appendix 5).

The formation is thickest in the deeper parts of the Mimosa Syncline (105 m in Cabawin No. 1) and thins southward (80 m in Tingan No. 1, 58 m in Minima No. 1 and Goondiwindi No. 1). Marine macrofossils of probably Neocomian and definitely Lower Aptian age occur in the Roma area (Day, 1967, 1968). Spores, pollen, and microplankton fall into Evans' (1966) divisions K1a and K1b (Exon & Vine, 1970). The deepest sample examined in BMR Dalby No. 4 belonged to division K1b-c (Kemp, Appendix 5), but the base of the formation was not reached.

Wallumbilla Formation

The Wallumbilla Formation in this area consists of the Doncaster Member and the overlying Coreena Member, and contains marine sandstone, siltstone and mudstone. The Doncaster Member was named and defined by Vine & Day (1965) as a member of the Wilgunya Formation. Later Vine, Day, Milligan, Casey, Galloway, & Exon (1967) elevated the Wilgunya Formation to subgroup status, and the Doncaster and Coreena (Vine et al., 1967). Members were defined as constituting the Wallumbilla Formation in the Surat Basin. In the type section in Wallumbilla Creek on the Roma Sheet, the formation consists of mudstone and siltstone with lesser limestone, sandstone, and intraformational conglomerate. The lower part, the Doncaster Member (Aptian), is dominantly mudstone, and the upper part, the Coreena Member (Albian), is silty. Both are widespread in the Surat Basin and in this area. The formation conformably overlies the relatively sandy Bungil Formation.

The Wallumbilla Formation of this marginal part of the Surat Basin is sandier than in the centre of the basin. On the Roma Sheet area marine macrofossils, mainly pelecypods, are ubiquitous. No fossils have been found in the Dalby-Goondiwindi area, and in the adjacent Surat Sheet area the fossils found were a few poorly preserved minute bivalves, which could represent the fauna of a restricted environment, perhaps one of reduced salinity (Thomas & Reiser, 1968). This macrofauna, and the comparative paucity of microplankton in the core samples, suggest a change in environment of deposition to shallower, brackish-water, and higher energy conditions. In general the conditions fluctuated from shallow marine to freshwater (deltas, swamps, streams). The Coreena Member, which is more sandy, was probably largely deposited in a beach environment.

Because of lack of outcrop, and deep weathering, the Wallumbilla Formation could not everywhere be subdivided, or separated from the Surat Siltstone, and some outcrops were assigned to a unit Kl representing Wallumbilla Formation plus Surat Siltstone. However, in the subsurface the various subdivisions were mapped.

Doncaster Member

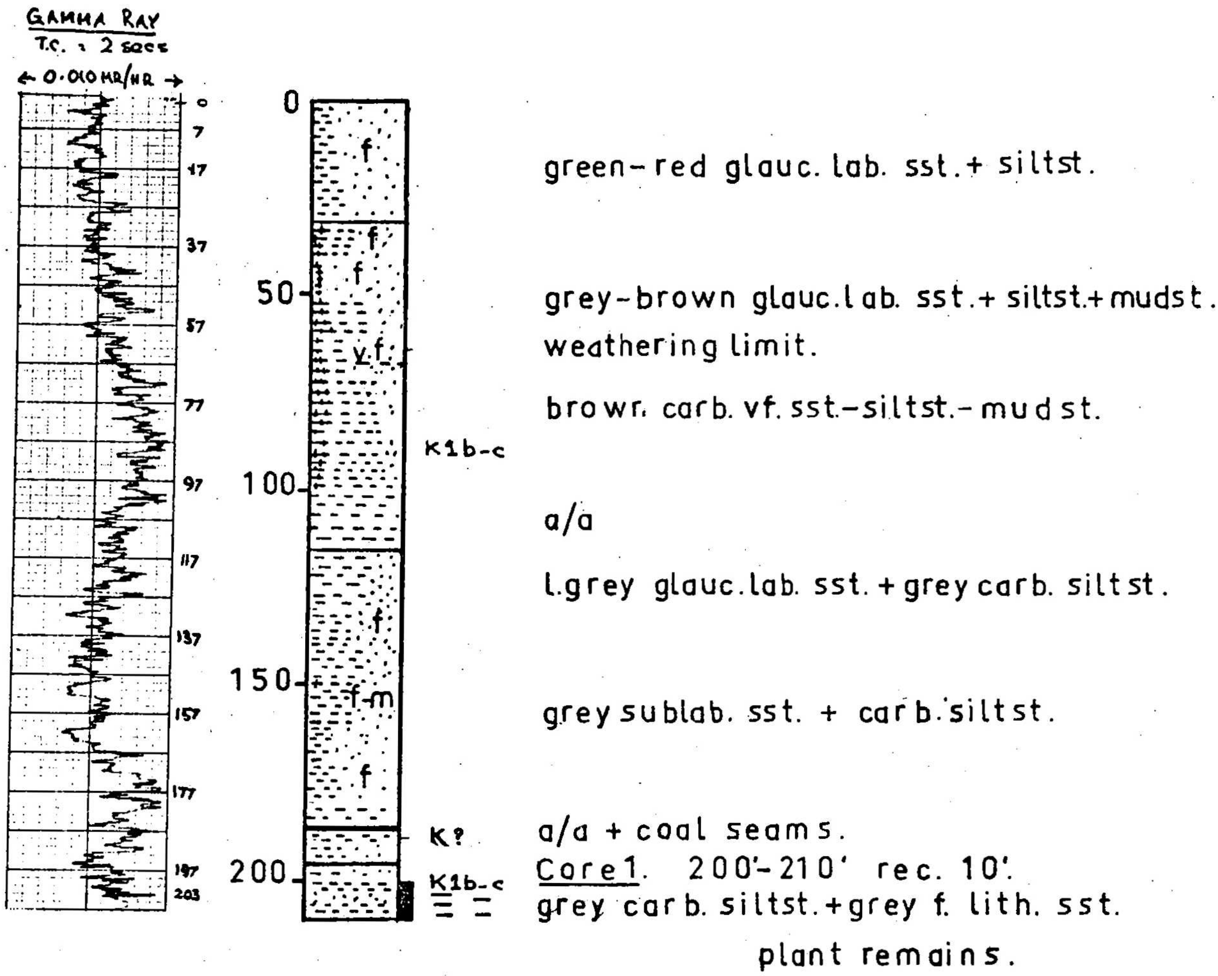
In the subsurface of the Dalby-Goondiwindi area the Doncaster Member consists of mudstone, siltstone, and sandstone. There is virtually no outcrop through the cover of black soil and alluvium. In the type area near Richmond in the Eromanga Basin, the lithology is described as 'blue grey mudstone with subsidiary glauconite siltstone' (Vine & Day, 1965).

In Minima No. 1 well sandstone predominates; it is cream to dark brown and light grey, fine to medium grained with subrounded grains, soft, with a clayey matrix and finely disseminated carbonaceous material. In Tingan No. 1 grey, dark grey and brown, soft, carbonaceous mudstone is interbedded with grey and brown argillaceous siltstone and medium beds of soft coal.

The Doncaster Member thins from 244 m in UKA Cabawin No. 1 in the north, and well into the Mimosa Syncline, to about 91 m in Minima No. 1, Tingan No. 1, and Goondiwindi No. 1, in the south. It is conformable on the Bungil Formation. Spores and marine microplankton belong to Evans' (1966) division K1b-c, and shelly macrofossils from the Roma area (Day, 1967) are of Aptian age.

DRILL HOLE B.M.R. DALBY No. 3.

BUNGIL FORMATION



Depths in feet

G56/A13/16 to accompany Record 1972/53

FIG. 11.

Coreena Member

In the subsurface, the Albian Coreena Member consists of light to dark grey, interbedded siltstone and mudstone, with finely disseminated carbonaceous material and a few interbeds of shaly coal and minor brown, tan and. cream, fine-grained sandstone with a clayey matrix and carbonaceous streaks and laminae.

No outcrops in the Dalby-Goondiwindi area were definitely assigned to the Coreena because they were deeply weathered, making identification very difficult. Most of the probable outcrop area is covered by alluvium. In its type area near Barcaldine in the Eromanga Basin (Vine et al., 1967) the member consists of interbedded siltstone and mudstone.

The Coreena Member thins southward from 148 m in Cabawin No. 1 to about 90 m in Minima No. 1, Tingan No. 1, and Goondiwindi No. 1. The unit contains Albian macrofossils in the Roma area (Day, 1967). Spores and marine microplankton in the lower part belong to Evans' (1966) division K1b-c; those in the upper part to division K1d.

Surat Siltstone

The Surat Siltstone, which consists of interbedded siltstone and mudstone in the Dalby-Goondiwindi area, was defined by Reiser (1970). The type section is in the continuously cored well GSQ Surat No. 1, 15 km northeast of Surat township, between 50 and 460 feet (15 and 140 m). The lowermost fifth of the formation is mainly mudstone and the remainder mainly siltstone. The siltstone is grey to black, micaceous, with carbonaceous plant remains; the sandstone is fine to very fine-grained, labile, commonly glauconitic, and contains minor garnet.

In outcrop in this area the formation has been included in unit K1, because of paucity of outcrop, which is, in any case, deeply weathered. In the subsurface, exploration well data suggest that it consists of interbedded siltstone and mudstone, which are light to dark grey, and locally pyritic, with disseminated carbonaceous matter, and minor light to dark grey very fine to fine-grained sandstone. Fifty metres of the upper part of the formation was intersected in BMR Dalby No. 2 (Fig. 12), where it consists of grey lithic sandstone, glauconitic in part, and siltstone and mudstone.

The Surat Siltstone conformably overlies the Coreena Member of the Wallumbilla Formation. It is at least 130 m thick in UKA Minima No. 1, but in all other wells the uppermost part is not recorded on electric logs, and correlation and estimation of thickness are not possible. The unit was deposited in a shallow marine low-energy environment.

Spores, pollen, and microplankton of Evans' units K1d, K2a, and K2b, of Aptian and Albian ages, were recovered from the Surat Sheet area (Kemp <u>in</u> Reiser, 1970). Foraminifera (Terpstra <u>in</u> Reiser, 1970) suggested a lower Albian age (possibly as old as uppermost Aptian, possibly as young as middle Albian), and marine bivalve fragments a very tentative Aptian age (Skwarko <u>in</u> Reiser, 1970). These data, and the belief that the unit overlies the Lower Albian Coreena Member of the Roma area, led Reiser to postulate a lower-middle Albian age for it. Spores of Evans' (1966) division K1d, and an indeterminate microplankton, were found in BMR Dalby No. 2 (Burger, Appendix 4).

Griman Creek Formation

The Griman Creek Formation consists largely of calcareous lithic sandstone and siltstone in this area.

Jenkins (1959) named and defined the 'Griman Creek Group' as a unit of about 100 m of areno-argillaceous partly marine Cretaceous rocks, exposed along Griman Creek near Surat (Surat Sheet area). Later Jenkins (1960) used the name 'Griman Creek Formation' for the same unit. Recently Reiser (1970) redefined the 'Griman Creek Formation'. Because the exposure along Griman Creek represents only the basal part of the formation as presently defined, a type section was taken in the continuous core of GSQ Surat No. 3 well, from 25 to 1 135 feet (8-345 m). The type section consists of finely interlaminated sandstone and siltstone, with considerable thickly bedded sandstone and muddy siltstone, and some intraformational conglomerate. The sandstone is fine to medium-grained, very labile, and glauconitic. The unit is confined to the central part of the Surat Basin.

The Griman Creek Formation is present in the western part of the Dalby-Goondiwindi area. However, most of it is covered by sand and soil, or deeply weathered. It crops out as relatively fresh sediment only on northwestern Goondiwindi Sheet south of the prominent cliffs that represent its deep-weathered capping. The best outcrops are on Tarrewinabar station and along the road from Tarrewinabar towards Goodar.

In outcrop the unit is brown and grey, calcareous lithic sandstone and siltstone. The sandstone is very fine to fine-grained, and grains are subangular to subrounded and poorly to fairly sorted. Thin section examination (Appendix 1) shows that it consists of 5-10% quartz, 3-15% feldspar (mostly plagioclase up to An_{45-50} and some orthoclase), minor biotite, 35-60% rock fragments (very fine-grained, altered, commonly-iron stained, probably acid to intermediate volcanics), 1-3% iron minerals (magnetite, lesser hematite), minor glauconite, 20-40% matrix (clayey, sandy-clayey or calcareous). In outcrop the sandstone weathers to give abundant calcareous concretions and there are intraformational conglomerates.

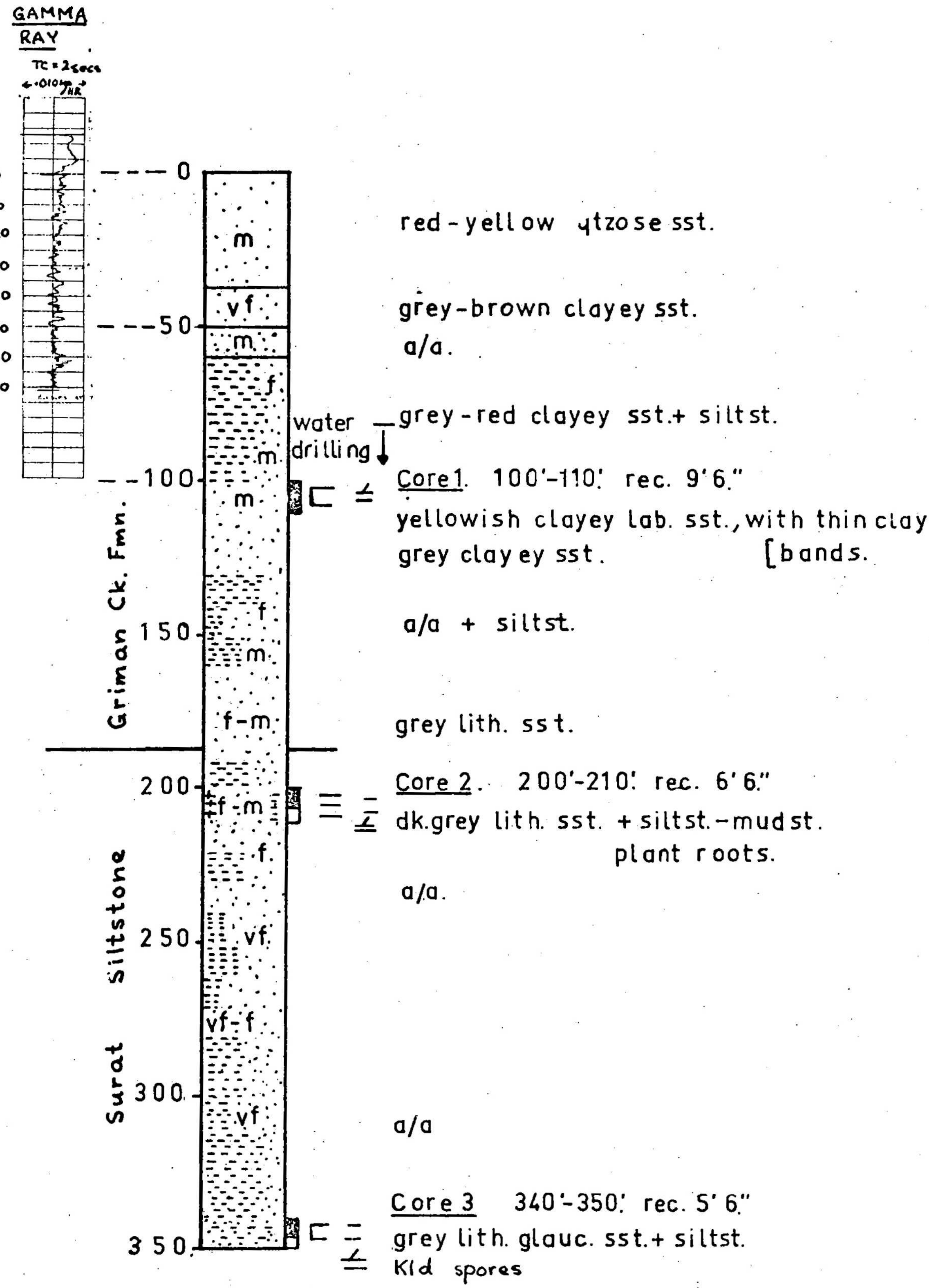
The shallow well BMR Dalby No. 2 (Fig. 12) contains very fine to medium-grained sandstone with siltstone bands. Where it is relatively unaltered the sandstone is yellowish grey, clayey and labile, but it is leached near the surface to a yellow or red, quartzose sandstone.

The Griman Creek Formation is the uppermost unit of the Cretaceous sequence and conformably overlies the Surat Siltstone.

