COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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Record No. 1968 / 56

The Geology of the Surat 1:250,000 Sheet Area

by

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** Geological Survey of Queensland*

THE GEOLOGY OF THE SURAT 1:250,000 SHEET AREA, QUEENSLAND

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Records 1968/56

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SUMMARY

The Surat 1:250,000 Sheet area lies near the centre of the Surat Basin, a sub-basin of the Great Artesian Basin.

Lower Cretaceous and ?Tertiary units crop out; subsurface study has revealed a section which ranges in age down into the Permian. Basement in the west of the Sheet area consists of ?Devonian metasediments which have been intruded by Carboniferous granite in the northwest; in the east, ?Carboniferous volcanics are regarded as economic basement. Virtually undisturbed sediments of the Permo-Triassic Bowen Basin, and the Jurassic-Cretaceous Surat Basin are present in the subsurface. The Bowen Basin sequence is best developed in the meridional downwarp of the Mimosa Syncline in the east where at least 6500 feet of section is present; the sequence thins to the west onto the Southern Roma Shelf. The Surat Basin sequence is a conformable succession of Jurassic and Lower Cretaceous sediments which reaches a maximum thickness of at least 10,000 feet in the Mimosa Syncline. It is present on the entire Sheet area, although in the west, the older units are truncated against the Southern Roma Shelf.

Surface exposures of Lower Cretaceous sediments were deeply weathered during the late Cretaceous or early Tertiary. Thin Tertiary and Quaternary cover obscures much of the Cretaceous sequence.

The entire area has been covered by seismic, aeromagnetic and gravity surveys. In spite of intensive drilling, particularly on the Southern Roma Shelf, significant finds of hydrocarbons have been made in only two areas. U.K.A. Major No. 1 struck gas in the Wandoan Formation and, at the Alton field, oil is being produced, probably from the Boxvale Sandstone Member. The main artesian aquifers in the area are within the Blythesdale - Orallo - Gubberamunda interval of the Surat Basin sequence. Shallow subartesian water is recovered from the Rolling Downs Group and particularly from the basal Griman Creek Beds.

INTRODUCTION

The Surat 1:250,000 Sheet was mapped by Thomas (B.M.R.) and Reiser (G.S.Q.) during the first ten weeks of the 1967 field season, as part of the Surat Basin Party mapping (party leader N. Exon). J.C. Rivereau (I.F.P.) prepared preliminary photo-geological maps of the area. Marine fossil collections were examined by R.W. Day (A.N.U.); D. Burger investigated the palynology of samples from bore cores.

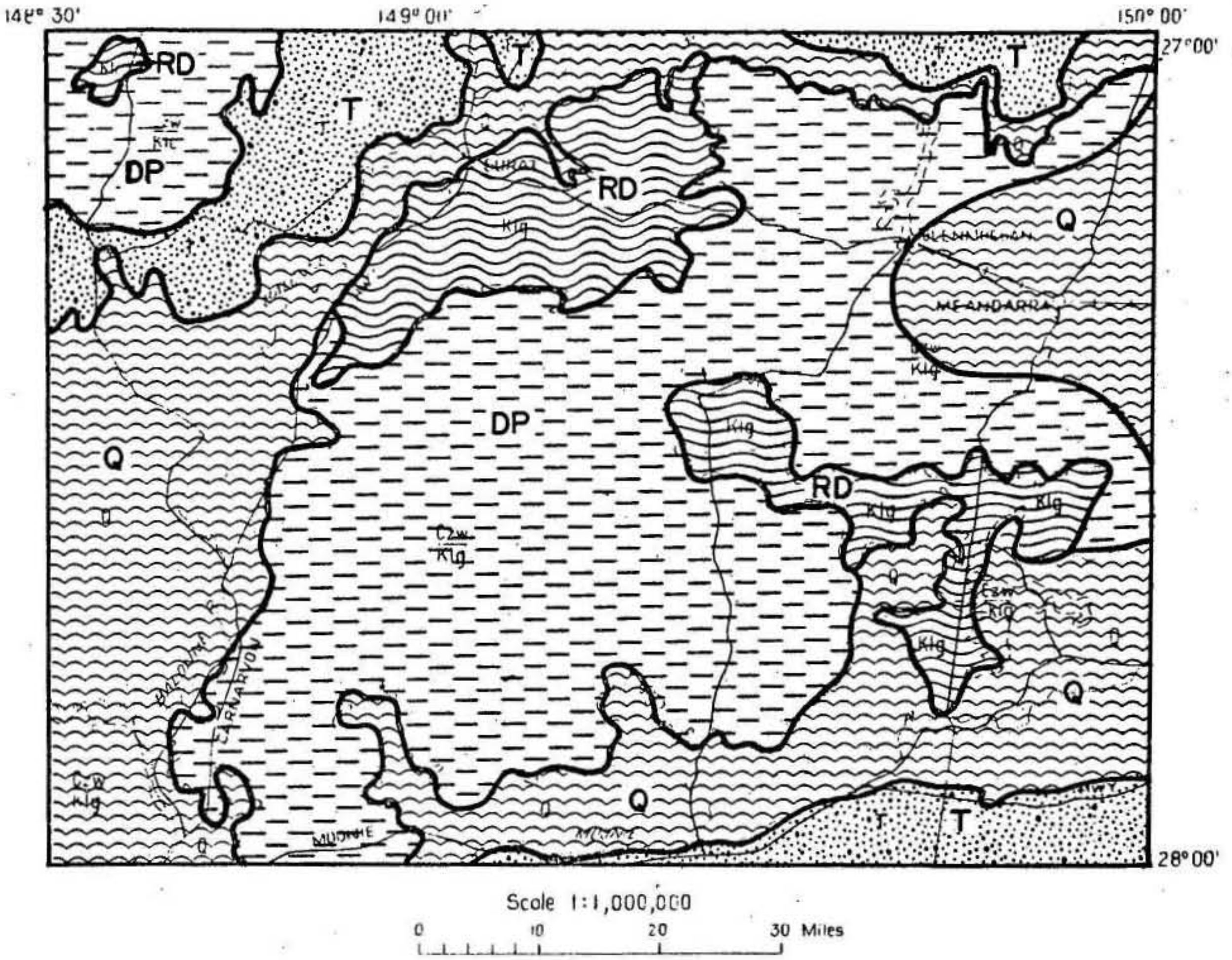
Two Cretaceous units, the Coreena Member of the Wallumbilla Formation and the Griman Creek Beds, crop out; they are separated by an unnamed mudstone Klz which is not exposed at the surface; an extensive deep weathering-profile is developed on the outcropping units. Tertiary and Quaternary alluvia occupy the river valleys.

The plains country once supported extensive brigalow and belah scrub, but this has been cleared in recent years and crops or improved pastures have been sown. In these areas, sheep raising is giving way to combined wheat and sheep farming, with some cattle fattening on larger holdings. The poorer country in the south-west is used solely for sheep raising.

Access throughout the area is good. There are thre townships, Meandarra, Glenmorgan, and Surat; the first two are linked by both rail (part of the Dalby-Glenmorgan Branch Railway) and sealed road. Surat is linked by formed roads with Glenmorgan, Roma, and Saint George. The Moonie Highway in the south gives ready access to Dalby. Heavy rain renders most unformed roads impassable. Water supplies are obtained from aquifers, generally at a depth greater than 2000', in the eastern half of the Sheet area. Earth tanks are the principal mode of storage of water in most areas, since stream flow in intermittent.

Details of the four shallow scout holes drilled in 1967 are shown in Appendix 1. Cores and cuttings are stored at the Bureau of Mineral Resources, Core and Cuttings Laboratory, Fyshwick, A.C.T. Specimens collected in the field, and retained for detailed examination are given numbers prefixed "SB". Thin section examination of the various rock types was carried out by O.A. Bavinton (G.S.Q.). Rock descriptions use the

SURAT G 55-16



QUATERNARY	Q	*Soil and sand cover, alluvium*
TERTIARY	T	*Quartzose sandstone*
	Czw	*Deep weathering-profile*
CRETACEOUS Griman Creek Beds	Klg	*Labile sandstone, siltstone, minor mudstone*
Coreena Member Wallumbilla Formation	Klc	*Siltstone, labile sandstone, carbonaceous mudstone*

PHYSIOGRAPHY

DP	Dissected plateaux and ridges of deep weathering-profile
RD	Rolling downs topography
T	Tertiary alluvium
Q	Quaternary alluvial plains

Wentworth Scale of grain size, and Crook's (1960) description of arenites (see also, Exon et al., 1967). Bedding nomenclature follows McKee and Weir (1943).

PHYSIOGRAPHY. (Figure 1)

High country on the Sheet area is capped by duricrust, which has been extensively dissected, so that a formerly almost featureless plain has been reduced to discontinuous areas of relatively rugged topography. Maximum relief in the area is only 200 feet, but ridges and plateaux of duricrust remnants are often bounded by scarps and steep slopes up to 100 feet high. The duricrust overlies the mottled zone of a deep weathering-profile developed on the Coreena Member in the northwest and on the Griman Creek Beds south and east of the Balonne River.

A northeast trending belt of duricrust residuals developed on Griman Creek Beds dominates the central part of the area. It consists of the Thomby Range in the southwest, and an extensive plateau-like tract in the northeast, the surface of which slopes gently inward from bounding scarps on the northwest, west, and south. The Thomby Range, and the southern bounding scarp of the northern plateau are the main watersheds, separating the tributaries of the Balonne River in the north and west, and those of the Moonie River in the southeast.

Erosion of the deeply weathered Cretaceous sediments has exposed unaltered Coreena and Griman Creek sediments, which have subsequently weathered to form grey and brown soils of heavy texture (Isbell, 1957). A rolling topography has developed, although relief is greater than is typical for the normal rolling downs of Western Queensland, because of the presence of resistant calcareous beds.

An unnamed mudstone unit (Klz) separates the Coreena Member from the Griman Creek Beds; the unit does not crop out, but extrapolation of the subsurface northeast trend established from oil well logs (shallow dip to the southeast) shows that the mudstone underlies the Tertiary and Quaternary alluvia of the Balonne River Valley. It is thought that the presence of the soft mudstone between the two deeply weathered sandstones localized the path of the Balonne River roughly along the regional strike in the northwest.

Alluvia fill the river valleys. Those mapped as Tertiary are partly consolidated and remain as rounded ridges and hills above the level of the present alluvial plain.

PREVIOUS INVESTIGATIONS

Geological

The eastern and northern parts of the Sheet area were first mapped by Jack & Maitland (1894) as part of a geological reconnaissance of inland Queensland. They mapped two formations, the Lower Cretaceous "Rolling Downs Beds" and the Upper Cretaceous Desert Sandstone. The "Rolling Downs Beds" in this area correspond to the Coreena Member and the lower part of the Griman Creek Beds, while the description of their Desert Sandstone - " a low escarpment of horizontally bedded sandstone", the base of which "weathers to form caverns and rock shelters" - and the areal extent shown, suggest that they were referring to the deep weathering - profile of the Griman Creek Beds.

The deep weathering-profile was described by Ball (1926, 1927a) as "porcellanized and laterized sandstone and shales" and correlated tentatively with the "Cretaceo-Tertiary of Tertiary Wintons"; later Ball (1927b), recorded a thickness of 100 feet of "Cretaceo-Tertiary" in the Borah Trust Bore, underlain by a thickness of 1100 feet of marine Cretaceous, and 400 feet of Transition Beds.

Laing & Allen (1955) in an unpublished report divided the pre-Quaternary sediments of the Sheet area into the Glenmorgan Formation (Lower Tertiary) and the Surat Formation (Lower Cretaceous). They reported faunas from two localities near Surat (within their Surat Formation, now included in the Griman Creek Beds), one of which contained the Aptian (Roma) belemnite <u>Peratobelus</u>, and the other, the Albian (Tambo) belemnite <u>Dimitobelus</u>;

these two genera had previously been found together in the basal "Tambo" (equivalent to the Coreena Member of the Wallumbilla Formation of current usage) with which, accordingly, the Surat Formation was correlated. In this report the Surat Formation is equated with the lower part of the Griman Creek Beds, the Glenmorgan Formation with the deep weathering-profile.

The first formally proposed, published nomenclature relevant to the area was put forward by Isbell (1957). He named the Tertiary alluvia to the south of the Moonie River the Moonie Formation. Furthermore, he was the first to suggest the possibility that the "lateritic residuals" might represent the upper, deeply weathered section of the marine Cretaceous sediments. He concluded that this was probably not the case since there was only one reported occurrence of lateritized Cretaceous rocks in far western Queensland.

The Cretaceous sediments and their deep weathering-profiles were given separate, formally published names by Jenkins (1959): the former, the Griman Creek Group, and the latter, the Telgazli Formation. For his Griman Creek Group he quoted the occurrence of Peratobelus, one of the two diagnostic ammonites (of Laing & Allen, 1955), and therefore deduced an Aptian age for his "Group". The Telgazli Formation was reported to rest with "non-angular unconformity" on Aptian and probably pre-Albian strata, and to be overlain by gilgaied clays. He suggested synonomy with the unpublished Glenmorgan Formation.

Mack (1963) makes passing reference to inliers of the Roma Formation near Surat and Coomrith.

The soils of the eastern part of the Sheet area have been described in two papers by Isbell (1957, 1962). The former deals in detail with all the soil types in this region, and their relation to the geology, while the latter treats only the soils of the brigalow-dominated areas.

TABLE 1

GEOPHYSICAL SURVEYS

Reference	Area	Survey
Lodwick and Watson, 1959	Surat Basin	Seismic (Traverse Sections) only
Smith and Lodwick, 1960	Surat Basin	" " "
U.O.D., 1960 (a)	Surat-Bowen Basin	Aeromagnetic
U.O.D., 1960 (b)	Glenmorgan	Seismic
U.O.D., 1960 (c)	South Dulacca-Meandarra	Seismic
Gibb, 1961	Surat Basin	Gravity
Kahanoff, 1962	Moree-Miles	Aeromagnetic
United Geophysical Corp., 1963	Middle Creek	Seismic
Aero Service Limited, 1963	Surat-Bowen Basin	Aeromagnetic
United Geophysical Corp., 1964a	Flinton	Seismic
United Geophysical Corp., 1964b	Moonie River	Seismic
United Geophysical Corp., 1965	Surat Shelf	Seismic
Lonsdale, 1965	Southern Queensland	Gravity
B.M.R., 1967	Surat 1:250,000 Sheet	Gravity (Map)
United Geophysical Corp., 1967	Maranoa	Seismic
Langron and van Son, 1967	N.E., N.S.W., S.E.Qld.	Gravity

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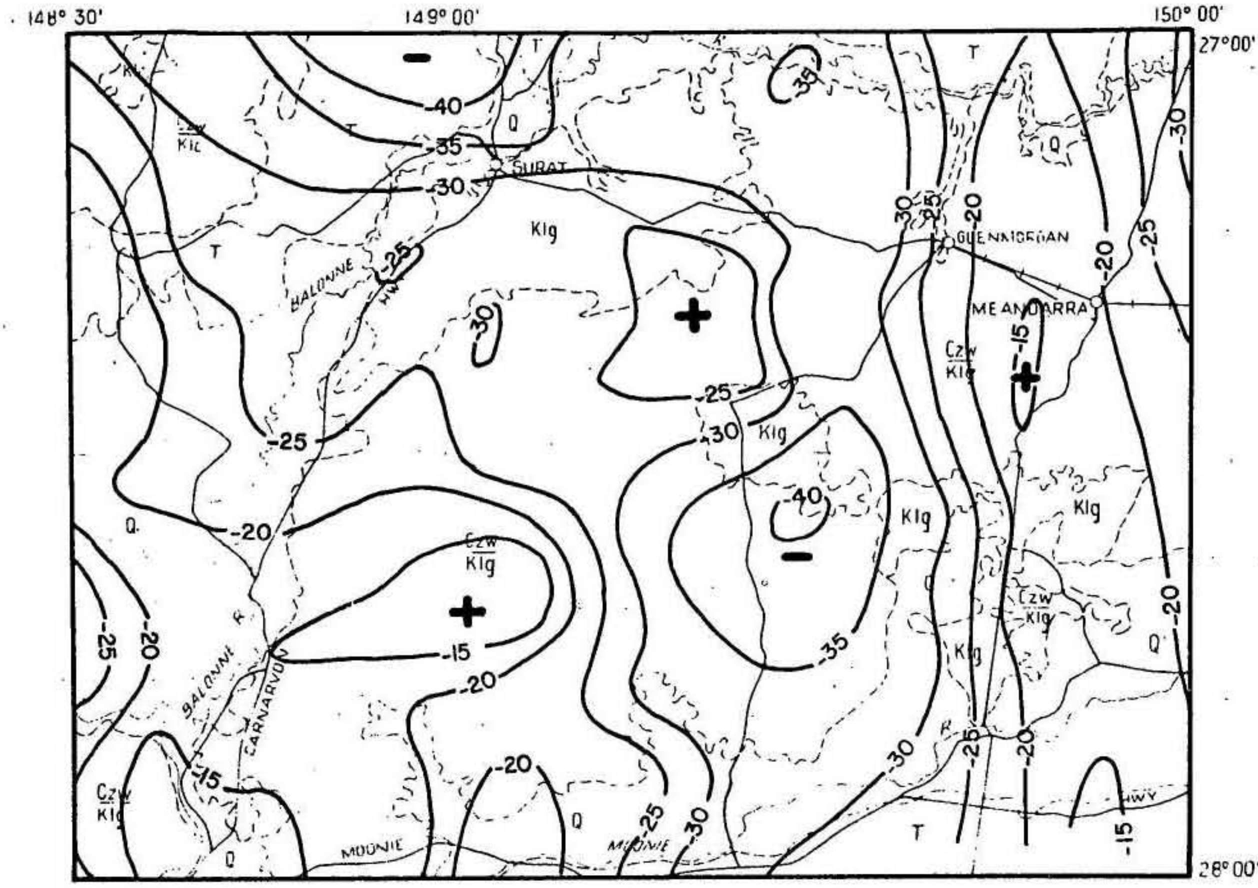


Scale 1:1,000,000
0 10 20 30 Miles

QUATERNARY	Q	Soil and sand cover, alluvium
TERTIARY	T	Quartzose sandstone
	Czw	Deep weathering profile
CRETACEOUS Griman Creek Beds	Klg	Labile sandstone, siltstone, minor mudstone
Coreena Member Wallumbilla Formation	Klc	Siltstone, labile sandstone, carbonaceous mudstone

BOUGUER ANOMALIES

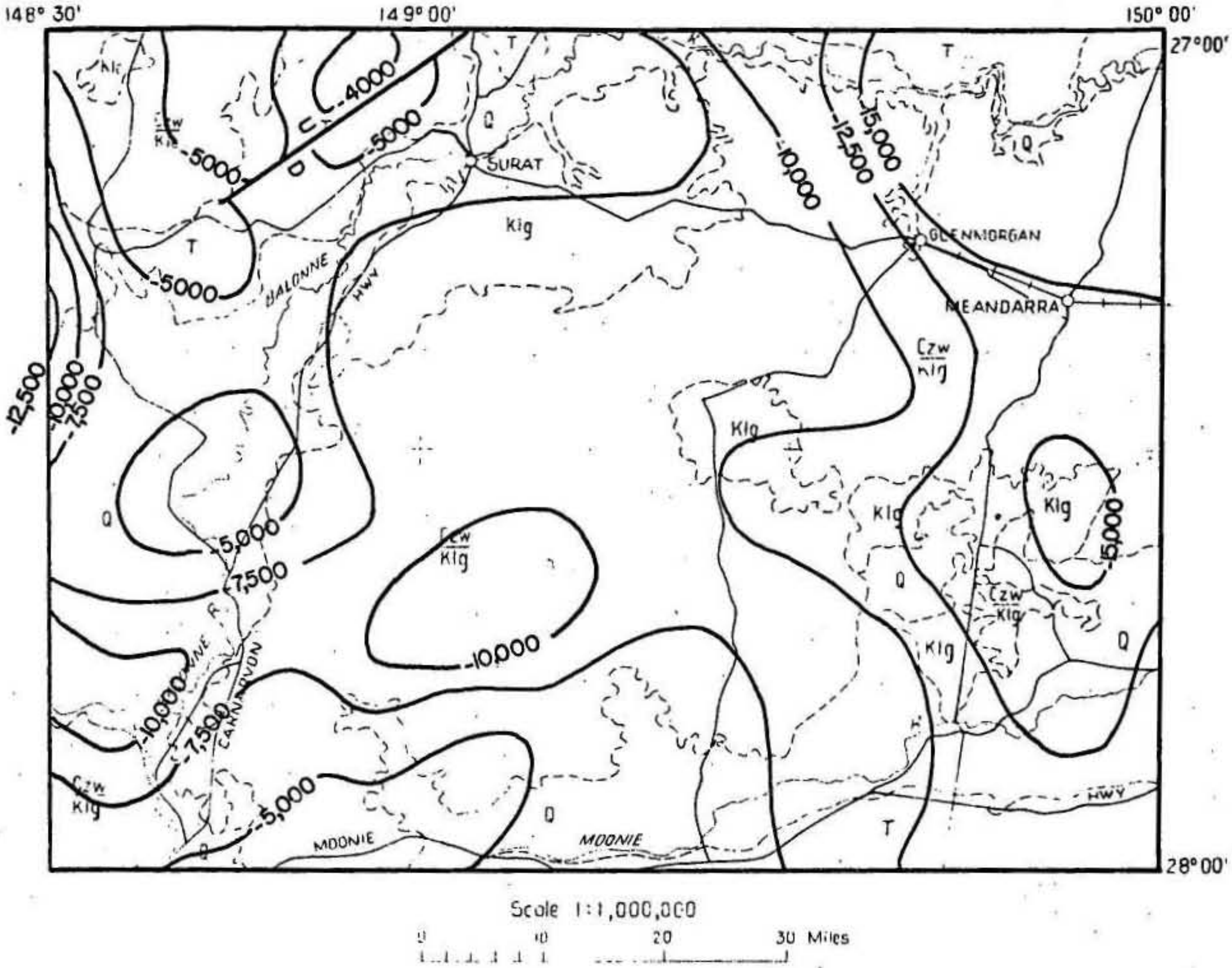
-40 milligals

+ "High" anomaly

– "Low" anomaly

From B.M.R.,1967

SURAT G 55-16



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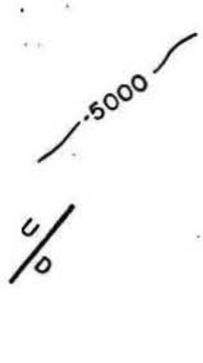
AEROMAGNETIC INTERPRETATION
1962