Little is known about the environment of deposition from outcrops in this area. It is probably similar to that in the Surat Sheet area (Reiser, 1970), where worm burrows, coquinas of marine pelecypods, intraformational conglomerates, and crossbedding with random foreset directions, indicate a beach or near-shore marine environment of deposition for the basal part. Day (in Reiser, 1970), on the basis of macrofossils from the Surat Sheet area, suggested a deltaic or paralic environment. Therefore, the basal Griman Creek Formation is regarded as a regressive strand-line deposit which marked the end of the marine phase within the Surat Basin. The uppermost part of the formation, with freshwater bivalves, is a largely freshwater deposit. The intervening section seems to have been deposited in a paralic or deltaic environment.

DRILL HOLE B.M.R. DALBY No. 2.

GRIMAN CREEK FORMATION AND SURAT SILTSTONE



Depths are in feet

G 56/A13/17 to accompany Record 1972/53

FIG. 12

Fossil plants are common but no determinable material has been collected. On The Apiti station there are abundant freshwater bivalves c.f. Mesohyridella, very similar to fossils found in the Winton Formation of the Eromanga Basin (R.W. Day, pers. comm.). Shelly macrofossils (see Reiser, 1970) show that the unit is of Aptian or Albian age. According to R.W. Day, the discovery of Peratobelus robustus in basal Griman Creek sediments could indicate an upper Aptian-lower Albian (upper Doncaster-basal Coreena) age, which would mean the assumption of superposition on the Coreena Member in the Roma area was false, unless the belemnite was reworked.

Spores and pollen of Evans' K1d - K2b units of Aptian and Albian ages have been extracted from Griman Creek Formation samples by Burger and Kemp (in Reiser, 1970).

CAINOZOIC STRATIGRAPHY

In earliest Cainozoic time a widespread deep-weathering profile developed. As this was eroded, lower Tertiary sandstone was laid down by extensive stream systems. In late Oligocene to early Miocene time basalt was deposited in much of the east and south of the area. Erosion and deposition continued and younger Tertiary and Quaternary sediments now form extensive blankets in the west and northeast of the area.

Deep-weathering profile

A deep-weathering profile was developed on all the Mesozoic units, but has been extensively stripped from some parts of the area. Where it is best exposed, on the Kumbarilla Beds in the northeast, it consists of a highly resistant ferruginous capping up to 2 m thick, and a less resistant leached zone more than 10 m thick. The rock types and bedding of the Mesozoic units are still recognizable in the leached zone, although they are strongly altered chemically and mineralogically. The profile is similar to that reported elsewhere in the Surat Basin (e.g., Exon, Langford-Smith, & McDougall, 1970; Thomas & Reiser, 1968) and belongs to the same period of alteration.

The ferruginous capping varies from a true ferricrete to a strongly indurated mottled zone. Its surface is generally very uneven, and in many areas a polygonal raised network of ferruginous material encloses depressions of leached material. The ferruginous ridges are of the order of 10 cm wide and 20 cm high, and the leached areas are some 30 cm in diameter. In places a ferruginous 'buckshot gravel' rests on the ferruginous rock.

The underlying leached zone is generally white, with reddish mottling in places. Calcite has been completely leached. Feldspar, rock fragments, and the original clay matrix have broken down to give kaolin. Iron minerals and some lithic rock fragments have been oxidized to hematite and limonite.

Where the ferruginous zone is still present, extensive plateaux have developed, which completely obscure the structure of the Mesozoic sediments. Even the leached zone appears to be marginally more resistant than most of the underlying Mesozoic sediments. Thus photo-interpretation is of little or no use in the mapping of the Mesozoic units in such areas.

The depth and uniformity of the profile over very large areas suggests that it probably formed during a widespread period of tectonic and climatic stability. The land surface was bevelled by erosion, and chemical alteration probably took place in a subtropical monsoonal climate, which caused great annual fluctuation in the height of the water table.

The deep weathering is no younger than late Oligocene, because it is overlain by basalt of that age in the Roma area (Exon et al., 1970), and no older than uppermost Cretaceous, because Winton Formation sediments are deeply weathered in the Eromanga Basin (Senior, Galloway, Ingram, & Senior, 1968). An Eocene or early Oligocene age for the weathering is most likely.

Tertiary Sediments

Consolidated alluvium of Tertiary age crops out in present-day valleys, showing the antiquity of the stream systems. The sediments are poorly sorted, variably consolidated, cross-bedded quartz-rich sandstone and conglomerates.

They are very limited in extent on the high area where the relatively resistant Kumbarilla Beds crop out. However, in the west and east, where low-level plains of early Tertiary age had developed on the unresistant Rolling Downs Group and Walloon Coal Measures respectively, extensive Tertiary alluvium was laid down. This has been largely covered by Quaternary alluvium, especially farther away from the topographic highs of Mesozoic sediments, but extensive outcrops lie along Paget Creek and the Weir River in the west, and along Paget Creek on the Kumbarilla Beds.

In the subsurface, although some reworking and erosion surely accompanied Quaternary deposition, Tertiary alluvium is probably very extensive, with thicknesses perhaps as much as 100 m. In the Condamine River alluvium, Tertiary sandstone crops out some 10 km north of this area, and the Pliocene Chinchilla Sand underlies 25 m of Pleistocene alluvium at Dalby (Bartholomai & Woods, 1968).

In the west, Tertiary sandstone is covered by loose sandy soil, with a sparse vegetation of pines and coarse grasses. The vegetation gives a characteristic photo-pattern to these sediments. The dominant lithology is massive, fine to medium-grained quartz-rich sandstone, with traces of feldspar and clay cement. A basal conglomerate, with scour-and-fill structure, containing resistant pebbles and also clasts of the underlying white and red clays, is commonly developed. Lenticular pebble bands are irregularly distributed throughout the rest of the sequence; pebbles in these bands are generally of quartz or silcrete.

In the east, sediments are generally similar; they range from fine-grained quartz-rich sandstone to conglomerates with silcrete and quartz pebbles and cobbles, and from very friable to silicified.

The Tertiary sediments are younger than the main period of deep weathering, as they contain deeply weathered material and they rest on the weathering profile in some areas in the west. In the Captain's Mountain area south of Millmerran, they are overlain by basalt which is considered to be of late Oligocene to early Miocene age. Most of the sediment is therefore probably of Lower Tertiary age, although younger Tertiary sediments certainly occur along the Condamine River and in other areas.

That chemical deep weathering was not restricted to one period is shown by the fact that the Tertiary deposits in the west exhibit some of the features of a deep-weathering profile, although mottling is subdued, probably because of the small amount of labile material in the sandstone. On them a resistant 'duricrust' is developed, 20 cm to 1 m thick, consisting of clay clasts and sandstone and silcrete, pebbles, intensely iron-cemented and silicified. Differential erosion has led to the formation of deep overhangs where the less resistant sandstone has been eroded away from beneath the 'duricrust'. A feature not typical of the older deep-weathering process is the weak silicification of the sandstone, suggesting minor mobilization of silica during weathering.

In the east, in contrast, silicification has been dominant, and true silcretes are present in the Tertiary sediments.

A maximum thickness of 11 m of Tertiary sediment was observed in one cliff-face in the west, but poor exposure made it generally impossible to determine reliable thicknesses. Thicknesses of more than 30 m along the larger streams are probable.

Tertiary volcanics

The Tertiary volcanics consist essentially of alkaline olivine basalts of the Main Range Volcanics in the northeast, and basalts of the central volcanic province of New South Wales in the south.

The northerly group erupted mainly from vents along the line of the present-day Main Range, and basalts flowed down the regional slope to the west. They have since been extensively eroded and some have been covered by alluvium. Massive and vesicular basalt are the dominant rock types; minor constituents include reddish tuff, agglomerate with volcanic clasts up to 10 cm across, beds of white, calcareous, clayey ?tuff, and thin beds of green clay. Most of the northern basalts are very fine-grained, some contain acicular feldspar, and a few are rich in olivine phenocrysts up to 3 cm across.

The outcrop thickness of Tertiary volcanics probably exceeds 120 m at Mount Squaretop, and thicknesses of more than 30 m are recorded in water bores below Quaternary cover on the Condamine River plains near Dalby. Potassium-argon isotopic age determinations on the Main Range Volcanics (Webb, Stevens, & McDougall, 1967) gave a late Oligocene to early Miocene age.

The southern volcanics are largely covered by Quaternary sediments, so little is known of their extent or thickness. They form low rises consisting largely of fine-grained basalt. This volcanic province extends as far south as Armidale and has yielded isotopic ages of lowermost Miocene (20.9-18.5 m.y.; McDougall & Wilkinson, 1967), slightly younger than those to the north (24-22 m.y.).

Quaternary sediments

Quaternary sediments have been subdivided on the maps into older river-terrace alluvium plus general sand and soil cover (Qs), and alluvium of the present-day valleys (Qa). The latter has been distinguished as Qpc along the Condamine River, where numerous Pleistocene fossils have been found (see Appendix 2).

Older alluvium, deposited by streams draining into the Condamine, Balonne and Macintyre Rivers, is widespread in the west, and thick recent alluvium extends along the valley of the Macintyre River, where the alluvial sands and clayey sands laid down are as much as 100 m thick in places, though some of this sequence is of Tertiary age.

The plains of the Condamine River in the northeast are also underlain by considerable thicknesses of sandy alluvium (67 m in A.P. Horrane No. 1), but parts of the sequence are Tertiary (Pliocene Chinchilla Sand occurs in the Dalby area). An extensive spread of older alluvium (Qs) rises slightly above the surrounding plains of younger alluvium (Qa) between Macalister and Bowenville. This may well have been preserved because it overlies basalt, which was resistant to lateral erosion as the streams meandered.

STRUCTURE

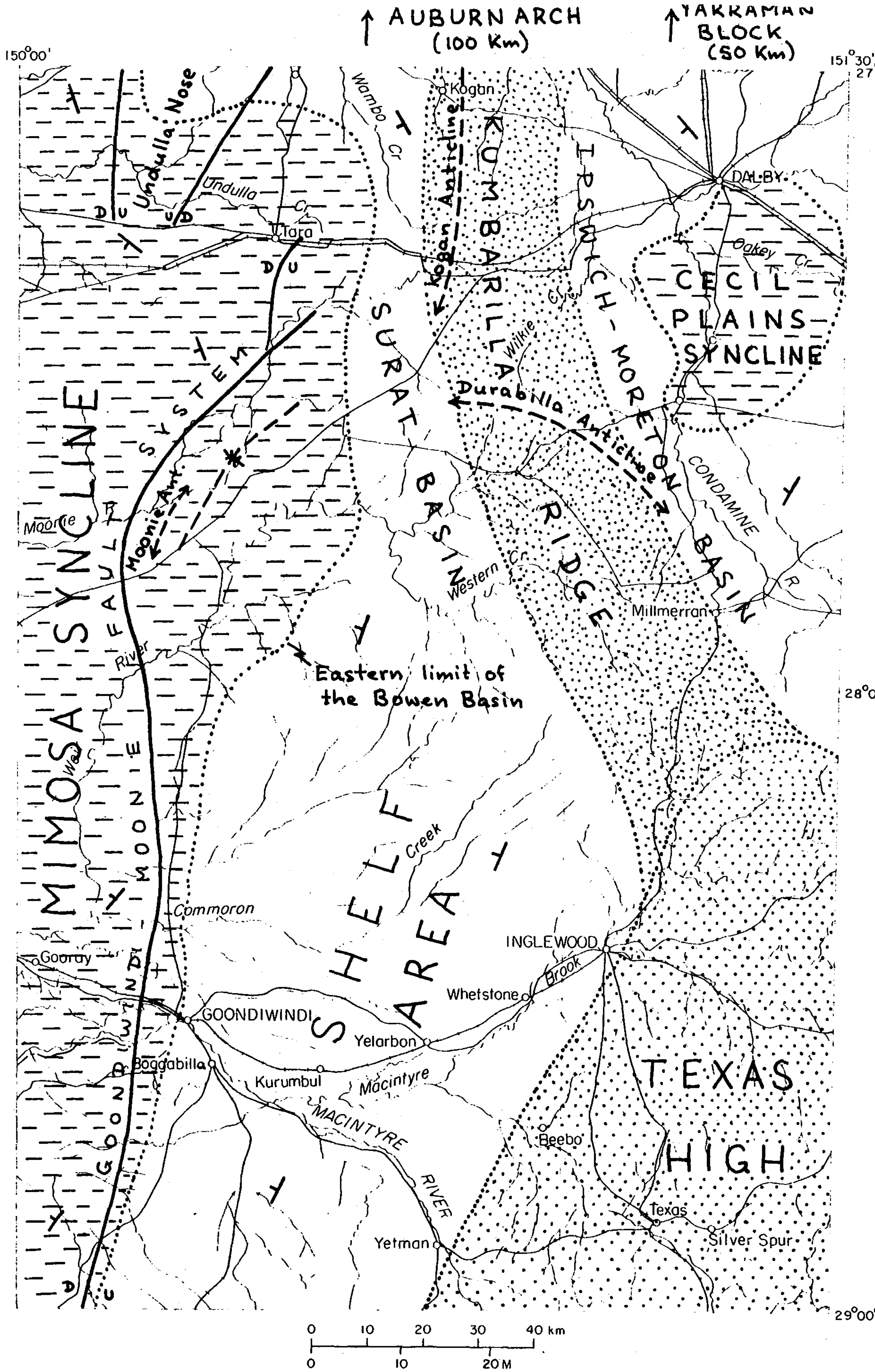
Structural divisions are shown in Figure 13, and the basement and Permian structure in Figure 4. Strongly deformed rocks, largely of Carboniferous age, form a generally westerly to southwesterly sloping basement to relatively undisturbed Permian and younger strata. The subsurface Kumbarilla Ridge connects basement rocks of the Texas High (part of the New England High) in the southeast to those of the Auburn and Yarraman Complexes 100 km north of the area.

West of the Kumbarilla Ridge is the Mimosa Syncline, which contains up to 5 000 m of virtually undeformed sediment, and east of the ridge is the Cecil Plains Syncline with 2 000 m of virtually undeformed sediment. The flanks of the Kumbarilla Ridge and Texas High are irregular shelves. On the eastern side of the Mimosa Syncline lies the Goondiwindi-Moonie Fault System*, which is downthrown to the west. Apart from these major structures there are numerous smaller basement faults, rises, and depressions, later movements of which have affected the overlying sequences.

The Mimosa Syncline, the eastern limb of which is present here, is a relatively smooth basement depression, disturbed by major faulting and associated folding along the Goondiwindi-Moonie Fault System. The basement surface slopes generally westerly. The westerly downthrow of the basement along the northerly trending fault is small in the south, but increases northward to more than 1500 m near Moonie, and decreases rapidly near Tara. Major parallel folds are the Moonie and Cabawin Anticlines, east and west of the fault respectively.

The basement configuration of the Cecil Plains Syncline is poorly known, as seismic work has succeeded in delineating it only in a few areas. It forms only a small part of the subsurface of the Ipswich-Moreton Basin sequence, which generally dips gently westward in this area. The syncline appears to be a fairly simple basinal structure somewhat disturbed by basement faulting and filled almost completely with Triassic sediment. A northwesterly-trending fault with a throw of about 1 000 m is present near Cecil Plains (Mellins, 1971).

* The Goondiwindi and Moonie Faults are shown separately on the accompanying maps, but they make one system which can often be conveniently discussed as a whole.



STRUCTURAL DIVISIONS

⅄ Shallow regional dip of Mesozoic strata

Q/A/399 to accompany Record 1972/53 FIG. 13.

The gentle structures in the Permian and younger sediments were formed by combinations of renewed movements of old faults and folds, warping of basement structures in response to isostatic loading, and compactional draping over old highs. Displacement of Permo-Triassic sequences on faults are as much as 1 000 m in both the Mimosa and Cecil Plains Synclines, but in younger sequences it is relatively small.

GEOLOGICAL HISTORY

In Carboniferous time the area was a sea, with land well to the west, into which a great deal of volcanic debris was being poured. The basin was subsiding and great thicknesses of graded-bedded sand and mud accummulated, perhaps from turbidity currents. Radiolarian chert suggests periods of slow, relatively deep-water deposition, and limestone with colonial corals indicates periods of relatively shallow-water deposition.

The Carboniferous sediments were strongly deformed during the Kanimblan Orogeny and then eroded. In the Lower Permian, gravel, sand, silt, and acid volcanics were laid down in a relatively shallow sea in which marine organisms flourished. Sedimentation continued when the sea withdrew in Upper Permian time and coal measures accumulated, except perhaps in the southeast, which may have been dry land.