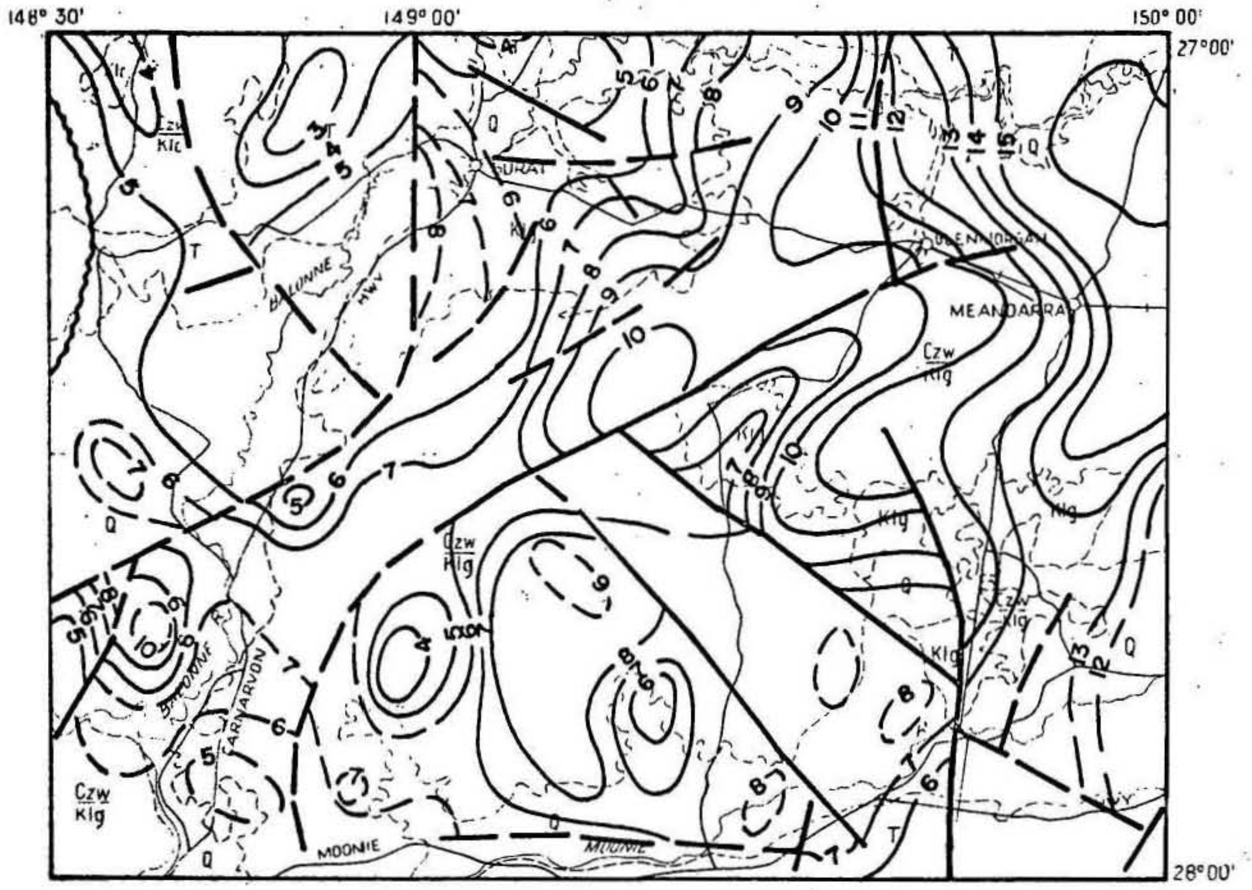


Feet below S.L.

Fault

From Kahanoff, 1962

SURAT G 55-16



Scale 1:1,000,000

0 10 20 30 Miles

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AEROMAGNETIC INTERPRETATION 1963

4 — **Feet below S.L. x 1000**

Fault

From Aero Service Ltd., 1963

To accompany Record 1968 **56** **G55/A16/8**

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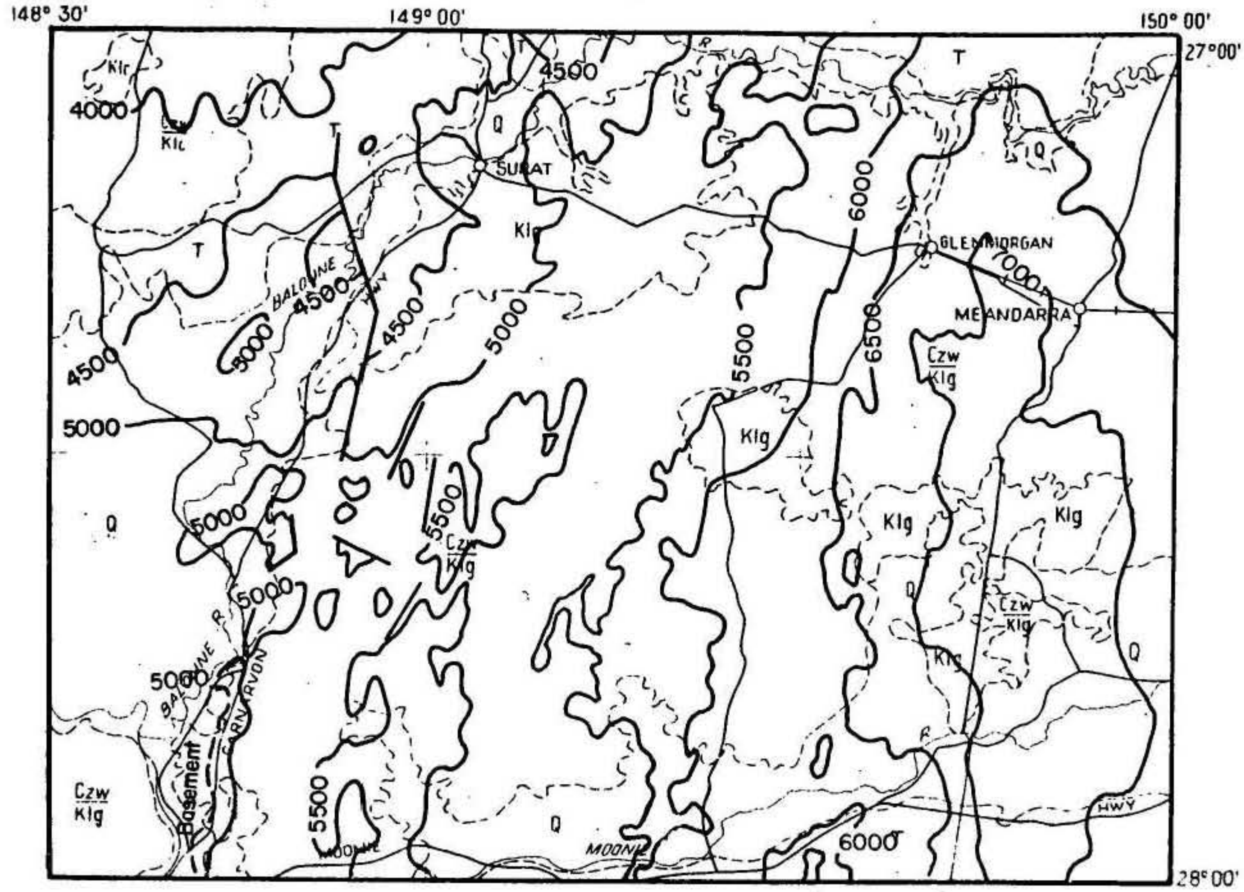

Scale 1 : 1,000,000

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SEISMIC INTERPRETATION

"G" HORIZON (? Top Evergreen)

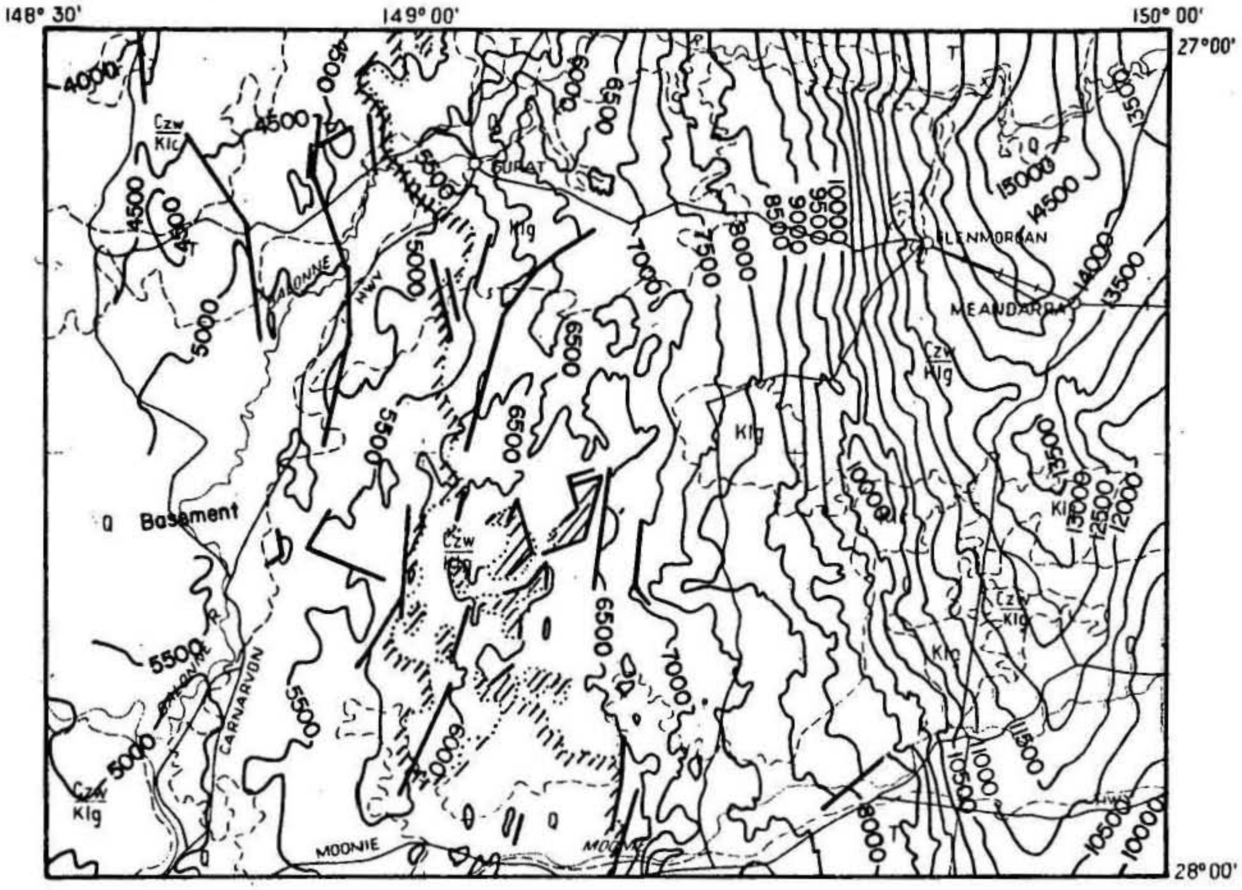
4000 Feet below S.L.

Fault

From United Geophysical Corp., 1965.

*To accompany Record 1968/*56 G55/A16/13

SURAT G 55-16



Scale 1:1,000,000

0 10 20 30 Miles

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SEISMIC INTERPRETATION

BASEMENT - "KIANGA"

7000 Feet below S.L.

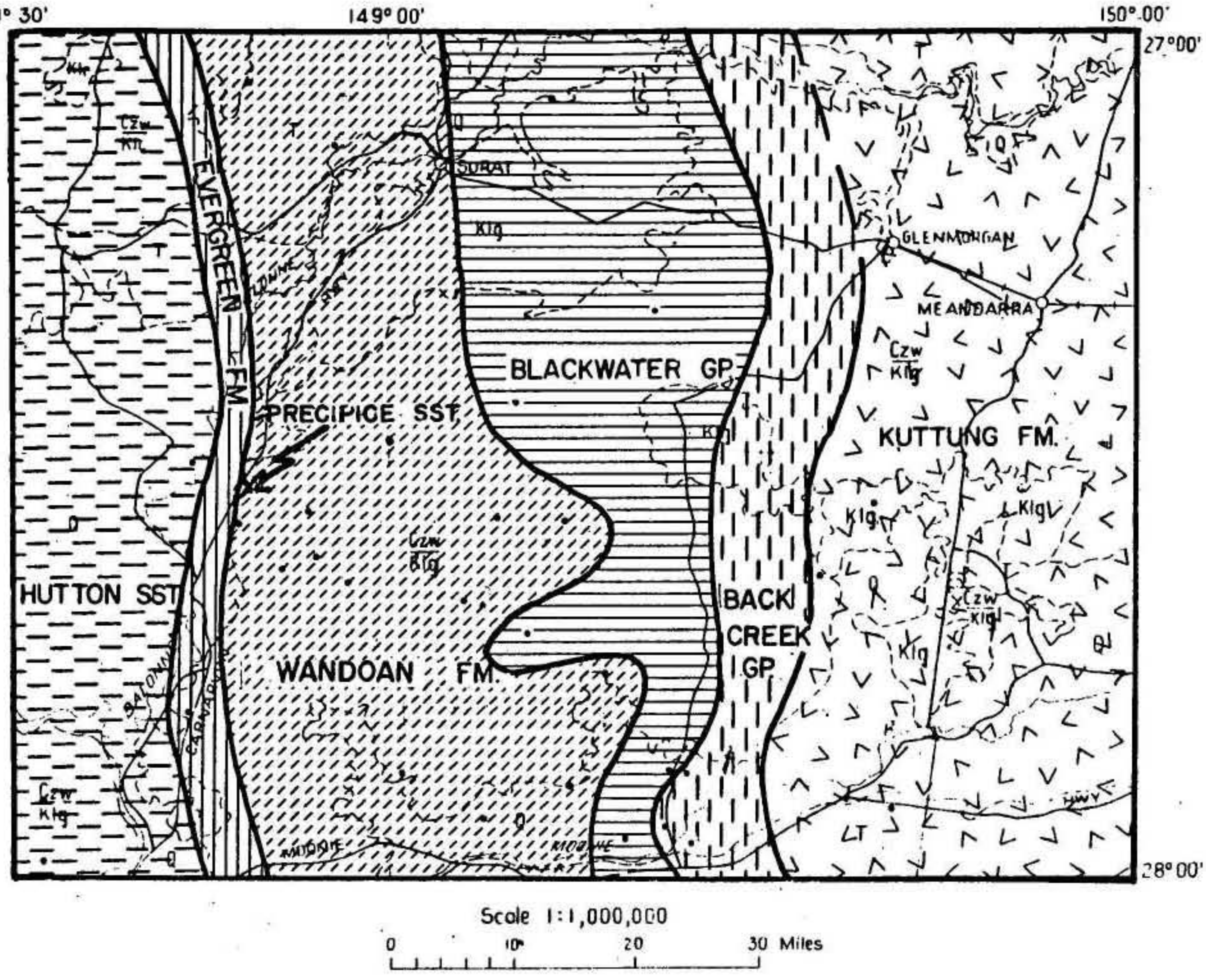
Fault

Basement / "Kianga" boundary

From United Geophysical Corp., 1965

To accompany Record 1968/56 G55/A16/14

SURAT G 55-16



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UNIT OVERLYING BASEMENT

Based on Oil Well Data

• Oil Well

TABLE 2. EXPLORATORY OIL WELLS

WELL	YEAR COMPLETED	COMMONWEALTH SUBSIDY	TOTAL DEPTH	HYDROCARBONS	INTERVAL	STATUS
A.O.G. No. 2 (Mirri Mirri)	1959	No	4645	Show of gas: 4570 feet		Water bore.
U.K.A. Bidgel No. 1	1963	Yes	6525			Abandoned
U.K.A. Coomrith No. 1	1963	Yes	8426			Abandoned
U.K.A. Flinton No. 1	1963	Yes	9123			Converted to Water Well
U.K.A. Lynrock No. 1	1963	Yes	6869			Abandoned
U.K.A. St George No. 1	1963	Yes	4695			Abandoned
U.K.A. Weribone No. 1	1963	Yes	7995	Gas 150 Mcf/day: 7066-7089 feet	Wandoan Fm.	Abandoned
U.K.A. Wunger No. 1	1963	Yes	6339	Oil 10 BPD: 6283-6301 feet	Wandoan Fm.	Abandoned
U.K.A. Alton No. 1	1964	Yes	7328	Oil 1150 BPD) 6060- Gas 440 Mcf/day) 6120 feet Gas 25 Mcf/day, tr. oil:6820-6853 Gas 20 Mcf/day:6834-6854 fractured	?Boxvale Sandstone Wandoan Fm. Wandoan Fm.	Completed as oil producer
U.K.A. Alton No. 2	1964	No	6139	Oil 2000 BPD) Gas 943 Mcf/day) 6094-6102 feet (Production test-perforated)		Completed as oil well.
U.K.A. Alton No. 3	1964	No	7200	Oil 1010 BPD 6027-6105 feet (Production test)		Completed as oil well.
U.K.A. Alton No. 4	1964	No	7292	Oil 2000 BPD) Gas 700 Mcf/day) 6070-6089 feet (Production test)		Completed as oil producer
U.K.A. Alton No. 5	1964	No	6925	Oil 850 BPD) Gas 388 Mcf/day) 6111-6094 feet (Production test)		Completed as oil producer
U.K.A. Alton No. 6	1964	No	6805	Oil 1000 BPD : 6165-6181 feet (Production test)		Completed as oil producer
U.K.A. Boggo Ck. No. 1	1964	Yes	6257	Shows: 5751-5755 feet 5870-5873 feet	?Boxvale Sandstone Wandoan Fm.	Plugged and abandoned
U.K.A. Colgoon No. 1	1964	Yes	4873	Gas 100 Mcf/day: 4699-4715 feet	Precipice Sst.	Plugged and abandoned.
U.K.A. Moombah No. 1	1964	Yes	5835			Plugged and abandoned.
U.K.A. Myall Creek No. 1	1964	Yes	7159	Gas 20 Mcf/day: 6218-6240 feet Oil scum: 6968-6989 feet	Rewan Fm. Blackwater Gp.	Plugged and abandoned.
U.K.A. Alton East No. 1	1965	No	7596	Shows: 7070-7546	Blackwater Gp-Back Ck Gp.	Plugged and abandoned
U.K.A. Alton West No. 1	1965	No	6882			Converted to water well.
U.K.A. Altonvale No. 1	1965	No	5931			Plugged and abandoned
U.K.A. Alton No. 7	1965	No	6817	Gas 50-100 MMcf/day: 6087-6102 Oil: 6087-6102, 6206-6221		Completed as potential oil well
U.K.A. Balonne No. 1	1965	No	5004	Trace of gas: 4933, 4950	Hutton Sst.	Plugged and abandoned.
U.K.A. Dalkeith No. 1	1965	No	6678			Plugged and abandoned.
U.K.A. Donga No. 1	1965	No	5236	Show:5172-5236	?Wandoan Fm.	Plugged and abandoned.
U.K.A. Elgin No. 1	1965	No	5445	Trace: 5317, 5292	?Precipice Sst.-Wandoan Fm.	Plugged and abandoned.
U.K.A. Glenearn No. 1	1965	No	5954	Trace: 5923-5954	Wandoan Fm.	Plugged and abandoned.
U.K.A. Goulamain No. 1	1965	No	6014	Trace: 5982	Wandoan Fm.	Plugged and abandoned.
U.K.A. Katoota No. 1	1965	No	5072			Plugged and abandoned.
U.K.A. Kooroon No. 1	1965	No	7602	Trace: 6528, 6722	Wandoan Fm.	Plugged and abandoned.
U.K.A. Kooroon No. 2	1965	No	7238			Plugged and abandoned.
U.K.A. Major No. 1	1965	No	5576	Gas 1.8 MMcf/day) Condensate 60 BPD (est.)) 5530-5577 ft.	Wandoan Fm	Completed as gas well
U.K.A. Major No. 2	1965	No	5585			Converted to water well
U.K.A. Maranoa No. 1	1965	Yes	4739			Converted to water well
U.K.A. Moullit No. 1	1965	No	5638			Plugged and abandoned
U.K.A. Thomby No. 1	1965	No	6271	Show of gas: 5992-6012, 6218-6271	Wandoan Fm.	Plugged and abandoned
U.K.A. Tralee No. 1	1965	No	6159			Plugged and abandoned
U.K.A. Wanganui No. 1	1965	No	5631	Trace: 5455, 5522	Wandoan Fm.	Plugged and abandoned
U.K.A. Warroo No. 1	1965	No	5251			Plugged and abandoned
U.K.A. Yoorooga No. 1	1965	No	6475			Plugged and abandoned
U.K.A. Kincora No. 1	1966	No	4896			Plugged and abandoned
U.K.A. Kinkabilla No. 1	1966	No	11752	Gas 0.01 MMcf/day) Oil 100 feet) 9587-9612 feet Gas 0.05 MMcf/day : 9651-9741 feet	Rewan Fm.	Plugged and abandoned

TABLE 3. STRATIGRAPHY

AGE	UNIT	SYMBOL	LITHOLOGY	THICKNESS	ENVIRONMENT	NOTES
CAINOZOIC – Quaternary		Qa	Alluvium	Superficial		
CAINOZOIC – Quaternary		Qs	Unconsolidated sand, soil.	Superficial		
CAINOZOIC – Undifferentiated		Czw	Deep weathering-profile	100-150		
CAINOZOIC – ?Tertiary		T	Quartzose sandstone,conglomerate, some clayey ferruginous sandstone	0-50	Fluviatile	
		? U N C O N F O R M I T Y				
Lower Cretaceous	Griman Creek Beds	Klg	Very fine to fine labile glauconitic sandstone,siltstone, minor mudstone. Shelly Fossils	up to 1200	Marine, brackish	
Lower Cretaceous		Klz	Carbonaceous mudstone,calcareous glauconitic siltstone, minor sandstone. Plant Remains.	200-600	Marine	
Lower Cretaceous	WALLUMBILLA FORMATION – Coreena Member	Klc	Calcareous,glauconitic siltstone, labile calcareous glauconitic very fine to fine sandstone, carbonaceous glauconitic mudstone. Shelly Fossils.	200-600	Marine	
Lower Cretaceous	WALLUMBILLA FORMATION – Doncaster Member	Kld	Carbonaceous,glauconitic mudstone, minor siltstone and sandstone.	200-900	Marine	
Lower Cretaceous	BLYTHESDALE FORMATION	Klb	Fine to medium,partly glauconitic sandstone;siltstone,mudstone.	300-900	Lacustrine- Marine	Artesian Aquifer
Lower Cretaceous	BLYTHESDALE FORMATION – Mooga Sandstone Member	Klm	Quartzose porous friable sandstone,minor siltstone and mudstone.	300-1000	Fluviatile	Artesian Aquifer
Middle to Upper Jurassic	Orallo Formation	Juo	Medium to coarse sandstone,minor pebbly beds, white clay matrix, minor siltstone and mudstone.	80-900	Fluviatile,deltaic, lacustrine,paludal.	Artesian Aquifer
Middle to Upper Jurassic	Gubberamunda Sandstone	Jug	Coarse quartzose friable porous sandstone, some pebbly.	300-1000	Fluviatile	Artesian Aquifer
Middle to Upper Jurassic	INJUNE CREEK GROUP	Ji	Lithic to lithic-sublabile friable clayey sandstone, siltstone, minor mudstone.	400-900	Deltaic, Lacustrine, Fluviatile.	
Middle to Upper Jurassic	INJUNE CREEK GROUP – Birkhead Formation	Jmb	Carbonaceous mudstone,coal,minor siltstone and lithic sandstone. Plant remains.	300-900	Lacustrine	
Lower Jurassic	Hutton Sandstone	Jlh	Quartzose friable porous sandstone, minor siltstone and mudstone.	100-700	Fluviatile-brackish	Trace of gas
Lower Jurassic	Evergreen Formation	Jle	Carbonaceous mudstone and siltstone,minor sandstone and coal. Plant remains.	0-700	Lacustrine	?Boxvale Sandstone Member-Oil horizon (Alton field)
Lower Jurassic	Precipice Sandstone	Jlp.	Quartzose fine to medium sandstone, some porous, clay matrix,minor siltstone and mudstone.	0-400	Fluviatile,lacustrine	Hydrocarbon shows
		U N C O N F O R M I T Y				