In late Permian and early Triassic times (Hunter-Bowen Orogeny) the areas corresponding with the Texas High and Kumbarilla Ridge were uplifted, and the underlying rocks were faulted and folded, and intruded by granite. At the same time the Taroom Trough* in the west subsided rapidly, forming the Mimosa Syncline, and the Goondiwindi-Moonie Fault System developed between the rising and sinking areas. The Ipswich Basin formed east of the Kumbarilla Ridge, the Cecil Plains Syncline being the deepest part of the basin in this area.

In the Triassic, sediment was eroded from the uplifted areas and deposited in the adjacent basins. In the Taroom Trough, Lower Triassic sand and gravel (Rewan Formation) were deposited by streams, mostly in the north. In later Triassic time stream, lake, delta, and shallow marine sediments (Clematis Sandstone and Moolayember Formation) were laid down. In the Cecil Plains Syncline volcanics were first extruded and later covered by thick deposits of gravel, sand, mud, and coal. A thin sand and mud sequence onlapped the eastern side of the Kumbarilla Ridge in late Triassic time.

Movements related to the Hunter-Bowen Orogeny persisted well into the Triassic and the older strata are displaced by up to 1 000 m on major faults in both basins. These movements had almost died out by middle Triassic time in the Taroom Trough, and by Upper Triassic time in the Cecil Plains Syncline.

* The Taroom Trough is here regarded as a depositional basin and the Mimosa Syncline as the present-day structure.

As the Kumbarilla Ridge was eroded, sedimentation in the Surat Basin in the west, and in the Moreton Basin in the east, became similar. In late Triassic time there had been some erosion in the west, exposing older units (see Fig. 5), before the basal sand of the Surat Basin sequence (Precipice Sandstone) was deposited by streams. This unit lapped farther up the Kumbarilla Ridge with time, and its youngest sediments intertongue with those of the corresponding sandy sequence (Helidon Sandstone) of the Moreton Basin.

In the Surat Basin, through into the Lower Cretaceous, stream-deposited quartz-rich sands alternate with coastal plain sands, silts, muds, and coals. Each sequence (formation) is generally more than 100 m thick and the total succession is around 2 000 m thick. The reason for the alternation between more and less energetic deposition is uncertain, but could be related to climatic, tectonic, or eustatic factors. In the Moreton Basin the sequence is similar, but the youngest preserved Mesozoic sediments are Jurassic.

In Lower Cretaceous times the sea returned to most of the area, and up to 1 000 m of lithic sand, silt, and mud (Rolling Downs Group) was laid down in shallow marine, deltaic, and estuarine environments. The sand was largely of andesitic volcanic origin, implying contemporary volcanism to the east, which was perhaps related to the separation of Australia and New Zealand.

Upper Cretaceous rocks are not present, and may never have been. Alternatively they may have been completely eroded in youngest Cretaceous time. By the early Tertiary a relatively flat surface had developed, and this was deeply chemically altered, probably under warm conditions with variable rainfall. As this weathered profile was eroded, lower Tertiary sands were laid down by extensive stream systems. In late Oligocene-early Miocene time up to 150 m of basalt poured into valleys in the northeast and south, from vents to the east and south. Erosion and deposition continued and younger Cainozoic sediments now blanket extensive areas in the west and northeast.

ECONOMIC GEOLOGY

Oil and Gas

Details of the 130 petroleum exploration wells drilled to the end of 1971 are given in Tables 2 and 3. The Moonie Oilfield, whose cumulative production to the end of 1971 was 16 million barrels, is the only commercial petroleum field in this area.

Moonie Oilfield: Up to the end of 1971 31 wells were drilled on the Moonie structure, delineating a production area of approximately 10 km^2. In 1964 a 304-km pipeline from Moonie to Brisbane was completed and the field went on to continuous production. The initial daily production was about 3 000 barrels and slowly increased to a peak of approximately 8 000 barrels/day in 1965, when total recoverable reserves were estimated at 27 million barrels; from then on production declined. Annual production was 2 600 000 tons in 1965 and 1 100 000 tons in 1970. In 1969 a three-dimensional electronic model study of the field was made to plan a production program for its remaining economic life.

Production is from two zones in the Lower Jurassic Precipice Sandstone at about 1 770 m. The lower zone or '58-0 sand' is a coarse sandstone 21-27 m thick and is by far the most important. The upper zone or '56-4 sand' is up to 12 m thick and is separated from the lower one by 9 to 15 m of siltstone and fine-grained tight sandstone.

The Moonie structure lies at the southern end of a southwest-plunging anticline which is 8 km long by about 1.6 km wide; vertical closure on the top of the lower (coarser) Precipice Sandstone is 40 m. The Moonie Anticline is a drape structure over a basement high, with enhanced relief due to movement on the surrounding faults.

The oil probably migrated into the Precipice Sandstone in the Middle Jurassic, possibly from the Evergreen Formation (Buckley, Bradley, & Zehnder, 1969) when the plunge of the Moonie structure was reversed (to the northeast); an alternative source is carbonaceous material in the Permian sequence of the Taroom Trough.

The Permian sequence in the Mimosa Syncline consists of marine fossiliferous sediments which are potential source rocks for hydrocarbons and may have supplied the Moonie oil. The overlying Triassic units have porous and permeable intervals which are potential reservoir rocks, but only minor shows have been recorded from them, and only in the Cabawin area.

Although there are numerous porous and permeable sandstone beds in the Jurassic sequence in both the Surat and Moreton Basins, they are generally filled with fresh water and are aquifers. The Cretaceous sediments of the Surat Basin are largely marine and contain a few porous and permeable beds, but depth of burial has probably been insufficient to generate hydrocarbons.

Drilling has been largely designed to test seismically defined closed structures, and the possibility of fault traps or stratigraphic wedge-outs remains. Numerous oil and gas shows suggest that the area still has a potential for further discoveries.

Groundwater

West of the Kumbarilla Ridge depths to aquifers which flow at the surface increase from east to west into the Surat Basin. Thus, near Inglewood, in the east, flowing water comes from a depth of only 100 m.

In the Surat Basin the main aquifers are the Coreena Member of the Wallumbilla Formation and the Mooga and Gubberamunda Sandstones; the best supplies come from the Gubberamunda Sandstone, although the shallower Mooga Sandstone is the aquifer used in most bores. Water from the lower two aquifers is generally suitable for stock and in many cases for human consumption. Salinity in a number of deeper bores in the area (Tables 4 and 5) ranges from 600 to 1300 ppm NaCl equivalent.

There are many more bores east of the Goondiwindi-Moonie Fault System, where the aquifers are much shallower. The density is particularly high north of Cabawin and near Goondiwindi. Nineteen oil exploration wells have been converted to water bores (Tables 2 and 3).

East of the Kumbarilla Ridge most water comes from the Cainozoic alluvium of the Condamine River System, with some supplies from the Tertiary basalt and the Walloon Coal Measures.

Surface water

The Condamine, Moonie, Weir, and Macintyre Rivers flow intermittently and contain permanent and semi-permanent waterholes. Earth tanks and dams are common throughout the area.

Coal

Coal seams in the Walloon Coal Measures are up to several metres thick. They are being explored at present, Coal is also present in the Permian Blackwater Group in the west, but at great depth, and in the Ipswich Coal Measures equivalents in the Ipswich Basin.

Construction Materials

Basalt is quarried at several localities in the northeast and south and is used as aggregate and for surfacing roads. Chemically altered Mesozoic sediments are also used locally for road surfacing, although they are not good quality.

REFERENCES

(Unpublished reports marked * refer to operations subsidized under the Petroleum Search Subsidy Acts, 1959-1969; copies are available for study at BMR, Canberra, and the Geological Survey of Queensland.)

*ADASTRA AIRWAYS PTY LTD, 1960 - Surat-Bowen Aeromagnetic Survey. For Union Oil Devel. Corp.

*AERO SERVICE LTD, 1963 - Interpretation report on airborne magnetometer survey of the Surat-Bowen Basin area, eastern Australia. Union Oil Devel. Corp. Rept. (unpubl.)

ALLEN, R.J. & HOGETOORN, D.J., 1970 - Petroleum resources of Queensland. Geol. Surv. Qld Rep. 43.

BARTHOLOMAI, A., and WOODS, J.T., 1968 - Notes on the Chinchilla Sand. in Bur. Miner. Resour. Aust. Rec. 1968/53, 71-3 (unpubl.)

BASTIAN, L.V., 1965 - Petrological report on the basement to Lower Jurassic sections of some subsidized wells in the Surat Basin. Bur. Miner. Resour. Aust. Rec. 1965/120 (unpubl.).

BASTIAN, L.V., and ARMAN, M., 1965 - Petrographic notes on some Triassic sediments in UKA Wandoan No. 1 well and in adjoining areas. Bur. Miner. Resour. Aust. Rec. 1965/227 (unpubl.).

BELL, D.W., 1962 - Photogeology of western half of ATP71P. For Phillips Petroleum Co. (unpubl.).

BUCKLEY, A.W., BRADLEY, K., and ZEHNDER, J.O., 1969 - Case histories of the Moonie and Alton oilfields, Surat Basin, Queensland, Australia. Econ. Comm. Asia Far East, 4th Petrol. Symp., Canberra, 1969.

BMR, 1967 - Bouguer Anomalies, Dalby, Qld. Bur. Miner. Resour. Aust. Map G56/B2-13.

BURGER, D., 1968 - Relationship of palynology to stratigraphy in the Lower Cretaceous of the Surat Basin, Queensland. Bur. Miner. Resour. Aust. Rec. 1968/125 (unpubl.).

BURGER, D., 1972 - Palynological zonation and sedimentary summary of the Neocomian in the Great Artesian Basin, Queensland. J. geol. Soc. Aust. Sp. Pap. 4

*BUTCHER, R.H., 1964 - Final report of the seismic survey of the Moonie River Area, Surat Basin, Qld. United Geophys. Corp. for Union Oil Devel. Corp. (unpubl.).

CAMERON, W.E., 1907 - The West Moreton Coalfields, Queensland. Geol. Surv. Qld Publ. 204, 1-37.

*CAREY, A.R., and KURASH, G.E., 1969 - Relinquishment of a portion of ATP 145 P, Queensland. Union Oil Devel. Corp. geol. Rep. 25 (unpubl.).

CASEY, D.J., GRAY, A.R.G., and REISER, R.F., 1968 - Comparison of the Lower Jurassic strata of the Surat and Moreton Basins. Qld Govt Min. J., 69, 462-465.

CONYBEARE, C.E.B., and CROOK, K.A.W., 1968 - Manual of sedimentary structures. Bur. Miner. Resour. Aust. Bull. 102.

CROOK, K.A.W., 1960 - Classification of arenites. Amer. J. Sci., 258, 419-28.

DARBY, F., 1965 - Gravity readings along seismic traverses, central and southern Queensland, 1963. Bur. Miner. Resour. Aust. Rec. 1965/91 (unpubl.).

DARBY, F., 1969 - Reconnaissance helicopter gravity surveys northern NSW and southern Qld, 1968. Bur. Miner. Resour. Aust. Rec. 1969/109 (unpubl.).

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

DAY, R.W., 1967 - Aptian and Albian macrofossils. Appendix 1 in Bur. Miner. Resour. Aust. Rec. 1967/63 (unpubl.).

DAY, R.W., 1968 - Marine Lower Cretaceous fossils from the Minmi Member, Blythesdale Formation, Roma-Wallumbilla area. Geol. Surv. Qld Publ. 335 (palaeont. Pap. 9).

DAY, R.W., 1969 - The Lower Cretaceous of the Great Artesian Basin in STRATIGRAPHY AND PALAEONTOLOGY; Essays in honour of Dorothy Hill. K.S.W. Campbell Ed. Aust. Nat. Univ. Press, 140-173.

DE JERSEY, N.J., 1960 - Jurassic spores and pollen grains from the Rosewood Coalfield. Geol. Surv. Qld Publ. 294.

DE JERSEY, N.J., 1963 - Jurassic spores and pollen grains from the Marburg Sandstone. Geol. Surv. Qld Publ. 313.

DE JERSEY, N.J., 1968 - Triassic spores and pollen grains from the Clematis Sandstone. Geol. Surv. Qld Publ. 338.

DE JERSEY, N.J., 1970 - Triassic miospores from the Blackstone Formation, Aberdare Conglomerate and Raceview Formation. Geol. Surv. Qld Publ. 348 (palaeont. Pap. 22).

DE JERSEY, N.J., 1970b - Early Triassic miospores from the Rewan Formation. Geol. Surv. Qld Publ. 345.

DE JERSEY, N.J., 1971 - Early Jurassic miospores from the Helidon Sandstone. Geol. Surv. Qld Publ. 351.

DE JERSEY, N.J., and HAMILTON, M., 1967 - Triassic spores and pollen grains from the Moolayember Formation. Geol. Surv. Qld Publ. 336.

DE JERSEY, N.J., and PATEN, R.J., 1964 - Jurassic spores and pollen grains from the Surat Basin. Geol. Surv. Qld Publ. 322.

DE JERSEY, N.J., PATEN, R.J., and HAMILTON, M.A., 1964 - The palynology of samples from Phillips-Sunray Cecil Plains No. 1 well. Geol. Surv. Qld Rec. 1964/2. (unpubl.).

DERRINGTON, S.S., GLOVER, J.J.E., and MORGAN, K.H., 1959 - New names in Queensland stratigraphy. Permian of the southeastern part of the Bowen Syncline. Aust. Oil Gas J., 5(8), 27-28.

DUNSTAN, B., 1915 - In Walkom, A., 1915. Mesozoic floras of Queensland. Pt. 1. Geol. Surv. Qld Publ. 252.

EVANS, P.R., 1962 - Microfossils associated with the 'Bundamba Group' of the Surat Basin, Queensland. Bur. Miner. Resour. Aust. Rec. 1962/115 (unpubl.).

EVANS, P.R., 1964a - The age of the Precipice Sandstone. Aust. J. Sci., 26(10), 323-4.

EVANS, P.R., 1964b - A correlation of some deep wells in the north-east Eromanga Basin, Central Queensland. Bur. Miner. Resour. Aust. Rec. 1964/197 (unpubl.).

EVANS, P.R., 1966 - Mesozoic stratigraphic palynology in Australia. Aust. Oil Gas J., 12(6), 158-63.

EXON, N.F., 1966 - Revised Jurassic to Lower Cretaceous stratigraphy in the south-east Eromanga Basin, Queensland. Qld Govt Min. J., 67, 232-238.

EXON, N.F., 1971 - Roma, Queensland 1:250,000 Geological Series. Bur. Miner. Resour. Aust. Explan. Notes SG/55-12.

EXON, N.F., 1972 - Shallow stratigraphic drilling in the eastern Surat Basin, Queensland, 1966, 1967 and 1968. Bur. Miner. Resour. Aust. Rec. 1972/54 (unpubl.).

EXON, N.F., LANGFORD-SMITH, T., and McDOUGALL, I., 1970 - The age and geomorphic correlations of deep-weathering profiles, silcrete, and basalt in the Roma-Amby Region, Queensland. J. geol. Soc. Aust., 17(1), 21-30.

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, Queensland. Bur. Miner. Resour. Aust. Rec. 1967/63. (unpubl.).

EXON, N.F., REISER, R.F., JENSEN, A.R., BURGER, D., and THOMAS, B.M., 1968 - The geology of the Chinchilla 1:250,000 Sheet area, southern Queensland. Bur. Miner. Resour. Aust. Rec. 1968/53 (unpubl.).

EXON, N.F., and VINE, R.R., 1970 - Revised nomenclature of the 'Blythesdale' Sequence. Qld Govt Min. J., 71, 48-52.

FEHR, A., 1965 - Lithological correlations of Middle-Upper Triassic and Lower Jurassic units in seven wells in the southern Bowen-Surat Basin, Queensland. Bur. Miner. Resour. Aust. Rec. 1965/175 (unpubl.).

*FJELSTUL, C.R., and BECK, R.E., 1963 - Geophysical report - reconnaissance and detail seismograph survey of western ATP 71P, Queensland, Australia. For Phillips Petroleum Co. (unpubl.).

GSQ, 1960-65 - Occurrence of petroleum and natural gas in Queensland (with supplements 1 to 4). Geol. Surv. Qld Publ. 299.

GIBB, R.A., 1965 - Gravity readings along seismic traverses in Surat Basin, Queensland and New South Wales, 1961. Bur. Miner. Resour. Aust. Rec. 1965/58 (unpubl.).

GOULD, R.E., 1968 - The Walloon Coal Measures: a compilation. Qld Govt. Min. J., 69.

GRAVES, D.T., 1963 - Moonie's significance in oil search. Qld Govt Min. J., 64, 558-9.