TABLE 3. STRATIGRAPHY

AGE	UNIT	SYMBOL	LITHOLOGY	THICKNESS	ENVIRONMENT	NOTES
Triassic	Wandoan Formation	Rw	Quartzose to lithic tight sandstone, white tuffaceous matrix, siltstone, mudstone.	0-1500	Fluviatile, brackish	Hydrocarbon shows, Gas well (U.K.A. Major No.1)
	D I S C O N F O R M I T Y					
	Rewan Formation	Rlr	Carbonaceous mudstone, green lithic sandstone, tuff; minor conglomerate and siltstone.	0-2500	Non-marine (Red beds)	Hydrocarbon shows.
	? U N C O N F O R M I T Y					
Permian	Blackwater Group	Puw	Carbonaceous shale, tuff, coal, minor siltstone, sandstone, conglomerate.	0-1000	Paludal	Hydrocarbon shows
	Black Creek Group		Pyritic shale, tuff, tuffaceous sandstone and siltstone. Shelly Fossils.	0-1500	Marine	Hydrocarbon shows
	U N C O N F O R M I T Y					
Pre-Permian	Kuttung Formation		Volcanic basement			
	Timbury Hills Formation		Metamorphic basement			
	Granite		Granite basement			

Geophysical

The entire Surat 1:250,000 Sheet area has been covered by gravity, reflection seismic and aeromagnetic surveys. A summary of B.M.R. and subsidized company work in the area is included as Table 1.

The first gravity survey in the area was that of Gibb (1961) who used seismic traverse lines. Further work was done by Langron and van Son (1967), and Lonsdale (1965). The Bureau has produced a Bouguer Anomaly map of the Surat Sheet area (see Fig. 2). The Mimosa Syncline is clearly defined in the east of the area by a large, north-trending positive anomaly. This positive anomaly in an area where the sedimentary section thickens may be explained by a great thickness of dense volcanics (Kuttung Formation) at depth in the syncline. Several positive and negative anomalies occur on the southern Roma Shelf. The negative anomaly on the northern margin of the area probably reflects the shallow granite basement (apparently less dense than Timbury Hills Formation) penetrated by U.K.A. Colgoon No. 1 and numerous other wells to the immediate north on Roma Sheet area. The - 25 milligal positive anomaly southeast of Surat probably indicates a somewhat thicker section in this area than elsewhere on the surrounding shelf area. This is supported by evidence from neighbouring oil wells, where considerable thicknesses of Permian strata were penetrated. The causes of other anomalies on the shelf are not evident, and most likely are due to density variation within the basement.

Airborne magnetometer surveys were made of the area between 1959 and 1962 and are described by U.O.D. (1960a), Kahanoff (1962) and Aero Service Limited (1963). The basement contour maps of Kahanoff and Aero Service Limited, although based on the same data, differ considerably in interpretation. These are included as Figures 3 and 4. In the 1963 interpretation, major block faults are hypothesized. In particular, the Mimosa Syncline is shown as bounded by a series of north trending faults with displacements of up to 5,000 feet. A second set of faults trending east to south-east combines to form a complex horst and graben pattern. The southern extension of the Roma granites (Houston, 1964) is well defined in the area north of Surat, and a faulted margin is suggested in both interpretations. Subsequent seismic work has failed to record the block faulting pattern interpreted by Aero Service Limited. Unfortunately the

"Kianga" horizon (Blackwater Group) was the deepest reflector contoured on the eastern half of the Surat Sheet, and very little faulting was detected at this level. The faulting may be confined to the pre-Permian basement, but displacements of several thousand feet would probably be reflected in the overlying section.

Since the evidence for these basement faults is inconclusive, the aeromagnetic basement shown on the cross-section of the Surat 1:250,000 Sheet is taken from the simpler interpretation of Kahanoff (1962).

The Bureau was responsible for the first seismic work in the area. Several traverses were made across the Surat Basin, including part of the Surat Sheet area (Lodwick and Watson, 1959; Smith and Lodwick, 1960). Between 1960 and 1965 several surveys were carried out for Union Oil Development Corporation in various areas covered by the Surat Sheet (see Table 1). A comprehensive report by U.O.D. (1965) includes all earlier seismic data and covers the entire area. Figures 5 and 6 are simplified results of this survey. The only recent subsidized seismic work in the area was the Maranoa Survey (United Geophysical Corporation, 1967).

The main seismic reflectors in the Surat Sheet area are the "G" Horizon (? Top Evergreen Formation), basement, and the "Kianga" Horizon (Blackwater Group) where it is present. The Mimosa Syncline is clearly defined by seismic work as a north-trending trough occupying the eastern half of the Sheet area and containing up to 15,000 feet of post-Permian sediment. The western half of the area is an easterly sloping shelf area with local faulted basement highs. The pinchout of the "Kinaga" horizon in Figure 6, corresponds very closely with the western limit of Blackwater Group sediments in oil wells in the area (see Fig. 7).

Exploratory Drilling

In 1959 the first oil exploration well was sunk by Australian Oil and Gas Corporation Ltd., when Mirri Mirri bore (I.W.S. Registered No. 13683) was deepened from 3000 feet to 4645 feet as A.O.G. No. 2. Australian Oil and Gas Corporation Limited, in conjunction with Kern County Land Company and Union Oil Development Corporation have since drilled a further 41 exploratory wells in the Surat Sheet area, of which 13 have been subsidized by the Commonwealth Government. The Surat Sheet area lies entirely within Authority-to-Prospect 57P.

Almost all of the drilling activity took place between 1963 and 1965, with the maximum of 22 wells drilled in 1965. The only producers in the area are the seven wells of the Alton field, which lies on the southern margin of the Sheet area. U.K.A. Major No. 1 was completed as a gas well. A.O.G. No. 2, and four of U.K.A.'s exploratory wells have been converted to water bores.

Details of all exploratory wells are included in Table 2, and are extracted from Publication 299 of the Geological Survey of Queensland (1960) with supplements for the years 1963 and 1964. Information on drilling in 1965 and 1966 is found in the Reports of the Undersecretary of Mines for those years.

SUBSURFACE UNITS

Basement

The term "basement" as employed in the Surat Basin embraces Lower Permian and older rocks which are unconformably overlain by sediments with petroleum-producing potential. Three distinct types of basement can be recognized in the subsidized wells on the Surat 1:250,000 Sheet area:

1. Timbury Hills Formation

   This unit generally consists of steeply dipping sandstone, siltstone or shale, or their metamorphosed equivalents; it was first defined by Derrington (1961) in A.A.O. Timbury Hills No. 2 (Roma 1:250,000 Sheet) where it is dominantly silty, with thin sandstone and shale interbeds, and dips at 60-80°. Plant fossils in A.F.O. Purbrook No. 1 and A.A.O. Pickanjinnie No. 2 indicate an Upper Devonian age for at least part of the unit. Most oil wells in the Surat Sheet area bottomed on this formation.

2. Granite

Colgoon No. 1 on the Surat Sheet area, as well as Brucedale No. 1 and surrounding wells on the Roma Sheet area, struck granite basement, probably parts of the same intrusion. This granite body is the most southerly of three basement intrusions defined in the Roma area (Houston 1964). In A.R.O. No. 1 (Hunterton) the granite is overlain by contact metamorphosed Timbury Hills sediments, and Houston concludes that the granite is intrusive into the Timbury Hills Formation. Stratigraphic considerations suggest a pre-Permian age; K/Ar age determinations indicate that the granites are Carboniferous. The intrusives are granite or adamellite, and except for the adamellite in A.A.O. Brucedale No. 1, all are micaceous.

3. Volcanics (Kuttung Formation)

In the east of the Surat Sheet area, in the Mimosa Syncline, "basement" is a dominantly volcanic sequence underlying the marine Back Creek Group. The volcanics have been penetrated by U.K.A. Flinton No. 1, U.K.A. Kinkabilla No. 1, and possibly U.K.A. Alton No. 1. Union Oil Development Corporation generally use the name Kuttung Formation for this unit and their usage is followed for convenience only. The Kuttung Formation crops out in the Warialda-Narrabri district of New South Wales. It consists mainly of coarse-grained tuffaceous sandstone, microbreccias, volcanic conglomerates, breccias, tuffs and flows. Fossils of early Carboniferous to late Carboniferous or Permian age have been found in this formation (Mack, 1963).

In Cabawin No. 1 (on western Dalby Sheet), a unit apparently similar to the Kuttung Formation is called Cracow Formation in the Union Oil Development Corporation well completion report. Mack (1963) considers the Cracow Formation to be equivalent to the upper part of the Kuttung Formation.

Denmead (1937) regarded his "Cracow Series" as a Triassic sequence unconformably overlying the "Lower Bowen Volcanics". Derrington, Glover and Morgan (1959) formalized the "Lower Bowen Volcanics" as the Camboon Andesite. Jensen, Gregory and Forbes (1964) could find no real lithological distinction between areas of Denmead's "Cracow Series" and the Camboon Andesite (which is regarded as Lower Permian in age). They adopted the latter name in their report.

A basement of andesitic volcanics occurs over a large area south of Wallumbilla and also north-west of Roma (Roma Sheet area). This formation, the Combarngo Volcanics, is named from the interval 5628 feet to 5985 feet in A.A.O. Combarngo No. 1 well. (Exon et al., 1967).

It appears that the names Kuttung Formation, Cracow Formation and Camboon Andesite are used interchangeably in the subsurface of the Surat Basin. The Combarngo Volcanics may also be an equivalent of the same unit. "Kuttung Formation" is adopted in this Record to refer to the volcanic basement in the Mimosa Syncline on the Surat Sheet area.

Back Creek Group

Schneeberger (1951) proposed "Back Creek Series" for approximately 5700 feet of tuffaceous, partly fossiliferous clastics with basal limestone beds exposed in Back Creek. A Permian age was assigned on macrofossil evidence.

Derrington et al., (1959) formally defined the Back Creek Group, which was later downgraded by Mack (1963) to a formation. Jensen, Gregory & Forbes (1964) and Wass (1965) employed the older term Back Creek Group, but pointed out that, as defined in the Cracow area, the group included a disconformity of regional significance. The sequence covered by this term is equivalent to the whole of the Middle Bowen Beds of the Bowen Basin. "Back Creek Group" is now used by the Bureau of Mineral Resources instead of the older informal term "Middle Bowen Beds".