*HASKETT, S., and BUCKLEY, T.M., 1970 - Experimental digital seismic reflection survey, Horrane Prospect, ATP 159P. Amalgamated Petrol. Expl. N.L. (unpubl.).

HILL, Dorothy, 1957 - Explanatory notes on the Springsure 4-mile geological Sheet. Bur. Miner. Resour. Aust., Note Ser. 5.

HOGETOORN, D.J., 1968 - Jurassic reservoirs of the Surat Basin. Qld Govt. Min. J., 69, 256-66.

ISBELL, R.F., 1955 - The geology of the northern section of the Bowen Basin. Pap. Dep. Geol. Univ. Qld 4(11).

ISBELL, R.F., 1957 - The soils of the Inglewood-Talwood-Tara-Glenmorgan Region, Queensland. Bur. Invest. Dep. Public Lands, Qld, tech. Bull. 5.

ISBELL, R.F., 1962 - Soils and vegetation of the Brigalow lands, eastern Australia. CSIRO Soils and Land Use Ser. 43.

JACK, R.L., 1895 - Artesian water in the western interior of Queensland. Geol. Surv. Qld Publ. 101 (Bull. 1), 1-16.

JACKSON, C.F.V., 1902 - Coal at Bringabilly Creek, Parish of Mingimarmy. Qld Govt Min. J., 3, 562-3.

JENKINS, T.B.H., 1959 - Surat (Thallon) Basin; in New names in Queensland stratigraphy (Part 4). Aust. Oil Gas J., 5(11), 29-30.

JENKINS, T.B.H., 1960 - The Surat Sub-basin in The Geology of Queensland. J. geol. Soc. Aust., 7, 315-7.

JENSEN, H.I., 1926 - Geological reconnaissance between Roma, Springsure, Tambo and Taroom. Geol. Surv. Qld Publ. 277, 215.

JENSEN, H.I., 1960 - Geology and oil indications of the Roma district. Qld geogr. J., 60, 13-20.

JENSEN, A.R., GREGORY, C.M., and FORBES, V.R., 1964 - The geology of the Taroom 1:250,000 Sheet area and of the western part of the Mundubera 1:250,000 Sheet area. Bur. Miner. Resour. Aust. Rec. 1964/61 (unpubl.).

JORGENSON, J.T., and BARTON, R.H., 1966 - Regional photogeology of the Ipswich Basin-Esk Trough, Queensland. APEA J., 1966, 121-5.

*KAHANOFF, S., 1962a - Preliminary final report on the Moree-Miles Aeromagnetic Survey. United Geophys. Corp. for Union Oil Devel. Corp. (unpubl.).

*KAHANOFF, S., 1962b - Final report of the Moonie seismic survey. Ibid.

*KAHANOFF, S., 1962c - Final report of Miles-Dulacca seismic survey. Ibid.

*KAHANOFF, S., 1963 - Final report of MacIntyre seismic survey. Ibid.

*KELLER, A.S., 1960 - Geology of the Cabawin Trend, Queensland. Union Oil Devel. Corp. Geol. Rep. 2 (unpubl.).

LANGRON, W.J., and VAN SON, J.R.H., 1967 - Regional gravity survey, north-eastern New South Wales and south-eastern Queensland, 1960-1961. Bur. Miner. Resour. Aust. Rec. 1967/12 (unpubl.).

LODWICK, K.B., and BIGG-WITHER, A.L., 1962 - Southern Surat Basin seismic survey, 1961. Bur. Miner. Resour. Aust. Rec. 1962/183 (unpubl.).

LODWICK, K.B., and WATSON, S.J., 1960 - Surat Basin seismic reconnaissance survey, Queensland, 1959. Ibid., 1960/107 (unpubl.).

LONGMAN, H.A., 1941 - A Queensland fossil amphibian. Mem. Qld Mus., 12(1), 29-32.

LONSDALE, G.F., 1965 - Southern Queensland contract reconnaissance gravity survey using helicopters, 1964 (by Wongela Geophysical Pty Ltd). Bur. Miner. Resour. Aust. Rec. 1965/251 (unpubl.).

MACK, J.E., Jr, 1963 - Reconnaissance geology of the Surat Basin, Queensland and New South Wales. Bur. Miner. Resour. Aust. Petrol. Search Subs. Acts Publ. 40.

*MACK, J.E., Jr, 1964a - Subsurface geology of the Moonie Trend. ATP 57P. Queensland, Australia. Union Oil Devel. Corp., Geol. Rep. 11 (unpubl.).

*MACK, J.E., Jr, 1964b - Subsurface geology of the Crowder-Weir Trend, ATP 57P, Queensland. Ibid., 13 (unpubl.).

*MACK, J.E., Jr, 1964c - Subsurface geology of the Undulla Nose, ATP 57P, Queensland. Ibid., 16 (unpubl.).

MACK, J.E., and KELLER, A.S., 1965 - Subsurface geology of the Crowder-Moonie area, Surat Basin, Queensland, Australia. 8th Comm. Min. metall. Cong., 5, 139-45.

McDOUGALL, I., and WILKINSON, J.F.G., 1967 - Potassium-argon dates on some Cainozoic volcanic rocks from northeastern New South Wales. J. geol. Soc. Aust., 14(2), 225-34.

McTAGGART, N.R., 1963 - The Mesozoic sequence in the Lockyer-Marburg area, southeast Queensland. Proc. Roy Soc. Qld, 73(7) 93-104.

MAFFI, C.E., 1968 - Report on the photo-interpretation of the Goondiwindi 1:250,000 scale sheet, Queensland and New South Wales. Bur. Miner. Resour. Aust. Rec. 1968/29 (unpubl.).

MALONE, E.J., OLGERS, F., and KIRKEGAARD, A.G., 1969 - The geology of the Duaringa and St Lawrence 1:250,000 Sheet areas, Queensland. Bur. Miner. Resour. Aust. Rep. 121.

*MAUREIRA, A.S., 1963 - Final report of the seismic survey of the Middle Creek area, Surat Basin, Qld. United Geophys. Corp. for Union Oil Devel. Corp. (unpubl.).

*MELLINS, I., 1971 - Horrane No. 1 well completion report. Amalgamated Petroleum Expl. N.L. (unpubl.).

MEYERS, N.A., 1970 - Correlation and lithofacies of Jurassic sediments: Cecil Plains - Ipswich. Geol. Surv. Qld Rep. 40.

MOLLAN, R.G., DICKINS, J.M., EXON, N.F., and KIRKEGAARD, A.G., 1969 - Geology of the Springsure 1:250,000 Sheet area, Queensland. Bur. Miner. Resour. Aust. Rep. 123.

MOLLAN, R.G., FORBES, V.R., JENSEN, A.R., EXON, N.F., and GREGORY, C.M., 1972 - The geology of the Eddystone and Taroom 1:250,000 Sheet areas and the western part of the Mundubbera 1:250,000 Sheet area. Bur. Miner. Resour. Aust. Rep. 142.

MOND, A., in press - Dalby, Queensland 1:250,000 Geological Series. Bur. Miner. Resour. Aust. Explan Notes SG56-13.

MORAN, W.R., and GUSSOW, W.C., 1963 - The history of the discovery and the geology of Moonie Oil Field, Queensland, Australia. 6th World Petrol. Cong. Proc. Geophys. Geol. Sec. 1, 595-609.

MOTT, W.D., 1954 - Review of geology and petroleum prospects of ATP held by Surat Basin Syndicate. For Assoc. Aust. Oilfields N.L. (unpubl.).

*NICKERSON, R., 1965 - Final report of the Surat Shelf seismic survey, Flinton seismic survey, and Goondiwindi-St George (eastern portion) seismic survey. United Geophy. Corp. for Union Oil Devel. Corp. (unpubl.).

*NICKERSON, R., 1967 - Final report of the Boolooroo seismic survey. Ibid., (unpubl.).

OLGERS, F., in press - Warwick, Qld and N.S.W. 1:250,000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SH/56-2.

OLGERS, F., and FLOOD, P.G., 1970 - Palaeozoic geology of the Warwick and Goondiwindi 1:250,000 Sheet areas, Queensland and New South Wales. Bur. Miner. Resour. Aust. Rec. 1970/6 (unpubl.). (also Bur. Miner. Resour. Aust. Rep. 164 (in press)).

PETTIJOHN, F.J., 1957 - SEDIMENTARY ROCKS. N.Y., Harper.

POWER, P.E., and DEVINE, S.B., 1968 - Some amendments of the Jurassic stratigraphic nomenclature in the Great Artesian Basin. Qld Govt Min. J., 69, 194-8.

POWER, P.E., and DEVINE, S.B., 1970 - Surat Basin, Australia - subsurface stratigraphy, history, and petroleum. Amer. Ass. Petrol. Geol. Bull., 54(12), 2410-37.

PYLE, D.E., and BUCKLEY, A.W., 1965 - Development and exploitation of the Moonie Oilfield. 8th Comm. Min. metall. Cong., 5, 271-6.

REEVES, F., 1947 - Geology of Roma District, Queensland, Australia. Bull. Amer. Ass. Petrol. Geol., 31(8) 1341-71.

REID, J.H., 1921 - Geology of the Walloon-Rosewood Coalfield. Qld Govt Min. J., 22, 223-7, 264-70, 310-6, 357-9.

REID, J.H., 1922 - Geology of the Walloon-Rosewood Coalfield. Geol. Surv. Qld Publ. 272.

REISER, R.F., 1970 - Stratigraphic nomenclature of the upper part of the Rolling Downs Group in the Surat Area. Qld Govt Min. J., 71, 301-3.

REISER, R.F., 1971a - Surat, Queensland - 1:250,000 Geological Series. Bur. Miner. Resour. Aust. Explan. Notes SG/55-16.

REISER, R.F., 1971b - Chinchilla, Queensland - 1:250,000 Geological Series. Bur. Miner. Resour. Aust. Explan. Notes SG/56-9.

RICHARDS, H.C., 1918 - The building stones of Queensland. Proc. Roy. Soc. Qld, 30, 97-157.

RIVEREAU, J.C., 1966 - Photogeological interpretation of Dalby 1:250,000 Sheet area. Bur. Miner. Resour. Aust. Map SG/56-13.

*SCHNEEBERGER, W.F., 1951 - Report on the geology of the Cracow-Prospect Creek area and the Monto-Yarrol Basin. Shell (Qld) Develop. Pty Ltd geol. Rep. 5 (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, southwest Queensland. Bur. Miner. Resour. Aust. Rec. 1968/35 (unpubl.).

SENIOR, B.R., 1971 - Structural interpretation of the southern Nebine Ridge area, Queensland. Aust. Oil. Gas. Rev. (Feb. 1971.)

SENIOR, D., 1972 - St George, Qld 1:250,000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SH/55-4.

SENIOR, D., in press - Goondiwindi, Qld and N.S.W. 1:250,000 Geological Series. Ibid., SH/56-1.

*SLOAT, J., 1960 - Final report of seismic survey of the Cabawin Area, Surat Basin, Qld Australia. ATP 57P. Union Oil Devel. Corp. (unpubl.).

SMITH, E.R., and LODWICK, K.B., 1962 - Surat Basin seismic reconnaissance survey, Queensland, 1960. Bur. Miner. Resour. Aust. Rec. 1962/133 (unpubl.).

STAINES, H.R.E., 1964 - Stratigraphic nomenclature of Bundamba Group in the Ipswich Area. Qld Govt Min. J., 65(747), 33-5.

STEVENS, N.C., 1965 - The volcanic rocks of the southern part of the Main Range, southeast Queensland. Proc. Roy. Soc. Qld, 77(4).

SWINDON, V.G., 1960 - Marburg Sandstone of the type area. J. geol. Soc. Aust., 7, 288-91.

*TALLIS, N.C., and FJELSTUL, C.R., 1965 - Geophysical report - detail seismograph survey of Tipton area, ATP 71P, Queensland, Australia. for Phillips Petrol. Co. (unpubl.).

THOMAS, B.M., and REISER, R.F., 1968 - The geology of the Surat 1:250,000 Sheet Area. Bur. Miner. Resour. Aust. Rec. 1968/56 (unpubl.).

TISSOT, B., 1963 - Correlations of the Permo-Triassic in the Bowen-Surat Basin. I.F.P. Miss. Aust. prog. Rep. 8, Aus/80 (unpubl.).

UNION (OIL DEVELOPMENT CORP.), 1964 - Summary of data and results, UKA Wandoan No. 1 and UKA Burunga No. 1. Bur. Miner. Resour. Aust. Petrol. Search Subs. Acts Publ. 53.

VINE, R.R., and DAY, R.W., 1965 - Nomenclature of the Rolling Downs Group, northern Eromanga Basin. Qld Govt Min. J., 66 (767), 417-21.

VINE, R.R., DAY, R.W., MILLIGAN, E.N., CASEY, D.J., GALLOWAY, M.C., and EXON, N.F., 1967 - Revision of the nomenclature of the Rolling Downs Group in the Eromanga and Surat Basins. Ibid., 68(786), 144-51.

WADE, A., 1941 - Report on the Palaeozoic and younger formations associated with the Stanthorpe-Tenterfield granite intrusion in the Toowoomba-Texas-Tabulam Triangle. Shell (Qld) Devel. Pty Ltd geol. Rep. 3 (unpubl.).

WEBB, A.W., STEVENS, N.C., and McDOUGALL, I., 1967 - Isotopic age determinations on Tertiary volcanic rocks and intrusives of southeast Queensland. Proc. roy. Soc. Qld, 79(7).

WHITE, Mary E., 1969 - Report on the 1968 collection of plant fossils from Surat and Clarence-Moreton Basins, Queensland. Bur. Miner. Resour. Aust. Rec. 1969/57 (unpubl.).

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

WHITEHOUSE, F.W., 1954 - The geology of the Queensland portion of the Great Artesian Basin. Appendix G in Artesian water supplies in Queensland. Dep. Co-ord. Gen. Public Works, Qld, parl. Pap., A, 56-1955.

APPENDIX 1

PETROGRAPHY OF SPECIMENS FROM THE DALBY-GOONDIWINDI AREA

by

N.F. Exon and J. Smart

Eighty thin sections and the related hand specimens of rocks were examined petrographically. Most specimens are from outcrop, but some are from BMR shallow drill holes and from UKA Cabawin No. 1. Four samples are from BMR Chinchilla No. 9, north of this area.

The localities of most of the outcrop samples are given in terms of the 10 000 yard grid. The localities of BMR drill holes are given in Exon (1972) and are shown on the 1:250 000 maps. Minerals were estimated without the aid of point counting.