Union Oil Development Corporation follows Mack (1963) in subsurface correlation and well completion reports. The Company has not been able to subdivide its Back Creek Formation in the subsurface of the Surat Basin. Mack (1963) suggests that the Back Creek Formation (10,358 to 11,662 feet) in U.K.A. Cabawin No. 1 represents only the top of the unit as seen in the type area near Cracow.

In this record the unit is termed Back Creek Group, although no subdivision is possible in the subsurface of the Surat Sheet area. The Back Creek Group was recognized only in the more easterly wells in the Sheet area. The unit is restricted to the Mimosa Syncline, pinching out westwards against the Southern Roma High and continuing eastwards in the subsurface on to Dalby Sheet.

U.K.A. Kinkabilla No. 1 passed through the thickest section of Back Creek Group known in the subsurface of Surat Sheet area (1154 feet) before bottoming in Kuttung Formation. This well lies eight miles west of the axis of the Mimosa Syncline where an even greater thickness would be expected. U.K.A. Cabawin No. 1 (Dalby Sheet area), sited on the eastern limb of the syncline, recorded 1310 feet of the unit.

The Back Creek Group, in the subsurface of this area, is composed of sandstone, mudstone and tuff. It is characterized by shelly fossils indicating a marine environment. The unit unconformably overlies the Kuttung Formation, or the older Timbury Hills Formation (see Plates 1 and 2). It is conformably overlain by the Upper Permian Blackwater Group.

Blackwater Group

The Blackwater Group (Malone, Olgers and Kirkegaard, in press) is a coaly, nonmarine sequence which crops out in the Bowen Basin. The unit was previously known as the Upper Bowen Coal Measures. In the Springsure area, Hill (1957) referred to it as the upper Bandanna Formation.

The Kianga Formation (Mack 1963) appears to be synonymous with the Blackwater Group and is the term used by Union Oil Development Corporation in their subsurface reports in the Surat Basin.

The characteristic Glossopteris flora indicates an Upper Permian to Lower Triassic age. The group may be entirely Upper Permian as the only spores found are of Evans' (1964) division P4.

The unit is about 1750 feet thick in the type area "in and near the Parish of Blackwater" (Duaringa Sheet). It consists of sandstone, siltstone, mudstone and coal. Plant fossils, carbonaceous material and fossil wood are common.

In the subsurface of the Surat Sheet area the Blackwater Group consists mainly of carbonaceous mudstone, tuff and coal, with minor siltstone, sandstone, and conglomerate. The unit is restricted to the Mimosa Syncline, but onlaps much further to the west than the underlying Back Creek Group or Kuttung Formation (see Plates 1 and 2; Fig. 7).

In this area the Blackwater Group conformably overlies the Back Creek Group, or unconformably overlies basement (Timbury Hills Formation).

Rewan Formation

The Triassic Rewan Formation (Isbell, 1955; Hill, 1957) is named after Rewan Homestead on Springsure Sheet area, where it reaches a maximum thickness of about 2,000 feet. The Cabawin Formation (Mack, 1963) has its type section in U.K.A. Cabawin No. 1 (Dalby Sheet area) and is regarded as synonymous with the Rewan Formation (Bastian and Arman, 1965).

The bulk lithology of the unit in the subsurface of the Surat area does not differ greatly from that of the type section. It is dominantly a "red-bed" sequence of mudstones, green lithic sandstones, and tuffs, with minor conglomerate and siltstone. The environment of deposition is considered to be non-marine and strongly oxidizing. (Malone, Olgers and Kirkegaard, in press; Mollan, Exon & Kirkegaard, 1964).

The unit contains probable Triassic plant remains and Lower Triassic spores (Evans, 1964). The Rewan Formations unconformably overlies the Permian Blackwater Group (Tissot, 1963).

In the Surat Sheet area the unit is restricted to the Mimosa Syncline. However, it laps on to the Southern Roma Shelf to a smaller extent than the underlying Blackwater Group, or the overlying Wandoan Formation. This is evident in oil wells along the margin of the Mimosa Syncline, where the Wandoan Formation lies directly on the Rewan Formation (U.K.A. Lynrock No. 1 and U.K.A. Alton No. 1).

Wandoan Formation

The type section of this unit (U.K.A., 1964) is defined as the interval 3,530 to 4,817 in U.K.A. Wandoan No. 1 on Roma Sheet area. It consists of 1287 feet of tuffaceous quartzose sandstone, carbonaceous shale and siltstone disconformably overlying the Rewan Formation (Cabawin Formation of Union Oil Development Corporation).

In the subsurface of the Surat Sheet area the Wandoan Formation is a quartzose to lithic, tight sandstone, with white tuffaceous matrix. Siltstone and mudstone are common, particularly towards the top of the sequence.

Bastian and Arman (1965) compared the Wandoan Formation type section with outcrop and shallow scout hole samples of Clematis Sandstone and Moolayember Formation. They concluded that the Wandoan Formation was equivalent to Clematis Sandstone (Jensen, 1926) plus Moolayember Formation (Reeves, 1947) and that both of these outcropping units could be recognized in U.K.A. Wandoan No. 1.

In the subsurface of the Surat Sheet area, the Wandoan Formation cannot be consistently divided into an upper, muddy sequence (Moolayember Formation) and a lower, sandy one (Clematis Sandstone). Consequently, the Union Oil Development Corporation term "Wandoan Formation" is retained in this Record for the interval apparently corresponding to the Moolayember Formation plus Clematis Sandstone. The Wandoan Formation is conformable on the Rewan Formation except for local unconformity (Tissot, 1963).

The Wandoan Formation is present at depth over most of the Surat Sheet area. It pinches out against the Southern Roma Shelf in the far west of the area.

The Clematis Sandstone shows clear indications of fluvial deposition. The polymodal sandstones formed as river deposits in a terrestrial, oxidizing environment (Bastian 1965). The carbonaceous, muddy Moolayember Formation was probably deposited in a brackish or non-marine reducing environment. The Wandoan Formation in this area is predominantly a sandy unit. This suggests that fluvial conditions were more persistent here than to the north, where brackish, reducing conditions succeeded the fluvial phase.

Mesozoic plant fossils are known from the outcrop areas of the Clematis Sandstone and Moolayember Shale. Spore determinations of this interval are Triassic (Evans, in prep.). Acritarchs have been found in the Moolayember Formation (Evans, 1964), suggesting some marine influence.

A basin-wide unconformity marks the end of the Triassic and the top of the Wandoan Formation (Fehr, 1965). The unconformity is recognizable both in outcrop and in the subsurface.

Precipice Sandstone

This name was first used by Whitehouse (1952) and later (Whitehouse, 1954) the type section was defined "in the gorge of Precipice Creek, a tributary of the Dawson River" (Taroom Sheet area). In outcrop the unit consists of strongly current bedded, non calcareous, commonly coarse grained, quartzose sandstone. Fehr (1965) carried out a detailed petrographic examination of various Triassic and Lower Jurassic units from subsurface oil well material. His descriptions show that there are no marked changes in lithology from the outcrop of Precipice Sandstone to the subsurface unit. Fehr also noted that angular garnet was a characteristic accessory mineral.

The Precipice Sandstone is present in the subsurface over most of the Surat Sheet area, except in the far west where it finally pinches out against the southern Roma Shelf. Oil well data suggests that the unit is very thin over the shelf area and thickens into the Mimosa Syncline. On the shelf, the unit is less than 100 feet thick and can be as thin as 12 feet (U.K.A. Weribone No. 1). Since all data is based on oil wells which are located on structural highs, it is possible that the unit thickens appreciably off-structure (see also "Oil and Gas").

The Precipice Sandstone is the result of fluvial deposition over a wide flood plain. It has been divided into a lower, coarse, cross-stratified fluviatile sandstone and an upper lacustrine fine grained sandstone and siltstone sequence (Jensen, Gregory and Forbes, 1964).

The Precipice Sandstone contains abundant fossil plant impressions and spores of Evans' division J1. The unit is regarded as Lower Jurassic in age (Evans, 1964).

Evergreen Formation

Whitehouse (1952, 1954) introduced the name "Evergreen Shales" for a sequence of "clay shales" in the valley of the Dawson River immediately below Evergreen Homestead. Forbes (in press) has renamed the unit as Evergreen Formation since the dominant lithology is a siltstone.

Within the silt and mud sequence, two members of contrasting lithology have been distinguished (Mollan et al., in prep). The Boxvale Sandstone Member is a quartzose sandstone horizon and is overlain by an interval characterized by oolitic ironstone (Westgrove Ironstone Member). These thin units tend to be lenticular and are absent in some areas.

In the subsurface of Surat Sheet area the Evergreen Formation consists of carbonaceous mudstone and siltstone, with minor sandstone, coal and fossil plant remains. A sandy horizon probably representing the Boxvale Sandstone Member ranges in thickness from 10 to 70 feet (U.K.A. Flinton No. 1), and is absent (U.K.A. Bidgel No. 1, U.K.A. Wunger No. 1) where the Evergreen Formation thins to less than 200 feet. The Westgrove Ironstone Member has not been recognized in the subsurface of Surat Sheet area, although Fehr (1965) reports pelletal claystone and ooliths from this interval.

The Evergreen Formation is present in the subsurface of the Surat Sheet area, except in the far west where it pinches out against the southern Roma Shelf. Only one oil well (U.K.A. Katoota No. 1) penetrated Evergreen Formation lying directly on basement (see Table 4). The unit reaches a maximum thickness of about 600 feet on the shelf, and is probably thicker in the Mimosa Syncline.

Abundant plant remains, thin coal seams and the absence of marine fossils suggest that the muds and silts of the Evergreen Formation were deposited in a fresh water environment. The virtual absence of coarse clastic material is probably the result of a mature source area. The Boxvale Sandstone Member is in part a fluviatile deposit. The overlying oolite horizon (Westgrove Ironstone Member) suggests an abrupt change to quiet conditions. The presence of pelletal chamosite indicates possible marine incursion, at least for a short time. Furthermore, Fehr (1965) considers the Evergreen Formation to be a shallow marine deposit, at least in part. Marine muds in the Evergreen Formation have also been considered as source beds for petroleum now found in the Boxvale Sandstone Member and the Precipice Sandstone. De Jersey (1965), found Evergreen spores (J2) in Moonie oil from the Precipice Sandstone.

The Evergreen Formation below the "oolite member" contains J1 spores, while the remainder contains a J2 microflora (Evans, 1965). Both spore zones are considered to be Lower Jurassic in age. Acritarch swarms occur in two horizons, one above and one below the Boxvale Sandstone Member (Evans, 1966).

Hutton Sandstone

The formation name was first used by Reeves (1947) in the vicinity of Westgrove Station on Eddystone Sheet area. A type section was later measured near Hutton Creek, east-north-east of Injune (Mollan et al., in prep.). In outcrop in the type area the unit is almost entirely fine to medium grained, thick bedded, cross-bedded quartzose to sublabile sandstone. In the subsurface it is a similar friable porous sandstone but with minor siltstone and mudstone interbeds, particularly towards the top of the unit in the north of the Sheet area.

This transitional sequence of interbedded sandstone, siltstone and mudstone, between the Hutton Sandstone and the muddy Birkhead Formation comprises the Eurombah Beds of Exon et al., (1967). The latter unit could be recognized only in the far north of the Surat Sheet area (U.K.A. Colgoon No. 1 and U.K.A. Myall Creek No. 1) where it reaches a maximum recorded thickness of 80 feet, (c.f. 350 feet on Roma Sheet area).

The Hutton Sandstone is present in the subsurface over the whole of the Surat Sheet area. It conformably overlies the Evergreen Formation except in the far west of the Sheet area where it lies unconformably on basement (Timbury Hills Formation).