MARBURG SANDSTONE

Field No. Registered No. Grid reference (yds)	Grain size	Quartz	Feldspar	Mica	Rock fragments	Opaque Minerals	Other Minerals	Clay Minerals	Matrix	Roundness	Sorting	Classification	Hand Specimen
420 68581114A 430522	very fine		-	-	-	Fe staining	Chlorite?	-	-	-	-	Very fine grained bimodal (Quartz + Feldspar)sandstone	Fine-grained sandstone, yellow
420 68581114B 430522	fine to medium	45%	20% Orthoclase	-	5% Quartzite	Fe staining	Chlorite?	clay in matrix	25% clay	Angular to Subangular	poor	Labile sandstone	Pink, fine-grained conglomerate with quartz particles.
422 68581115(1) 430522	medium	45%	11% Orthoclase 10% Plagioclase 1%	Accessory minor biotite		Fe staining	-	-	40% calcitic	Angular to Subangular	good	Sublabile sandstone	Brownish-grey, medium grained sublabile sandstone; fissile, strongly weathered
422 68581115(2) 430522	fine to medium	37%	37% Orthoclase 35% Plagioclase 2%	1% Muscovite	10%	Fe staining	minor calcite	clay in matrix	20% clay	Angular to Subrounded	good	Labile sandstone	-
426 68581116 428522	medium to coarse	42%	15% Orthoclase	-	7%	Fe staining	minor tourmaline, zircon, chlorite	Clay in matrix	30% Clay	Angular to subrounded	poor	Labile sandstone	Coarse grained, very weathered fissile, haematitic quartzose sandstone
430 68581117A 428518	medium to coarse	30%	12% Orthoclase 10% Plagioclase 2%	2% muscovite	-	Fe staining	minor calcite, chlorite	Clay in matrix	50% clay	Angular to Subrounded	poor	Sublabile sandstone	Fissile, medium grained, labile, clayey, micaceous, sandstone
430 68581117B 428518	fine to medium	38%	15% Orthoclase	1% Muscovite	10%	Fe staining	minor zircon, tourmaline	Clay in matrix	30% Clay	Angular to Subangular	poor	Labile sandstone	Fissile, medium grained, labile, clayey, micaceous sandstone
472 68581118A 410476	fine to coarse	15%	15% Orthoclase	5% Sericite	12%	Fe staining		Clay in matrix	50% Clay	Angular to Subangular	poor	Lithic sandstone	-
472 68581118B 410476	very fine	-	-	-	-	Fe staining	-	Clay in matrix	clayey	-	-	Sandstone?	Too fine grained for mineral identification
480 68581119 423471	> 2	10%	-	-	65% Acid volcanics	25% Fe stained particles	-	-	-	Angular	poor	Ferruginized breccia	Basal breccia, ferruginized. coarse (up to 2½ cm)
488 68581121A 412509	fine to medium	30%	6% Orthoclase 5% Plagioclase 1%	Minor muscovite	3%	Fe staining	-	Clay in matrix	60% Clay	Angular to Subangular	good	Sublabile sandstone	Medium grained, clayey, ferruginized, labile sandstone.
488 68581121B 412509	fine to brecciated	35%	-	-	minor	Fe staining	-	Clay in matrix	60% Clayey ferruginised	Angular to Subangular	good	Breccia	Medium grained, clayey ferruginised, lithic sublabile sandstone
495 68581122 419500	very fine to brecciated	50%	-	-	5%	Fe staining	minor augite	Clay in matrix	40% Clayey, ferruginised	Angular to Subangular	poor	Quartzose sandstone	-
906 68581300	fine to coarse	35%	minor	-	-	-	-	Clay in matrix	60% clayey, ferruginised	Angular to Subangular	poor	Quartzose sandstone	Medium to coarse, poorly sorted, slightly reddish sandstone

Field No. Registered No. Grid reference (yds)	Grain size	Quartz	Feldspar	Mica	Rock fragments	Opaque Minerals	Other Minerals	Clay Minerals	Matrix	Roundness	Sorting	Classification	Hand Specimen
914 68581301	fine to coarse	20%	15% Orthoclase 10% Plagioclase 5%	1% Muscovite, minor chlorite	15%	-	-	-	50% quartz	Angular to subangular	good	Labile Sandstone	Matrix, quartz and felspar with lesser biotite and lithics. White, soft, sandstone.
.53 1307 403441	0.3-2.0	50%	10% K feldspar	minor biotite	40% acid volcanics	1% iron ore	minor tourmaline	clay in matrix	1% clay	Subangular to subrounded	poor	Lithic sandstone	Yellow, medium to coarse grained, quartzose, porous friable sandstone.

Marburg Sandstone in B.M.R. Chinchilla No. 9

Field No. Registered No. Grid reference (yds)	Grain size	Quartz	Feldspar	Mica	Rock fragments	Opaque Minerals	Other Minerals	Clay Minerals	Matrix	Roundness	Sorting	Classification	Hand Specimen
998 108'2" Core 2	0.3-0.6	20%	10% Orthoclase, albite	-	50% Quartzite, igneous rocks	3% Fe ore (Magnetite)	-	-	17% Rock fragments	Subrounded	fair	Lithic sandstone	
998 153'5" Core 3	0.05-0.5	40%	5% Orthoclase, albite	5% Biotite, chlorite	-	traces of Fe ore (Magnetite)	-	Clay in matrix	50% sandy clay + rock fragments	Subangular	poor	Lithic sandstone	
998 202'9" Core 4	0.05-0.3	45%	minor feldspar (acid)	30% Biotite, chlorite	5 % schist?	minor magnetite			20% sandy and chloritic	Subangular	poor	Lithic sandstone	
998 302'10" Core 5	0.1-1.0	70%	minor	10% Biotite, chlorite	minor	minor			20% sandy and chloritic	Subangular	poor	Lithic sandstone	

WALLOON COAL MEASURES

Field No. Registered No. Grid reference (yds)	Grain size	Quartz	Feldspar	Mica	Rock fragments	Opaque Minerals	Other Minerals	Clay Minerals	Matrix	Roundness	Sorting	Classification	Hand Specimen
529 68581124A 433524	0.2-2.0	10%		minor Chlorite		Detrital Fe ore		-	80%, Calcitic 40%, altered to limonite 40%	Angular to subrounded	-	Calcarenite	Medium to coarse, very lithic, grey to greyish-brown sandstone
530 68581125 432524	0.05-0.4	40%	40% K-felispars 30% Plagioclase 10%	-	5%	5% Limonite	-	-	10% Calcitic	Angular to subrounded	good	lithic sandstone	Medium grained, very lithic sandstone
531 1126A	0.2-0.3	15%	10% plagioclase + K feldspar	minor altered biotite	25% volcanics and other rocks	1% detrital Fe ore	calcite in matrix	-	50% calcite	Angular to subrounded	-	Calcareous lithic sandstone	Well bedded, grey-brown sandstone: calcareous.
531 1126B	0.1-0.2	15%	5% K feldspar + plagioclase	1% muscovite, biotite	25%	1% detrital Fe ore	calcite in matrix	-	50% calcite	Subangular to subrounded	-	Calcareous lithic sandstone	
611 68581204 447638	very fine to medium	10%	40% K-felispar 35% Plagioclase 5%	-	10%	10% Limonite	-	-	30% Calcitic	Subangular	poor	Feldspathic sandstone	Calcareous, light brown to pale grey, labile, ferruginised sandstone
919 68581302 404442	fine to medium	20%	30% K-feldspar 25% Plagioclase 5%	5% Muscovite, minor biotite, chlorite	minor	-	minor zircon	Clay in matrix	40% Clay	Angular to subangular	poor	Feldspathic sandstone	Pale yellow, weathered sandstone with sandy matrix
960 68581303 367423	fine to medium	25%	minor	minor biotite	minor	Fe staining		Clay in matrix	70% Clayey, ferruginised	Angular to subangular	fair	Quartzose sandstone	Fine grained, weathered sandstone
967 68581304 414354	fine 0.1-0.4	25%	15% Orthoclase, minor plagioclase	minor biotite, 5% muscovite, chlorite		Fe staining	minor tourmaline	Clay in matrix	50% Clay, ferruginised	Angular to subangular	good	Labile sandstone	Fine grained, well sorted labile sandstone

Walloon Coal Measures (cont.)

Field No. Registered No. Grid reference (yds)	Grain size in mm	Quartz	Feldspar	Mica	Rock Fragments	Opaque Minerals	Other Minerals	Clay Minerals	Matrix	Roundness	Sorting	Classification	Hand Specimen
949 68581305 South of North Star, on Inverell Sheet	fine to medium	40%	10% Orthoclase, minor plagioclase	minor muscovite, biotite	2%	Fe staining	minor tourmaline, fluorite, calcite	-	40% calcitic	Angular to subrounded	good	Quartzose sandstone	Hard calcareous, moderate-well sorted sandstone
529 68581124B 433524	0.05-0.2	20%	15% K-feldspar 10% Plagioclase 5%	-	-	6% Limonite 5% other Fe 1%	-	-	50% Calcitic	Angular to subangular	-	Lithic sandstone	Medium grained, very lithic sandstone
UKA CABAWIN 1 9540'- 9540'3"	0.1-0.5	25%	minor	minor	35%	minor Fe ore	3% almandine, 2% carbonaceous fragments	Clay in matrix	30% Clayey	Subangular to subrounded	poor	Lithic sandstone	Grey sandstone with dark specks, clayey, calcareous

SPRINGBOK SANDSTONE

Borehole sample	Grain size in mm	Quartz	Feldspar	Mica	Rock fragments	Opaque minerals	Other minerals	Clay minerals	Matrix	Roundness	Sorting	Classification	Hand Specimen
UKA CABAWIN 1 4,197'2"- 4,197'6"	0.1-0.6	45%	5% Albite + orthoclase	minor	15% igneous?	minor Fe ore	5% almandine	clay in matrix	30% clayey, calcareous	Subangular to subrounded	poor	Lithic sandstone	Grey rock with dark specks (garnets), calcareous
BMR DALBY 1 162'3"	0.2-0.6	25%	5% Orthoclase + albite	1% Biotite, chlorite	30% volcanics	20% Magnetite	7% almandine	clay in matrix	30% clayey	Subangular to subrounded	poor	Lithic sandstone	Grey with dark green specks (garnet)
BMR DALBY 1 244'9"	0.1-0.4	35%	5% Orthoclase + plag. up to An_{50}	minor biotite, chlorite	25% volcanics	2% magnetite	8% Almandine, minor glauconite?	clay in matrix	25% clayey	Subangular	poor	Lithic sandstone	Light grey with greenish specks (garnets, etc.)
BMR DALBY 1 316'4"	0.1-0.4	30%	5% Orthoclase, plagioclase up to An_{50}	minor	40% volcanics	1% magnetite	4% Almandine, minor carbonaceous material	clay in matrix	20% clayey	Subrounded	poor	Lithic sandstone	Grey rock with darker specks, slightly calcareous.

KUMBARILLA BEDS

Field No. Registered No. (prefix 6858) Grid reference (yds)	Probable Formation within the Beds	Grain size in mm	Quartz	Feldspars	Mica	Rock Fragments	Opaque Minerals	Other Minerals	Clay Minerals	Matrix	Roundness	Sorting	Classification	Hand Specimen
68 1001 372564	Orallo Formation	0.3	60%	25% F>Plag.	Minor, muscovite, chlorite	5% acid volcanics	7% ferruginised rounded blobs	minor zircon	clay in matrix	3% clay	Subangular to subrounded	fair	Feldspathic sandstone	
105 1002 381568	Orallo Formation	0.3-0.5		25% Andesine		50% acid volcanics with fine feldspathic needles		calcite in matrix		25% calcite	Angular to subrounded		calcareous lithic sandstone	

Kumbarilla Beds (cont.)

Field No. Registered No. (prefix 6858) Grid reference (yds)	Probable Formation within the Beds	Grain size in mm	Quartz	Feldspars	Mica	Rock Fragments	Opaque Minerals	Other Minerals	Clay Minerals	Matrix	Roundness	Sorting	Classification	Hand Specimen
300 1127 425535	Springbok Sandstone	0.05–0.4	10%	15% Orthoclase and albite	-	30% mostly fine grained igneous	traces magnetite and some iron staining	-	clay in matrix	45% sandy clay	Subangular	poor	Lithic sandstone	Dull red-brown colour, medium to fine grained, calcareous no apparent structure.
301 1100 420538	Springbok Sandstone	0.3–0.5	15%	10% Plagioclase	minor muscovite, chlorite	60% acid volcanics, recrystallized	detrital limonite		clay in matrix	15% clay	Angular to subrounded		Ferruginous lithic sandstone	
303 1101 408544	?Springbok Sandstone	0.3–0.5	30%	minor altered plagioclase	minor muscovite, chlorite	70% acid volcanics, altered	detrital Fe ore	-	-	-	Angular to subrounded		Lithic sandstone	Reddish-brown, fine to medium grained, strongly bedded sandstone
332 68581103 413533	?Springbok Sandstone	< 2.5 mm fine to coarse	30%	8% Microcline 2%, Albite 2%, Orthoclase 2%, Plagioclase 2%	-	10% very fine grained quartzite	-	Minor chlorite, accessory zircon	clay in matrix	45% clay	Angular to subangular		Labile sandstone	-
333 1104 419530	?Springbok Sandstone	0.5–1.0	35%	5% K feldspar	-	50% acid volcanics	iron minerals	-	-	10% clay, Fe minerals	Angular to subrounded	fair	Lithic sandstone	Coarse brown sandstone
484 1120 411520		0.3–0.5	30%	10% K feldspar + plagioclase	bleached biotite	55% acid volcanics?	1% detrital Fe ore	-	clay in matrix	-	Subangular to subrounded	fair	Lithic sandstone	Fine to medium grained, yellowish-brown, lithic sublabile sandstone.
645 1209 381640	Orallo Formation	0.2–0.4	10%	1% plagioclase	minor bleached mica, chlorite	85% acid volcanics and other	minor iron minerals		clay in matrix	5% clay	Angular to subrounded		Lithic sandstone	Fine to coarse grained greenish clayey labile sandstone
660 1211 358625	Orallo Formation	0.2–0.5	20%	5%	biotite, chlorite, muscovite	70% acid volcanics	1% detrital iron ore	minor tourmaline, zircon	clay in matrix	5% clay	Angular to subrounded		Lithic sandstone	Clayey labile sandstone, white, with clay clasts and plant roots.
719 1216 367604	Orallo Formation	0.5	10%	25% K feldspar, 15%, andesine 10%	-	60% acid volcanics	1% detrital Fe ore	-	clay in matrix	5% clay	Subangular to subrounded		Lithic sandstone	Brownish, very fine to coarse grained, sublabile sandstone

Borehole sample	Grain size in mm	Quartz	Feldspar	Mica	Rock Fragments	Opaque Minerals	Other Minerals	Clay Minerals	Matrix	Roundness	Sorting		Hand Specimen
GUBBERAMUNDA SANDSTONE													
UKA CABAWIN 1 3280-3280'4"	0.1-0.4	50%	5% orthoclase & albite, minor perthite	-	10%	2% magnetite	3% almandine	clay in matrix	30% clayey	Subangular to subrounded	poor	Lithic sandstone	Light grey, medium grained sandstone, quartzose appearance
UKA CABAWIN 1 3785'6"-3785'11"	0.05-0.3	35%	5% albite & orthoclase	minor	20%	1% magnetite	4% almandine	clay in matrix	35% clayey	Subangular	poor	lithic sandstone	Light grey, clayey sandstone
ORALLO FORMATION													
UKA CABAWIN 1 2095'-2100'		Small, angular quartz grains in fine lithic matrix. Only recognizable minerals are quartz and sericite.				Abundant carbonaceous streaks.						Siliceous shale	Grey, fine grained rock
UKA CABAWIN 1 2232'10"-2233'	0.05-0.4	40%	5% albite & some orthoclase	2% Biotite, chlorite	25%	3% Fe ore	garnet	clay in matrix	25% clayey	Subangular to subrounded	poor	Lithic sandstone	Light grey fine sandstone
UKA CABAWIN 1 2789'8"-2790'	0.1-1.5	40%	5% albite & orthoclase	minor	20%	minor Fe ore	5% almandine	clay in matrix	30% clayey	Subangular to subrounded	poor	Lithic sandstone	Grey, medium to coarse grained sandstone with visible garnet; calcareous
BUNGIL FORMATION													
BMR DALBY 3 205'1½"	0.1-0.3	35%	5% albite & orthoclase	minor	35%	minor Fe ore	-	clay in matrix	25% clayey	subangular	poor	Lithic arenite	Light grey, fine grained sandstone with darker grains (lithic fragments)
UKA CABAWIN 1 1584'9"-1585'	0.1-0.3	30%	minor orthoclase & albite	minor chlorite	30%	minor Fe ore	-	clay in matrix	40% clayey	subangular to subrounded	poor	Lithic arenite	Light grey, medium grained, clayey sandstone
SURAT SILTSTONE													
BMR DALBY 2 201'1"	0.05-0.15	20%	10%	5% biotite, chlorite	20%	3% magnetite	7% carbonaceous streaks, glauconite	clay in matrix	35% clayey	subangular	poor	Lithic sandstone	Fine grained, dark grey rock.
BMR DALBY 2 344'10"	0.05-0.2	20%	5% orthoclase & plagioclase	minor biotite	20%	minor Fe ore	20% glauconite, 5% carbonaceous fragments	clay in matrix	30% clayey	subangular	poor	Lithic arenite	dark grey with black specks; sandstone

UNDIFFERENTIATED WALLUMBILLA FORMATION AND SURAT SILTSTONE (Kl)

Field No. Registered No. (Prefix 6858) Grid Reference (yds)	Grain size in mm	Quartz	Feldspar	Mica	Rock Fragments	Opaque Minerals	Other Minerals	Clay Minerals	Matrix	Roundness	Sorting	Classification	Hand Specimen
370 1106 362525	0.05–0.2	5%	-	minor muscovite	80% acid volcanics	detrital iron ore	-	altered clay	15% clay and iron minerals	-	-	Silty lithic sandstone	Silty lithic sandstone
381 1107 322511	<0.1	5%	5% plagioclase	-	-	2% iron ore	calcite cement	clay in matrix	90% calcite and clay	-	-	Calcilutite	Clayey calcareous siltstone with plant debris
387 1142 313523	0.02–0.2	50%	-	-	-	minor Fe ore	-	-	50%	subangular	poor	Quartzose sandstone	Buff coloured, fine grained rock. Massive with irregular fracture, often iron stained
388 1108 316522	0.2–0.4	40%	1%	minor muscovite	minor acid volcanics	iron ore in matrix			60% silty	angular to subangular		Silty quartzose sandstone	Silicified deeply weathered sandstone
392 1143 325501	0.03–0.4	35%	-	-	-	traces iron ore	-	-	65% sandy-clay degraded rock fragments	subangular	poor	Lithic sandstone	Light grey rock with reddish (Fe stained) partings. High matrix content, leached, weathered.
997 68581306 328420	medium to coarse	45%	22% Orthoclase 15%, Anorthoclase 5%, Plagioclase 2%	Muscovite, chlorite	5%	-	minor zircon, ilmenite	Clay in matrix	20% clay	Angular to subrounded	poor	Labile sandstone	Labile sandstone.

GRIMAN CREEK FORMATION

Field No. Registered No. (Prefix 6858) Grid Reference (yds)	Grain size in mm	Quartz	Feldspar	Mica	Rock Fragments	Opaque Minerals	Other Minerals	Clay Minerals	Matrix	Roundness	Sorting	Classification	Hand Specimen
395 68581109 318512	0.01–0.4	50%	2% plag. up to An 50, some orthoclase		35% volcanics altered, stained	3% Fe ore		Clay in matrix	10% Clay, calcareous	subangular to subrounded	poor	Lithic sandstone	light grey, highly calcareous, no apparent structure
400 68581110A 309515	0.1–0.3	15%	10% plag. up to An 45	1% Biotite	50% volcanics altered Fe stained	3% Fe ore	1% Glauconite	Clay in matrix	20% Clay, calcareous	subrounded (occ. subangular)	poor	Lithic sandstone	dark grey, prominent banding associated with Fe staining, calcareous
400 68581110B 309515	0.1–0.4	5%	5% plagioclase up to An 45	trace Biotite	60% fine grained volcanics	2% Fe ore	traces Glauconite	Clay in matrix	28% Clay, Fe-stained	subrounded (occ. subangular)	fair	Lithic sandstone	Yellowish-brown with dark grains in light matrix, calcareous
400 68581110C 309515	0.1.–0.3	5%	5% plagioclase up to An 45	traces Biotite	60% volcanics	1% Fe ore	traces Glauconite	Clay in matrix	29% Clay, Fe staining, calcareous	subangular to subrounded	fair	Lithic sandstone	dark brownish-grey, with irregular light streaks (calcareous) which emphasise bedding
400 68581110D 309515	0.05–0.3	8%	10% plagioclase up to An 45	traces Biotite	55% volcanics	2% Fe ore	traces Glauconite	Clay in matrix	25% Clay, calcareous	subangular to subrounded	fair	Lithic sandstone	grey. Dark or light coloured grains in light matrix, calcareous
400B 68581112 305497	0.05–0.2	10%	15% plagioclase up to An 55		40% volcanics	1% Fe ore (magnetite)	traces Glauconite	Clay in matrix	34% sandy, clay, calcareous	subangular to subrounded	poor	Lithic sandstone	grey with pink irregular dark lines (Fe rich) emphasize bedding, calcareous
402 68581113A 312522	0.05–0.2	10%	10% plagioclase up to An 50		40% volcanics	3% Fe ore (magnetite)	traces Glauconite	Clay in matrix	37% sandy clay, calcareous	subangular to subrounded	Poor	Lithic sandstone	grey uniform appearance no structure apparent, calcareous

Griman Creek Formation (Cont.)

Field No. Registered No. (Prefix 6858) Grid Reference (yds)	Grain size in mm	Quartz	Feldspar	Mica	Rock Fragments	Opaque Minerals	Other Minerals	Clay Minerals	Matrix	Roundness	Sorting	Classification	Hand Specimen
402 68581113B 312522	0.05-0.2	5%	3% plagioclase up to An 50		55% volcanics	2% (magnetite)	-	Clay in matrix	35% sandy clay, calcareous	subrounded	poor	Lithic sandstone	Yellowish-brown: no internal structure apparent, calcareous
400A 68581111 309510	0.02-0.06	Fabric dominated by fine, slightly irregular banding, similar to algal growth. The bands are heavily Fe stained (limonite), sometimes almost opaque. No evidence of dolomitization is visible, but the texture is partly obscured by the Fe staining.										algal Limestone	buff coloured rock in the prominent banding produced by thin, dark irregular lines (algal bands)

TERTIARY BASALT

Field No. Registered No. (Prefix 6858) Grid reference (yds)	Grain size	Plagioclase	Augite	Olivine	Opaque minerals	Matrix	Texture	Classification	Hand Specimen
602 1200 437642	Fine	80% labradorite in long laths	7%	6% altered and iron stained	7% magnetite or ilmenite	labradorite, augite, olivine, iron minerals	Fairly typical basalt, but flow banding not obvious. Few phenocrysts (plagioclase) and some fragments of fine basalt	Basalt	Massive basalt, slightly porphyritic in olivine
607 1202 445647	Porphyritic	80% labradorite in long laths; phenocrysts labradorite - bytownite	12%	3% Phenocrysts altered and iron stained	5% magnetite or ilmenite	Labradorite, augite, olivine, iron minerals	Typical flow-banded porphyritic basalt, with phenocrysts of plagioclase and olivine	Porphyritic Basalt	Porphyritic basalt
622 1205 449608	Porphyritic	80% labradorite in long laths; phenocrysts labradorite - bytownite	10%	5% altered	5% magnetite or ilmenite	Labradorite, augite, olivine, iron minerals	Typical flow banded basalt, with large phenocrysts of plagioclase	Porphyritic Basalt	Porphyritic basalt olivine phenocrysts up to 1 cm
350 1140 420539	Porphyritic	labradorite in matrix	10% phenocrysts 1 mm	10% Phenocrysts 2 mm	minor iron ore	80% labradorite, augite, olivine, iron ore.	Typical basaltic, long feldspar laths showing slight flow banding	Porphyritic Basalt	Dark, fresh basalt, fairly fresh phenocrysts of olivine and augite.
351 1141 420540	Porphyritic	labradorite in matrix	minor	12% Phenocrysts, fairly fresh, some alteration to serpentine up to 2 mm	minor iron ore	88% labradorite, olivine, some augite and iron ore	Typical basaltic, with long labradorite laths	Porphyritic olivine basalt	Dark coloured porphyritic basalt, very fresh, with olivine phenocrysts.

TERTIARY SEDIMENTS

Field No. Registered No. (Prefix 6858) Grid reference (yds)	Grain size in mm	Quartz	Feldspar	Mica	Rock Fragments	Opaque Minerals	Other Minerals	Clay Minerals	Matrix	Roundness	Sorting	Classification	Hand Specimen
? 1000	0.05-0.6	80%	-	sericite in matrix	5% quartzite?	3% magnetite	-	-	12% sandy	subangular to subrounded	good	Quartzose sandstone	
315 1102 453592	< 0.02	Bulk of rock is fine carbonate crystals, with larger (up to 0.8 mm and much longer) rounded fragments, apparently of similar composition, but finer grained. Fine grained limestone, with carbonate clasts, possibly dolomitised.									-	-	White soft rock
499 1123 420482	0.02-0.4	75%	-	-	-	5% magnetite hematite	-	-	20% fine, sandy	subangular to subrounded	poor	Quartzose sandstone	fine stained reddish sandstone, with abundant reduction spots
315 1128 453592		White, fine-grained limestone, with small subrounded fragments of darker, finer-grained limestone.										Limestone	Limestone, interbedded with basalt.
331 1129 421534	0.1-1.0	Consists of quartz fragments up to pebble size with traces of iron staining. The fragments are usually full of irregular, close fractures.										Pebbly quartzose sandstone	light coloured pebble sandstone, pebbles of white and pink quartz. Thin irregular bedding.
334 1130 423527	0.05-0.2	100%				minor Fe ore				Subrounded	poor	Quartzose sandstone. (texture is slightly interlocking but not completely recrystallized).	White with faint reddish grains. Hard fine-grained highly quartzose rock.

APPENDIX 2

NOTES ON THE FOSSILIFEROUS PLEISTOCENE FLUVIATILE DEPOSITS OF THE EASTERN DARLING DOWNS

Alan Bartholomai
Queensland Museum

Geological interest in the widespread fluviatile deposits of the eastern Darling Downs, developed to the east of Warra and exposed largely in the banks of the Condamine River and its tributaries, has centred largely on the abundant remains of Pleistocene vertebrates, collected widely from the area since the first settlement in the 1840's.

Leichhardt (1847), Stutchbury (1853, 1854), Bennett (1872), and Gregory (1879) made notes on the geology of the deposits. A full discussion, together with described sections for King Creek and the Condamine River, is presented in Woods (1960). Most of the fossil vertebrates recovered have come from poorly consolidated black and dark red-brown calcareous clay soils, although coarse ferruginous quartzose sands contribute to a limited extent in the Dalby - Macalister area. Pleistocene soils have resulted from dissection of the widespread Miocene surface, with major contribution from the basalts of the Great Divide. The Main Range, the Bunya Mountains, and attendant spurs and mesas represent the remnants of this major source. The sands appear to have been derived from Mesozoic rocks.

Recent black surface soil, which does not appear to be much more than a metre deep, is widespread, but knowledge of the distribution of the underlying Pleistocene sediments is restricted to sporadic occurrences in creeks and wells. While these deposits generally stand at a higher topographic level than the recent drainage system in the area, the stratigraphy is complicated by the lenticularity, discontinuity of outcrop, and rapid lateral gradation of the sediments.

In the past, some information on the distribution of the Pleistocene sediments away from the river sections was provided from wells. Bennett (1872) recorded a fossil kangaroo from 140 feet depth at Jimbour Plains, and Pleistocene species have been recorded from nearby surface exposures along Jimbour Creek, giving some idea of the possible minimal thickness of Upper Cainozoic sediments in that area. Woods (1960) indicates that alluvial thickness extends up to 163 feet in the Dalby section of the Condamine, although this could include possible Pliocene sediments.

The Pleistocene fluviatile deposits have been referred to as 'Older Alluvial or Fossil Drift' by Gregory (1879), and Etheridge (Jack & Etheridge, 1892) applied the term 'Fluviatile Deposits' to them. In the same publication, Jack listed 'High-Level River and Lake Drifts' and 'Bone Drifts' in his post-Pliocene deposits. The name 'Diprotodon Beds' was proposed by Bryan (1928) for these fossiliferous alluvia. Macintosh (1967) informally introduced several stratigraphic names for soil units in the Dalyrymple-King Creek area to the southeast, but recent CSIRO Soils Division cores retrieved from that area suggest a more complex stratigraphic relationship than envisaged in that paper.

Bartholomai & Woods (1968) have shown that the Pleistocene alluvia are superimposed on the possibly Pliocene Chinchilla Sand at Dalby at a depth of about 87-90 feet.

Among fossil vertebrates recorded from the Pleistocene fluviatile deposits, marsupials predominate, but birds, reptiles, and fish are also known to be present. The monotreme Ornithorhynchus agilis is rare. The large marsupial Diprotodon optatus dominates the fauna, but other diprotodontids, including D. minor, Nototherium inerme, Zygomaturus trilobus, and Palorchestes azael are also widely distributed. Dasyurids are represented by Thylacinus cynocephalus, Sarcophilus laniarius, and Dasyurus sp., and phalangerids include the 'marsupial lion', Thylacoleo carnifex. Smaller marsupials, including peramelids, are poorly represented. The Macropodidae is numerically the best represented family, with grazing forms morefrequently encountered than browsing types. Propleopus oscillans is recorded, but is rare. Macropus titan is particularly abundant, and other kangaroos such as M. ferragus and M. altus are also present. Extinct protemnodonts constitute a large proportion of the fossil sample and include Protemnodon anak, P. brehus, and P. raechus. Troposodon minor is also moderately well represented, but potoroines, including Aepyprymnus, are less common. Wallabies such as 'Halmaturus' siva, 'H'. thor, and 'H'. indra are occasionally encountered, as are the more specialized macropodids Sthenurus andersoni, S. oreas, S. pales, S. tindalei, Procoptodon goliah, P. rapha, and P. pusio. Vombatids present include Phascolonus gigas, Phascolomys augustidens, P. magnus, P. medius, P. mitchelli, and Lasiorhinus latifrons.

Among reptilian fossils are the large horned tortoise Meiolania oweni and the gigantic goanna Megalania prisca. Crocodilian and tortoise remains are rare.

A large bird fauna includes Tophaetus brachialis, Pelecanus proavus, Lobivanellus sp., Progura gallinacea, Gallinula peralata, G. strenuipes, Lithophaps ulnaris, Metapteryx bifrons, Platalea subtenuis, Dromaius patricius, Palaeopelargus nobilis, Nacraster alacer, and Tribonyx effluxus. The supposed Queensland Moa, Dinornis queenslandiae, has been shown by Scarlett (in press) to have been derived from a New Zealand Maori midden site.

Literature Cited

BARTHOLOMAI, A., and WOODS, J.T., 1968 - Notes on the Chinchilla Sand. Bur. Miner. Resour. Aust. Rec., 1968/53, 71-3 (unpubl.).

BENNETT, G., 1872 - A trip to Queensland in search of fossils. Ann. Mag. nat. Hist. Ser. 4, 9, 314-21.

BRYAN, W.H., 1928 - A glossary of Queensland stratigraphy. Spec. Publ. Dep. Geol. Univ. Qld, 1-69.

GREGORY, A.C., 1879 - On the geological features of the south-eastern district of Queensland. V. & P. legisl. Assem. Qld, 1879(2), 365-74.

JACK, R.L., and ETHERIDGE, R., Jun., 1892 - The geology and palaeontology of Queensland and New Guinea. Geol. Surv. Qld Publ. 92.

LEICHHARDT, L., 1847 - JOURNAL OF AN OVERLAND EXPEDITION IN AUSTRALIA. London, Boone.

MACINTOSH, N.W.G., 1967 - Fossil man in Australia. Aust. J. Sci., 30, 86-98.

SCARLETT, R., in press - On the alleged Queensland Moa, Dinornis queenslandiae De Vis. Mem. Qld Mus., 15(3), 207-12.

STUTCHBURY, S., 1853 - Eleventh tri-monthly report upon the geological and mineralogical structure of New South Wales. Sydney, Legisl. Counc. Pap., 1853.

STUTCHBURY, S., 1854 - Twelfth tri-monthly report upon the geological and mineralogical structure of New South Wales. Ibid., 1854.

WOODS, J.T., 1960 - Fossiliferous fluviatile and cave deposits. J. geol. Soc. Aust., 7, 393-403.

APPENDIX 3

PALYNOLOGY OF BMR CHINCHILLA NO. 9

by D. Burger

Two samples from BMR Chinchilla 9 have been processed and examined.

C.1, 58'11" - 59'. MFP 4710

An abundant, reasonably well preserved assemblage was recovered.

Classopollis torosus (30% approx.)
Nevesisporites vallatus
Ischyosporites sp.
Osmundacidites comaumensis
Polycingulatisporites sp.
Stereisporites antiquasporites
Dictyophyllidites sp.
Tripatina sp.
Cardargasporites reticulatus
Duplexisporites gyratus
Classopollis cf. simplex
Alisporites spp.
Vitreisporites pallidus
Inaperturopollenites turbatus
Gingkocycadophytus magnus
Tsugaepollenites dampieri (very rare)

The most notable thing about the assemblage is the abundance of Classopollis. Species of Alisporites are the next dominant form. Only one specimen of Tsugaepollenites dampieri was observed in a total scan of two fairly rich slides. No acritarchs are present.

The combination of abundant Classopollis with the presence of Cardargasporites reticulatus, and the virtual absence of Tsugaepollenites suggests Unit J1, or at most very low in J2. This probably makes it of middle to upper Evergreen age.

C.5, 305'11" - 306'. MFP 4712

Darkened woody fragments were very abundant in this assemblage, but spores were rare.

Classopollis torosus
Duplexisporites gyratus
Klukisporites sp.
Cyathidites minor

The above list represents all the specimens which could be identified in the residue. D. gyratus was represented by several reasonably preserved specimens - it may be differentially resistant. The age, on this not very substantial evidence, is probably basal Jurassic, if we accept the convention of drawing the boundary at the incoming of Classopollis.

APPENDIX 4

PALYNOLOGY OF BMR DALBY NO. 2, CORE 3

by

D. Burger

Well preserved spores and pollen grains were recovered from a sample from core 3 in the 340-345 foot interval (MFP 4763), BMR Dalby No. 2 Scout Hole. The assemblage extracted was fairly rich in species and contained the following types that have stratigraphic significance:

Spores : Cicatricosisporites australiensis
Cyclosporites hughesi
Crybelosporites striatus
Aequitriradites spinulosus
Foraminisporis wonthaggiensis
F. asymmetricus
F. dailyi
Cicatricosisporites ludbrooki
Balmeisporites holodictyus
Pilosisporites parvispinosus (fragment)
cf. Dictyotosporites speciosus
cf. Laevigatosporites ovatus

Incertae sedis: Schizosporis reticulatus

Microplankton : Dinoflagellate indet. (1 specimen)

In view of the co-occurrence of C. australiensis, C. hughesi, and C. striatus, the microflora can be attributed to the interval of spore units K 1d and K 2a (Burger, 1968), while the absence of Coptospora paradoxa, which only occurs in K 2 assemblages, further restricts the age to unit K 1d. The presence of cf. L. ovatus might indicate that the microflora belongs within the upper part of the K 1d interval.