Environmental evidence on the Hutton Sandstone is sparse. The presence of fossil plant stems and logs, combined with the collection of one mytiloid pelecypod suggests a brackish environment for at least part of the unit. Brackish formation water has been reported from the unit (Jensen, Gregory and Forbes, 1964). The Hutton Sandstone contains spores of Evans' (1966) division J2-3, which is considered to be Lower Jurassic in age. The Eurombah Beds on Roma Sheet area contain spores of division J4, indicating a Middle Jurassic age.

Injune Creek Group

Jensen (1921) first used the name "Injune Creek Coal Beds" for Jurassic sediments in the Roma-Injune area. He later introduced the term "Walloon Coal Measures" which has subsequently been modified and used in a variety of ways. Exon (1966) replaced the informal name Injune Creek Beds with Injune Creek Group.

In the Surat Basin west of Roma, the Injune Creek Group is divisible into two formations - Birkhead Formation and Westbourne Formation. The Springbok Sandstone Member is distinguished as a sandy interval at the top of the Birkhead Formation. The three units are defined by Exon (1966). East of Roma and to the south in the subsurface, these subdivisions are no longer all recognizable. In the Surat Sheet area, the Birkhead Formation is clearly defined in electric logs from oil wells. The Walloon Formation of Union Oil Development Corporation is equivalent to this unit. The Birkhead Formation consists of carbonaceous mudstone and coal, with minor siltstone and lithic sandstone.

From available oil well data it has not been possible to differentiate the Springbok Sandstone Member from the Westbourne Formation everywhere in this area, although the division appears to exist in some well logs (see Appendix 6). The interval (Springbok & Westbourne equivalent) is represented on the Surat 1:250,000 map as Ji. The dominant lithology is lithic,labile to sublabile, friable, clayey sandstone, with some siltstone and minor mudstone.

The Injune Creek Group is present throughout the entire Surat Sheet area. It generally exceeds 1000 feet in thickness but thins in the far west to 720 feet (U.K.A. Maranoa No. 1). The group is thickest in the north and east of the Sheet area where 1400 foot sections have been recorded (U.K.A. Myall Creek No. 1 and U.K.A. Coomrith No. 1).

The environment of deposition of the Birkhead and Westbourne Formations was dominantly lacustrine to deltaic. The Springbok Sandstone Member represents a fluviatile interval and the presence of acritarchs in the Westbourne Formation suggests some marine influence (Mollan et al., in prep.).

Fragmentary plant remains are found throughout the Injune Creek Group. Whitehouse (1954) suggested a Jurassic age for the unit on palaeobotanical evidence. The Birkhead Formation lies mainly within Evans' spore zone J4, although spores of division J5 have been found in the upper part of the unit (Evans, 1966). On this basis a Middle Jurassic age has been assigned to the unit. De Jersey and Paten (1964) gave a similar age to spores from the Walloon Formation. The Westbourne Formation contains J5 and J6 spores, and is regarded as Upper Jurassic in age (Evans, in prep.).

Gubberamunda Sandstone

Reeves (1947) first used the name "Gubberamunda Sandstone" without defining any type area or section. Day (1964) nominated the type area which lies 20 to 24 miles from Roma along the main Roma-Injune road.

The lithology of the unit in the subsurface of the Surat Sheet area is similar to that of the type area. It is mainly a coarse grained quartzose sandstone. The unit is characteristically friable and porous, with some pebbly horizons. The rock is virtually uncemented. To the north on Roma Sheet, the Gubberamunda Sandstone is about 200 feet thick, and reaches 300 feet in the Mimosa Syncline (Exon, et al., 1967). In the subsurface of the Surat Sheet area the section is much thicker, averaging around 700 feet, and reaching 965 feet in U.K.A. Maranoa No. 1. The unit is present in the subsurface throughout the Sheet area.

The Gubberamunda Sandstone is defined very clearly on electric logs from subsidized oil wells and is a particularly useful horizon for correlation.

The coarse grain size and the large scale cross-bedding of the unit in outcrop (Roma Sheet area) suggest a fluviatile environment of deposition for the Gubberamunda Sandstone. Only a few plant fossils have been found. Spores of Evans' division J6 have been recovered from this unit, indicating an Upper Jurassic age (Evans, in prep.).

Orallo Formation

This unit was formally defined by Day (1964) to replace the name "Orallo Coal Measures" of Jensen (1960). The Orallo Formation is also synonymous with the widely used terms Fossil Wood Beds (Whitehouse, 1954) and Fossil Wood Stage (or Series) (Reeves', 1947).

In the subsurface of the Surat Sheet area the Orallo Formation consists of a medium to coarse grained sandstone, in places pebbly, with a white clay matrix. Minor interbeds of siltstone and mudstone occur. In outcrop in the Roma Sheet area the upper Horizons of the formation are coaly and in some places bentonitic (Exon et al., 1967). The Orallo Formation is present at depth over the entire Surat Sheet area. The unit varies greatly in thickness (U.K.A. Moombah No. 1 - 80 ft, U.K.A. Myall Creek No. 1 - 540 ft) with an average of about 300 feet (see Appendix 6). In oil well logs the horizon taken as the base of the Orallo Formation can be easily and consistently traced across the Sheet area. However, the upper boundary with the Mooga Sandstone Member of the Blythesdale Formation is at times difficult to pick, suggesting a gradational relationship between the two units. It is possible that both the upper and lower boundaries are strongly time transgressive.

Marked vertical and lateral variation in lithology within the unit seems to reflect repeated variations of conditions, ranging from fluviatile and deltaic to lacustrine and paludal. Cross-bedding and fossil wood debris are notable features of the unit in outcrop north of the Surat Sheet area. There is no direct indication of marine incursion, except for the hand specimen identification of "glauconite" (Exon et al., 1967).

Difficulties concerned with the identification, composition and significance of glauconite make this evidence very tenuous. The presence of bentonitic clay and ?tuffaceous horizons in the upper part of the Orallo Formation in Yuleba Creek (Duff and Milligan, 1967) indicates probable late Upper Jurassic volcanism in the area and raises the question of marine influence in the formation of this deposit. However similar tuffaceous deposits low in the Orallo Formation (or high in the Injune Creek Group) in the Miles area (Exon and Duff, 1968) are of fluviatile origin.

A variety of fossil plant specimens collected from the Orallo Formation are listed by Day (1964). Unfortunately, the flora is poorly known and is of little use in correlation and age determination. Spores of Evans' (1966) division J6 have been recovered from the unit, indicating an Upper Jurassic age.

Blythesdale Formation

As a result of his work in the Roma area, Day (1964) redefined the Blythesdale Formation in an attempt to resolve the confusion which had resulted from widely differing usage of Jack's (1895) term "Blythesdale Braystone". Day divided his Blythesdale Formation into four members (in order of deposition) - Mooga Sandstone Member, Kingull Member, Nullawurt Sandstone Member, Minmi Member. In subsurface correlation in the Surat Sheet area, Day's nomenclature was followed (see Appendix 6) but some difficulty was experienced in separating the upper three members of the formation. Consequently, in the cross-section on the Surat 1:250,000 map the three members are grouped as one unnamed unit K1b. This twofold division of the Blythesdale Formation corresponds with that of Whitehouse (1955), in which he calls the Minmi-Nullawurt-Kingull interval "Transition Beds" (see Day (1964), Table 2).

1. Mooga Sandstone Member

This unit consists mainly of quartzose, porous, friable sandstone, with minor siltstone and mudstone interbeds. In the Surat area the unit varies between 500 and 800 feet in thickness, but thins in the far west of the Sheet area to 405 feet in U.K.A. Maranoa No. 1. This is probably only a local variation, as nearby U.K.A. St. George No. 1 penetrated 650 feet of Mooga Sandstone Member.

The unit consists entirely of fresh water sediments which are mainly fluviatile, with the muddy horizons probably representing back swamp or lacustrine conditions. Fossil plant remains are found throughout the unit, but are of little value in age determination. Spores of Evans' (1966) division K1a have been recovered from the member. This spore division is regarded as probably Lower Cretaceous in age (Evans, in prep.) and by convention the base of the Mooga Sandstone Member marks the Jurassic - Cretaceous boundary in the Surat Basin.

2. Undivided Kingull, Nullawurt Sandstone and Minmi Members of the Blythesdale Formation.

The dominant lithology is a fine to medium grained sandstone, which is commonly glauconitic. Siltstone and mudstone are subordinate but plentiful. The variation and alternation of lithologies seem to reflect a variety of environments. On Roma and Mitchell Sheet areas, the fine grained lithology of the Kingull Member suggests a lacustrine environment, which in turn graded to shallow marine in some areas during Nullawurt time (Exon et al., 1967). The Minmi Member shows definite indication of a marine environment of deposition. The sands are commonly glauconitic and the unit contains a marine shelly fauna. The Minmi Member is the first widely widespread marine unit in the Surat Basin above the Permian.

A Marine ?Neocomian macrofauna from the Nullawurt Sandstone Member on Mitchell Sheet area is described by Day (1967). Freshwater pelecypods and plant fossils are also known from this unit. The Minmi Member contains a rich marine Aptian macrofauna where it crops out along the northern margin of the Surat Basin (Day, 1964).

Spores of Evans' (1966) division K1a have been found in the Kingull, Nullawurt Sandstone and lower Minmi Members. K1b-c spores are known in the uppermost Minmi Member (Exon et al., 1967). Both divisions are of Lower Cretaceous age.

Doncaster Member (Wallumbilla Formation)

The Doncaster Member of the Wallumbilla Formation is a marine, dominantly mudstone sequence which spans most of the Aptian in the Surat and Eromanga Basins. The unit was originally defined by Vine and Day (1965, p. 4) as a member of the Wilgunya Formation; later (Vine et al., 1967), this formation was elevated to the rank of sub-group, and the interval embracing the Doncaster and Coreena (Vine et al., 1967) Members was named the Wallumbilla Formation. The Doncaster Member conformably overlies the Blythesdale Formation.

The Doncaster Member does not crop out in the Surat Sheet area, but is encountered at depth in all oil wells on the Sheet area. The thickness of the Doncaster varies over the shelf area from 200 feet to nearly 600 feet, the greatest thickness probably being in the Mimosa syncline. In the type area near Richmond in the Eromanga Basin, the lithology is described as "blue grey mudstone with subsidiary glauconitic siltstone" (Vine and Day, 1965). In the Roma area immediately north of Surat Sheet, outcrops of the unit are essentially similar to those in the type area but glauconite is seldom seen (Exon, et al., 1967). However glauconite is present in the subsurface in that area. The macrofauna is dominated by pelecypods (Vine and Day, 1965); genera represented include Maccoyella, Pseudavicula, Fissilunula, and Panopea; the belemnite Peratobelus oxys is common in the Doncaster Member, but is not confined to it.

The unit was deposited in shallow marine conditions, with some phases of brackish and littoral sedimentation.(Exon et al., 1967).

OUTCROP GEOLOGY

Coreena Member (Wallumbilla Formation)

The Coreena Member of the Wallumbilla Formation was formally defined by Vine et al., (1967). In the type area, near Barcaldine in the Eromanga Basin, the unit consists of interbedded siltstone and mudstone; the siltstone is coarse-grained, grading into very fine and fine-grained sandstone. In the Roma area, north of the Surat Sheet, these rock types persist with siltstone dominant.