Spore unit K 1d is well-known from eastern Australia (Evans, 1966; Burger, 1968). In the Eromanga and Surat Basins the unit appears to be associated with the Ranmoor/Coreena Member of the Wallumbilla Formation. Recently, the unit was identified in assemblages from the Coreena in UKA Cabawin No. 1 and UKA Coomrith No. 1 Wells, central Surat Basin. The section of Coomrith No. 1 is the first example of unit K 1d incorporating younger strata; microfloras of that age were recovered from as high as the Griman Creek Beds (Burger, 1968), which are indistinguishable from the Coreena in lithology.

Near-absence of marine micro-organisms might point to non-marine environments of deposition.

REFERENCES

BURGER, D., 1968 - Relationship of palynology to stratigraphy in the Lower Cretaceous of the Surat Basin in Queensland. Bur. Min. Resour. Aust. Rec. 1968/125 (unpubl.).

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

APPENDIX 5

PALYNOLOGY OF BMR DALBY NOS 3 and 4

by

Elizabeth Kemp

BMR Dalby No. 3

The deepest sample from this well (200-210 ft) indicates the palynological unit K1b-c. A diverse spore assemblage includes the presence of the spores Dictyotosporites speciosus, Pilosisporites notensis, Foraminisporis dailyi, and F. wonthaggiensis, which characterize this unit, and the dinoflagellate Dingodinium cerviculum.

The cuttings from shallower depths (180-190 and 80-90 ft) yielded impoverished assemblages in which almost all the forms were long-ranging, so that no additional evidence could be used to date them more precisely. Full microfloral lists are given below.

The depositional environments suggested by the assemblages recovered from the samples are interesting. Dinoflagellates occur only in the deepest sample, and even these are rare, and only two genera, Dingodinium and Gonyaulacysta, are represented. The assemblage from these cuttings suggests a possible near-shore marine environment. It is dominated by saccate pollens which may have been derived from a source quite close to the site of deposition.

In the cuttings between 180 and 190 feet there is no indication of marine influence. Although spores are very rare and in general poorly preserved, the residue is dominated by woody fragments and darkened plant tissue.

A return to at least brackish conditions seems indicated by the presence of acritarchs (Michrystridium spp.) in the assemblage recovered from 80-90 feet.

Details of the assemblages are listed below:

MFP 4752. Cuttings 80-90ft.

Preservation fair, assemblage not very diverse.

Spores & pollen:

Alisporites spp.
Cyathidites australis
Klukisporites scaberis
Gleicheniidites circiniidites
Gingkocycadophytus sp.
Microcachryidites antarcticus
Lycopodiumsporites austroclavatidites
Dictyotosporites speciosus
Classopollis torosus
Cyathidites minor
Contignisporites multimuratus

Microplankton:

Michrystridium spp.

MFP4746-Cuttings 180-190 ft.

Large quantity of darkened wood, tracheids etc., with very rare, long-ranging spores.

Alisporites sp.
Microcachryidites antarcticus
Cyathidites australis
Lycopodiumsporites austroclavatidites

MFP4748. Core 200-210 ft.

Diverse, generally well preserved assemblage. Composition, based on count of 200 grains, is given below.

Spores & pollen:

Cyathidites asper	1%
Dictyotosporites complex	x
Gleicheniidites circiniidites	10%
Alisporites spp.	58%
Gingkocycadophytus sp.	5%
Podocarpidites ellipticus	1%
Microcachryidites antarcticus	8%
Lycopodiumsporites nodosus	x
L. austroclav.	4%
Dictyotosporites speciosus	1%
Pilosisporites notensis	x
Striate saccate (reworked Permian)	x
Klukisporites scaberis	1%
Foraminisporis dailyi	x
F. wonthaggiensis	x
Foveotriletes sp.	x
Vitreisporites pallidus	x
Cyathidites minor	9%
Araucariacites sp.	x

Microplankton:

Dingodinium cerviculum	x
Gonyaulacysta sp. (fragments)	
Michrystridium spp.	1%

BMR Dalby No. 4

MFP 4753. Cuttings 80-90 ft.

A reasonably well preserved and diverse assemblage. Palynological unit Kla seems indicated by the presence of Cicatricosisporites australiensis and C. hughesi, and by the absence of any forms characterizing higher units. Full microfloral list is:

Osmundacidites comaumensis
Cyathidites minor
C. asper
Biretisporites spectabilis
Contignisporites multimuratus
C. cooksoni

Cicatricosisporites australiensis
C. hughesi
Klukisporites scaberis
Concavissimisporites sp.
Aequitriradites spinulosus
Neoraistrickia truncata
Tsugaepollenites dampieri
Laevigatosporites sp.
Podocarpidites ellipticus
Microcachryidites antarcticus
Alisporites sp.
Classopollis torosus
Parasaccites sp. (reworked Permian form)

APPENDIX 6

MICROPALAEONTOLOGICAL EXAMINATION OF BMR DRILL HOLES DALBY NOS 2, 3, and 4

by

G.R.J. Terpstra

Dalby No. 2

Core 1.	100'-109'5½"	No Foraminifera	
Core 2.	200'-206'6"	" "	Megaspores
Core 3.	340'-342'9"	No Foraminifera	
Cuttings	0'-240'	No Foraminifera	
	260'-300'	" "	Megaspores
	300'-340'	" "	

Dalby No. 3

Cuttings	0'-60'	No Foraminifera	
	90-100'	" "	Megaspores
	120'-200'	" "	
Core No. 1.	200'-207'3"	" "	Megaspores

Dalby No. 4

Cuttings	0'-60'	No Foraminifera	
	90'-110'	" "	
	110'-120'	" "	Megaspores
	140'-170'	" "	

No marine microfossils have been found, but Megaspores occur in some samples of each drill hole, indicating non-marine sediments of Lower Cretaceous age.

APPENDIX 7

Petroleum Technology Laboratory, Bureau of Mineral Resources, Geology and Geophysics, Canberra

CORE ANALYSIS RESULTS

NOTE: (i) Unless otherwise stated, porosities and permeabilities were determined on two plugs (V&H) cut vertically and horizontally to the axis of the core. Ruska porosimeter and permeameter were used with air and dry nitrogen as the saturating and flowing media respectively. (ii) Oil and water saturations were determined using Soxhlet type apparatus. (iii) Acetone test precipitates are recorded as Neg., Trace, Fair, Strong or Very Strong.

WELL NAME AND NO. SURAT (BMR) SCOUT NO. 3

DATE ANALYSIS COMPLETED 17 September 1968

Core No.	Sample Depth		Lithology	Average Effective Porosity two plugs (% Bulk Vol.)	Absolute Permeability (Millidarcy)		Average Density (gm/cc.)		Fluid Saturation (% pore space)		Core Water Salinity (p.p.m. NaCl)	Acetone Test	Fluorescence of freshly broken core	ALL CORES IN GRIMAN CREEK FORMATION
	From	To			V	H	Dry Bulk	Apparent Grain	Water	Oil				
1	50'2"	50'6"	Sandstone v.f. gr.	32	N.D.	N.D.	1.82	2.68	N.D.	N.D.	N.D.	N.D.	NIL	
2	160'7"	160'11"	Siltstone, sandy	32	N.D.	N.D.	1.82	2.67	N.D.	N.D.	N.D.	N.D.	NIL	
3	249'6"	249'10"	Siltstone, shaly	30	N.D.	N.D.	1.90	2.70	N.D.	N.D.	N.D.	N.D.	NIL	
4	349'1"	349'7"	Shale, silty	32	N.D.	N.D.	1.86	2.74	N.D.	N.D.	N.D.	N.D.	NIL	
5	454'6"	455'1"	Siltstone, shaly	29	N.D.	N.D.	1.92	2.72	N.D.	N.D.	N.D.	N.D.	NIL	

Remarks: - CORES BADLY BROKEN

General File No. 62/399
Well File No. ____________

Petroleum Technology Laboratory, Bureau of Mineral Resources, Geology and Geophysics, Canberra

CORE ANALYSIS RESULTS

NOTE: (i) Unless otherwise stated, porosities and permeabilities were determined on two plugs (V&H) cut vertically and horizontally to the axis of the core. Ruska porosimeter and permeameter were used with air and dry nitrogen as the saturating and flowing media respectively. (ii) Oil and water saturations were determined using Soxhlet type apparatus. (iii) Acetone test precipitates are recorded as Neg., Trace, Fair, Strong or Very Strong.

WELL NAME AND NO. SURAT (BMR) SCOUT NO. 4

DATE ANALYSIS COMPLETED 17 September 1968

Core No.	Sample Depth		Lithology	Average Effective Porosity two plugs (% Bulk Vol.)	Absolute Permeability (Millidarcy)		Average Density (gm/cc.)		Fluid Saturation (% pore space)		Core Water Salinity (p.p.m. NaCl)	Acetone Test	Fluorescence of freshly broken core	ALL CORES IN GRIMAN CREEK FORMATION
	From	To			V	H	Dry Bulk	Apparent Grain	Water	Oil				
1	90'0"	90'5"	Siltstone	32	N.D.	N.D.	1.82	2.67	N.D.	N.D.	N.D.	Neg.	NIL	
2	195'0"	195'6"	Siltstone, sandy, carb.	27	N.D.	N.D.	1.92	2.64	N.D.	N.D.	N.D.	Neg.	NIL	
3	301'10"	302'4"	Sandstone, v.f. gr.	30	N.D.	N.D.	1.88	2.67	N.D.	N.D.	N.D.	Neg.	NIL	

Remarks: - CORES BADLY BROKEN

General File No. 62/399

Well File No.

DALBY
QUEENSLAND

Reference

CAINOZOIC	QUATERNARY	HOLOCENE		Qa	Alluvium
		PLEISTOCENE TO HOLOCENE		Qs	Sand; some alluvium and gravel
				Qpc	Sandy alluvium of Condamine River; vertebrate fossils
	TERTIARY	UPPER OLIGOCENE TO LOWER MIOCENE		T	Sublabile to quartzose sandstone, conglomerate
				Tmb	Basalt; some tuff, agglomerate
				Tl	Quartzose sandstone, conglomerate; silicified and ferruginized
					Chemically altered (silicified, kaolonized and ferruginized) sediments
MESOZOIC		LOWER CRETACEOUS	Rolling Downs Group: Griman Creek Formation	Klg	Labile sandstone, siltstone, minor mudstone, quartzose sandstone; commonly glauconitic and calcareous; some wood, shelly fossils
			Surat Siltstone	Kl	Siltstone, mudstone, labile sandstone; glauconitic and calcareous in part
				Kls	Carbonaceous mudstone and siltstone; commonly glauconitic and calcareous; minor labile sandstone; shelly fossils
			Wallumbilla Formation: Coreena Member	Klc	Labile sandstone, siltstone, minor mudstone; commonly glauconitic and calcareous; shelly fossils (section only)
			Doncaster Member	Kld	Carbonaceous mudstone and siltstone, minor labile sandstone; commonly glauconitic and calcareous; shelly fossils (section only)
			Kumbarilla Beds	JKk	Sandstone, siltstone and mudstone; some conglomerate
			Bungil Formation	Kly	Carbonaceous labile sandstone and sublabile to quartzose sandstone; some siltstone and mudstone, calcareous and glauconitic beds in upper part; shelly fossils
			Mooga Sandstone	Klm	Sublabile to clayey lithic sandstone, some porous; minor siltstone, mudstone, conglomerate (section only)
		UPPER JURASSIC	Orallo Formation	Juo	Crossbedded clayey lithic to very lithic sandstone; siltstone, mudstone, minor coal (section only)
			Gubberamunda Sandstone	Jug	Crossbedded sublabile to clayey lithic sandstone, some porous; minor siltstone, conglomerate (section only)
		MIDDLE TO UPPER JURASSIC	Springbok Sandstone	Js	Crossbedded clayey lithic to very lithic sandstone, some porous; siltstone, mudstone (section only)
			Walloon Coal Measures	Jw	Carbonaceous mudstone and siltstone; some sandstone and coal
		LOWER JURASSIC	Marburg Sandstone	Jlm	Sublabile to labile sandstone, some pebbly; quartzose sandstone at base
			Hutton Sandstone	Jlh	Quartzose sandstone, some friable and porous; some conglomerate, siltstone, mudstone
			Evergreen Formation	Jle	Carbonaceous mudstone, siltstone, sandstone
			Precipice Sandstone	Jlp	Clayey quartzose sandstone; some siltstone, mudstone
		UPPER TRIASSIC TO LOWER JURASSIC	Helidon Sandstone	Jll	Sandstone, feldspathic sandstone, shale, siltstone
		UPPER TRIASSIC	Raceview Formation	Rur	Interbedded green and red siltstone and shale; some conglomerate
			Aberdare Conglomerate	Rua	Conglomerate, green and red shale
		MIDDLE TO UPPER TRIASSIC		Rv	Andesitic lava, tuff (section only)
			Moolayember Formation	Rm	Labile sandstone, minor siltstone (section only)
			Clematis Sandstone	Rc	Quartzose to sublabile sandstone, conglomeratic in places; some siltstone and shale (section only)
		LOWER TRIASSIC	Rewan Formation	Rlr	Multicoloured volcanic and lithic sandstone, conglomerate, siltstone and shale (section only)
PALAEOZOIC		UPPER PERMIAN	Blackwater Group	Puw	Tuff, coal, shale, sandstone, conglomerate (section only)
		LOWER TO UPPER PERMIAN	Back Creek Group	Pb	Tuffaceous sandstone and siltstone, coal, calcareous siltstone, shale and sandstone (section only)
		UPPER DEVONIAN ? TO UPPER CARBONIFEROUS	Kuttung Formation	C	Andesite, dacite, tuffaceous sandstone, siltstone, tuff (section only)
			Texas Beds	Clt	Sandstone, conglomerate, siltstone, shale, tuff (section only)

Geological boundary

Anticline, showing plunge

Syncline, showing plunge

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

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

Direction of movement of sediment-bearing currents (cross bedding)

SB1016 Plant fossil locality, with reference number

SB1207 Vertebrate fossil locality, with reference number

Oil field; petroleum wells Moonie 2-31 not shown

Petroleum exploration well – dry, abandoned
W – completed as water well

Petroleum exploration well with show of oil – abandoned
W – completed as water well

Gas well

Petroleum exploration well with show of gas – abandoned
W – completed as water well

Oil and gas well

Petroleum exploration well with show of oil and gas-abandoned

Stratigraphic hole

Open cut or quarry

Artesian bore, flowing } deeper than 150 metres
Sub-artesian bore }
13826 Reg. No. (Qld. Irrig. Water Supply Comm.)
Earth tank

Dam on stream
WH Waterhole on stream
Spring
Marsh, swamp

Highway
Road
Vehicle track
Railway with station and siding
Airport
Landing ground
Town
"Dunbar" Homestead
Building
Yd Yard
Trigonometrical station
.390 Height in metres, approximate

Gravity station

Bouguer anomaly (milligals)

Isogal

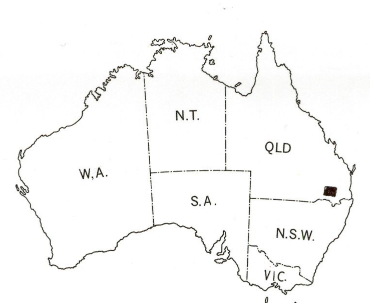
Gravity anomaly—relative high

Gravity anomaly—relative low

Bouguer anomalies are based on the 1962 observed gravity values at pendulum gravity base stations in and near the area

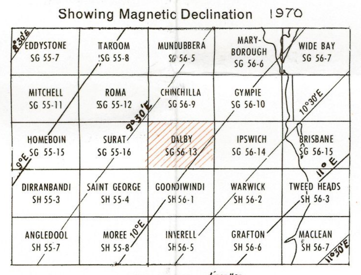
For the calculation of Bouguer anomalies 2.2 g/cm³ has been adopted as an average rock density

Published by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development, in conjunction with the Geological Survey of Queensland. Issued under the authority of the Hon. Sir Reginald Swartz, K.B.E., E.D., Minister for National Development. Base Map compiled by the Royal Australian Survey Corps from aerial photography at 1:85,000 scale



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination 1970



ANNUAL CHANGE 1'37"E

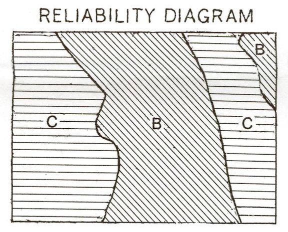
Scale 1:250,000

5 0 5 10 15 20 25 KILOMETRES

5 0 5 10 MILES

GREY NUMBERED LINES ARE 20,000 METRE INTERVALS OF THE AUSTRALIAN MAP GRID, ZONE 56
GREY TICKS WITH ITALIC NUMBERS INDICATE THE 20,000 YARD GRID, ZONE 8 (AUSTRALIA SERIES)
TRANSVERSE MERCATOR PROJECTION

RELIABILITY DIAGRAM



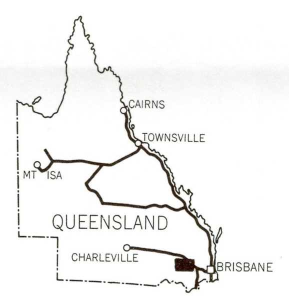
Geology B Detailed reconnaissance and air-photo interpretation

C General reconnaissance: some traverses and air-photo interpretation

Gravity Detailed survey

Reconnaissance

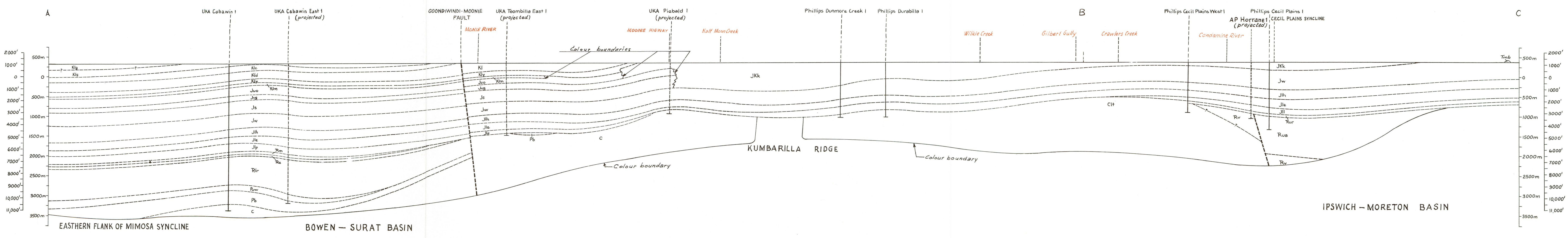
Geology and compilation 1968 by N.F. Exon, A. Mond (BMR); R.F. Reiser (GSQ)
Gravimetry 1960 to 1964 by Geophysical Branch, BMR
Cartography by Geological Branch, BMR
Printed by Mercury—Walch Pty Ltd., Hobart, Australia



Section

Cainozoic sediments omitted

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



"SECOND PRELIMINARY EDITION 1972"

DALBY

SHEET SG 56-13

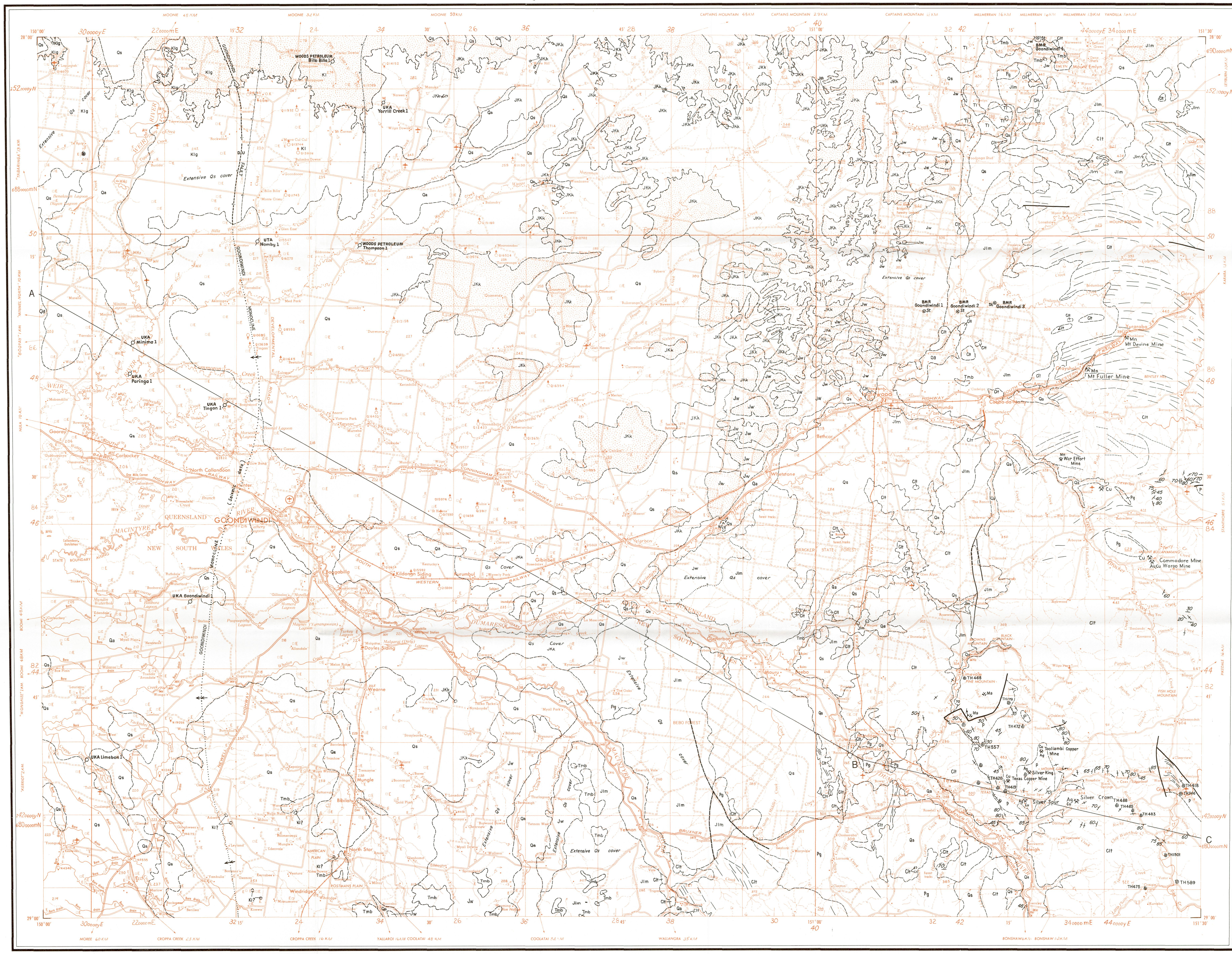
Copies of this map may be obtained from the Bureau of Mineral Resources, Geology and Geophysics, Canberra, A.C.T., or the Geological Survey of Queensland, Brisbane

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

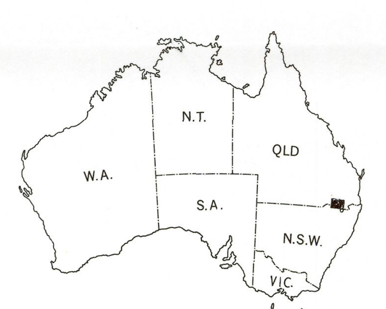
GOONDIWINDI

QUEENSLAND AND NEW SOUTH WALES

SHEET SH 56-1



Published by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Issued under the authority of the Hon. R.W. Swartz, M.B.E., E.D., Minister for National Development. Base map compiled by the Division of National Mapping from aerial photography at 1:85,000 scale



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination 1970

MITCHELL SG 55-11	ROMA SG 55-12	CHINCHILLA SG 56-9	GYMPIE SG 56-10	
HOMEBOIN SG 55-15	SURAT SG 55-16	DALBY SG 56-13	IPSWICH SG 56-14	BRISBANE SG 56-15
DIRRANBANDI SH 55-3	SAINT GEORGE SH 55-4	GOONDIWINDI SH 56-1	WARWICK SH 56-2	TWEED HEADS SH 56-3
ANGLEDOOL SH 55-7	MOREE SH 55-8	INVERELL SH 56-5	GRAFTON SH 56-6	MACLEAN SH 56-7
WALGETT SH 55-11	NARRABRI SH 55-12	MANILLA SH 56-9	DORRIGO SH 56-10	COFFS HARBOUR SH 56-11

ANNUAL CHANGE 1'30"

Scale 1:250,000

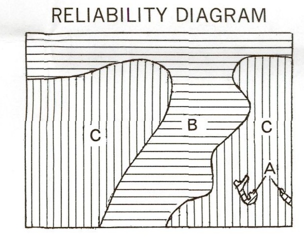
5 0 5 10 15 20 25 KILOMETRES

5 0 5 10 MILES

GREY NUMBERED LINES ARE 20,000 METRE INTERVALS OF THE AUSTRALIAN MAP GRID, ZONE 56
GREY TICKS WITH ITALIC NUMBERS INDICATE THE 20,000 YARD GRID, ZONE 8 (AUSTRALIA SERIES)
TRANSVERSE MERCATOR PROJECTION

Mesozoic geology, 1968, by A. Mond and D. Burger (BMR), P. Rasmus (GSNSW)
Palaeozoic geology, 1968, by F. Olgers, P.G. Flood and W.J. Perry (BMR), P. Rasmus (GSNSW)
Compiled, 1968, by A. Mond, F. Olgers and P.G. Flood
Gravimetry 1960 and 1968, by Geophysical Branch, BMR
Cartography by Geological Branch, BMR
Printed by Mercury-Walch Pty Ltd., Hobart, Australia

RELIABILITY DIAGRAM

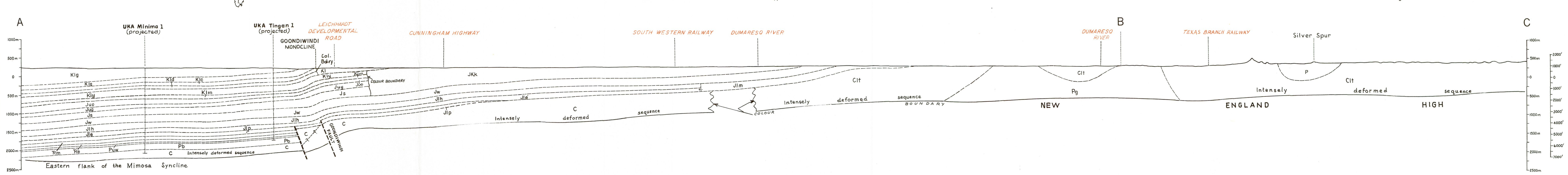


Geology A Detailed mapping
B Detailed reconnaissance: numerous traverses and air-photo interpretation
C General reconnaissance: some traverses and air-photo interpretation
Gravity Reconnaissance

Section

Cainozoic sediments omitted

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



Reference

CAINOZOIC	QUATERNARY		Qa	Alluvium	
			Qs	Sand, soil	
	TERTIARY — UPPER OLIGOCENE TO LOWER MIOCENE		Tmb	Basalt, tuff, agglomerate	
			Tl	Quartzose sandstone and conglomerate, silicified	
			(stippled)	Deeply weathered sediments (kaolinized, in part silicified and ferruginized).	
MESOZOIC	LOWER CRETACEOUS	Rolling Downs Group: Griman Creek Formation	Klg	Lithic sandstone and siltstone, commonly glauconitic and calcareous	
		Surat Siltstone and Wallumbilla Formation	Kl	Siltstone, mudstone, lithic sandstone, glauconitic and calcareous in part	
		Surat Siltstone	Kls	Carbonaceous mudstone and siltstone, commonly glauconitic and calcareous, minor sandstone	section only
		Wallumbilla Formation: Coreena Member	Klc	Siltstone and mudstone, minor labile sandstone; commonly carbonaceous; glauconitic and calcareous in part	section only
		Doncaster Member	Kld	Carbonaceous mudstone, minor siltstone and sandstone; glauconitic and calcareous in part	section only
		Bungil Formation	Kly	Siltstone, mudstone, carbonaceous sandstone; glauconitic and calcareous in part	section only
		Mooga Sandstone	Klm	Clayey lithic sublabile to lithic sandstone interbedded with siltstone and mudstone; coal	section only
	MIDDLE JURASSIC TO LOWER CRETACEOUS	Kumbarilla Beds	JKk	Sandstone, siltstone, mudstone; some conglomerate	
	UPPER JURASSIC	Orallo Formation	Juo	Siltstone, lithic to very lithic sandstone and mudstone, carbonaceous, clayey, calcareous in part	section only
		Gubberamunda Sandstone	Jug	Clayey lithic sublabile to lithic sandstone, interbedded with siltstone and mudstone; slightly carbonaceous	section only
	MIDDLE TO UPPER JURASSIC	Springbok Sandstone	Js	Clayey lithic sublabile to very lithic sandstone; calcareous in part; interbedded with carbonaceous mudstone and siltstone	
		Walloon Coal Measures	Jw	Very labile to sublabile sandstone, calcareous in places, minor mudstone and siltstone	
	LOWER JURASSIC	Marburg Sandstone	Jlm	Labile to quartzose sandstone, some siltstone, mudstone, conglomerate and breccia	
		Hutton Sandstone	Jlh	Quartzose sandstone; minor conglomerate, siltstone, mudstone	section only
		Evergreen Formation	Jle	Siltstone and mudstone, lesser sandstone; minor coal	section only
		Precipice Sandstone	Jlp	Quartzose sandstone, conglomeratic in places; minor siltstone, mudstone	section only
	MIDDLE TO UPPER TRIASSIC	Moolayember Formation	Rm	Sublabile to labile sandstone, siltstone, mudstone; tuffaceous	section only
		Clematis Sandstone	Re	Conglomeratic quartzose to sublabile sandstone, mudstone, sandstone, siltstone, calcareous	section only
?	PERMIAN OR TRIASSIC		Pg	Granite	
PALAEOZOIC	UPPER PERMIAN	Blackwater Group	Puw	Tuff, shale, sandstone, conglomerate, coal seams; micaceous in part	section only
	LOWER TO UPPER PERMIAN	Back Creek Group	Pb	Tuffaceous shale, siltstone, sandstone, calcareous in upper part; coal	section only
	LOWER PERMIAN		P	Fossiliferous mudstone, pebbly mudstone, conglomerate, lithic sandstone; minor limestone	
	UPPER DEVONIAN ? TO UPPER ? CARBONIFEROUS	Kuttung Formation	C	Tuff, andesite, dacite, siltstone, sandstone, conglomerate, shale	section only
		Texas Beds	Clt	Interbedded lithic sandstone and mudstone, shale; minor chert, jasper, fossiliferous limestone, andesite, intraformational conglomerate	

Geological boundary

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

Monocline

Where location of boundaries 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

Unmeasured strike and dip of strata

Vertical strata

Dip < 15° — air-photo interpretation

Trend lines — air-photo interpretation

Joint pattern — air-photo interpretation

Unmeasured strike and dip of foliation

TH179 Macrofossil locality with collection number

Dyke; b-basic

Mine, not worked

Open cut, quarry

Ag Silver

Au Gold

Cu Copper

Ma Marble

Mn Manganese

W Well-dry, abandoned (W-indicates completion as a water well)

St Stratigraphic hole

Q2822 Artesian bore, flowing — deeper than 1000 feet, with registered number of the Queensland Irrigation and Water Supply Commission (Q) and Water Conservation and Irrigation Commission of New South Wales (N)

N1246 Sub-artesian bore — deeper than 1000 feet, with registered number of the Queensland Irrigation and Water Supply Commission (Q) and Water Conservation and Irrigation Commission of New South Wales (N)

E Earth tank or dam

Dam on stream

WH Waterhole on stream

Windpump

Highway

Road

Vehicle track

Railway with station and siding

Airport

Landing ground

"Brentwood" Homestead

Building

Trigonometrical station

.387 Elevation in metres, accurate

.500 Elevation in metres, approximate

Gravity station (BMR)

Bouguer anomaly (milligals)

Isogal

Gravity anomaly - relative high

Gravity anomaly - relative low

Bouguer anomalies are based on the May 1965 observed gravity value at Isogal gravity base stations in and near the area

For the calculation of Bouguer anomalies 2.2 g/cm^3 has been adopted as an average rock density

"SECOND PRELIMINARY EDITION 1972"

GOONDIWINDI

SHEET SH 56-1

Copies of this map may be obtained from the Bureau of Mineral Resources, Geology and Geophysics, Canberra, A.C.T., the Geological Survey of Queensland, Brisbane or the Geological Survey of N.S.W., Department of Mines, Sydney