The unit is poorly developed on the Surat Sheet area. Outcrop is confined to the north-west, where a small area of unaltered Coreena sediments is surrounded by a much greater area of the deep weathering - profile. The only outcrop material suitable for thin-sectioning was the sandstone preserved in calcareous boulders in the unaltered material; the sandstone was fine-grained and labile, with feldspar exceeding lithics in the labile fraction. Intraformational conglomerates and disrupted mudstone beds are common and well preserved in the deeply weathered Coreena Member. The lithology revealed by B.M.R. Surat No. 1 showed a much greater proportion of fine-grained sediment (mostly siltstone, with minor mudstone), than was suggested by the outcrop, but the section was dominantly sandy. (B.M.R. Surat No. 1 was sited near the top of the weathering-profile of the Coreena Member; it penetrated approximately 380feet of Coreena sediments and possibly bottomed in the uppermost Doncaster Member, which conformably underlies it.).

Because of the poor outcrop of the unaltered sediments, and the masking effect of the deep weathering-profile, correlation with the Coreena Member as mapped on the Roma Sheet area cannot be proved. Furthermore, the outcrop could not be differentiated from the surface exposure of the Griman Creek Beds which are separated from the Coreena Member by an unnamed mudstone Klz. However, comparison of the logs of B.M.R. Surat No. 1 with those of B.M.R. Roma No. 9 in the south-west of the Roma Sheet area, and with those of the deep oil wells on the Surat Sheet area, where the Coreena Member can be picked accurately, suggests that the correlation is a reasonable one.

SHALLOW STRATIGRAPHIC HOLE

B.M.R. ROMA No. 9

Coreena Mbr. - Doncaster Mbr.

E-LOG

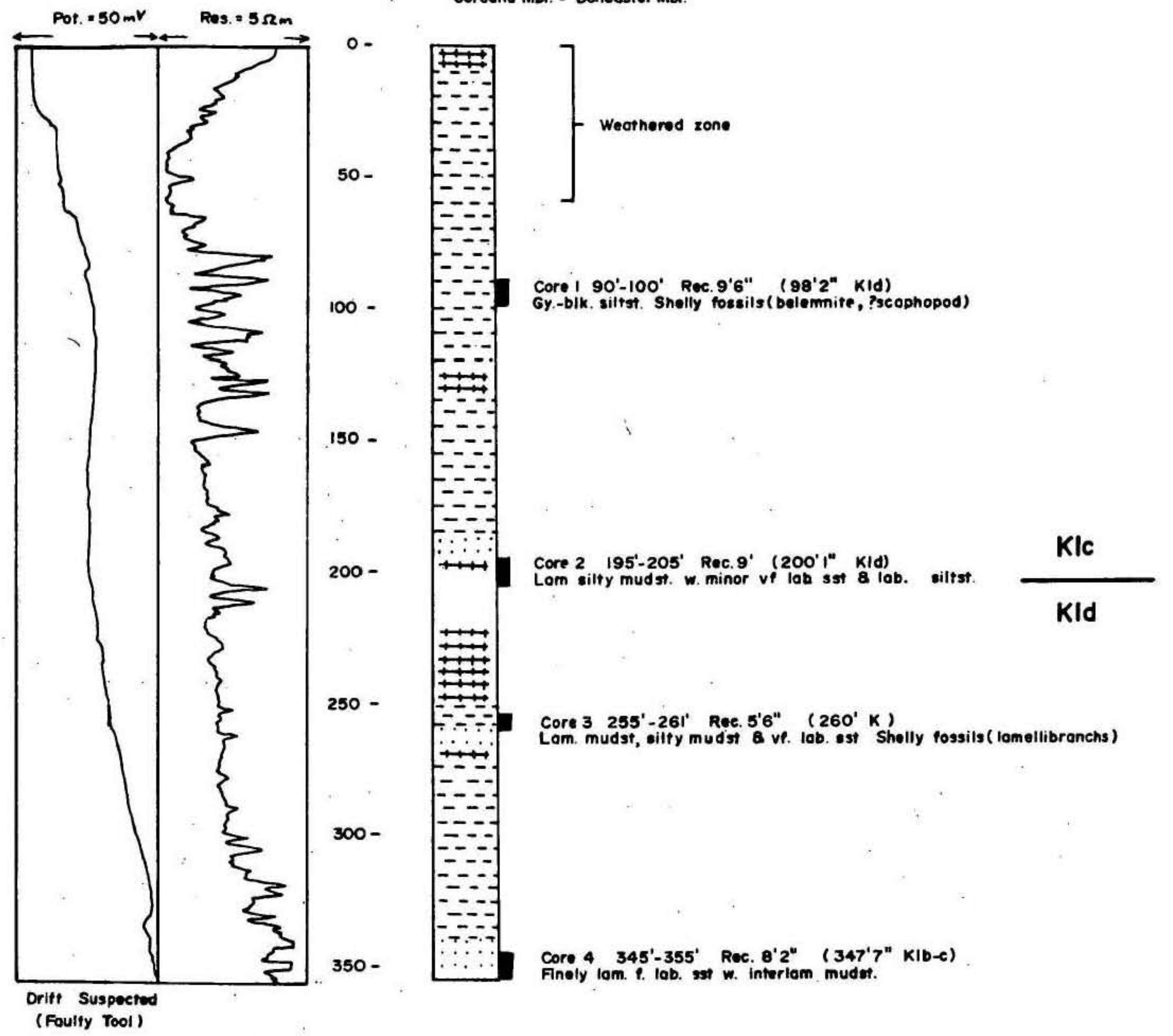
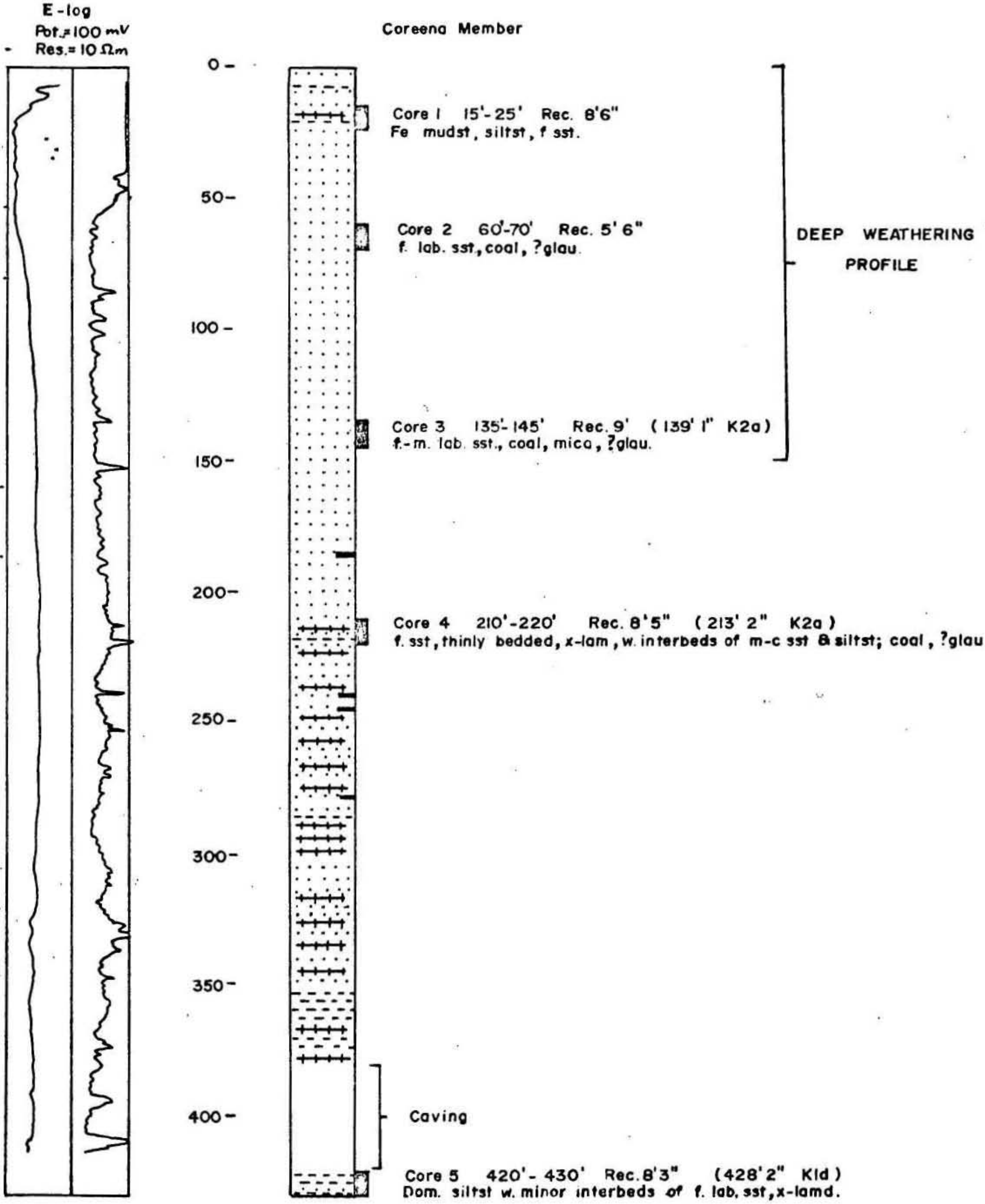


FIG. 9

SHALLOW STRATIGRAPHIC HOLE
B.M.R. SURAT No.1



Assuming correct correlation, then, the Coreena Member is much sandier on the Surat Sheet area; further difference from the Coreena to the north is the comparative paucity of microplankton in the core samples. Hence, a gradual change in environment of deposition from the Mitchell and Roma Sheet areas south and east onto the Surat Sheet area is suggested: increase in grain size suggesting shallower water and higher energy conditions, the paucity of microplankton a decrease in salinity. The only macrofossils collected were a few, poorly preserved, minute bivalves, which could represent the fauna of a restricted environment, perhpas one of reduced salinity.

Unit Klz

Unit Klz is an unnamed mudstone which conformably underlies the Griman Creek Beds. It does not crop out, and was only discovered by examination of scout holes and oil bores on the Surat Sheet area. By extrapolation of the subsurface trend, the unit is closest to the surface in the north-west (see map cross section) where it is now covered by Tertiary and Quaternary alluvial sediments in the flood-plain of the Balonne River. The weakly resistant mudstone probably localized the path of the Balonne River approximately along the strike of the beds, between the more resistant sandstones of the Griman Creek Beds and the Coreena Member. Unit Klz consists of carbonaceous mudstone, carbonaceous, calcareous, glauconitic siltstone and minor fine-grained labile sandstone; plant remains, very fine cross-bedding and pellets of siltstone and mudstone in the sandstone, are common. The known range of thickness is from 225 feet in U.K.A. St. George No. 1 for the Southern Roma Shelf, to 480 feet in U.K.A. Bidgel No. 1 closer to the Mimosa Syncline; the unit is presumably thickest in the syncline.

Griman Creek Beds

"Griman Creek Beds" is an informal term proposed for the Cretaceous sediments which crop out on the Surat Sheet area to the south and east of the Balonne River. A deep weathering-profile has developed, and the unaltered sediments are exposed only where this has been stripped by erosion.

The name is based on Jenkins' (1959) Griman Creek Group (subsequently referred to by the same author (Jenkins, 1960) as Griman Creek Formation). Jenkins (1959) treated the deep weathering-profile separately, as the Telgazli Formation, but this is now included within the Griman Creek Beds. The Griman Creek Beds are not formally defined since neither stratigraphic range nor lithology is completely known.

Outcrop is poor, except near the base of the unit around Surat. Here, the sequence consists of interbedded fine-grained, labile sandstones, grading to siltstone, and mudstone, which weather to a characteristic khaki-yellow colour; macrofossils are fairly abundant, sometimes forming coquinites. The remainder of the area marked as Griman Creek on the Sheet area, excluding the deep weathering-profile, consists almost entirely of black soil plains and low rounded hills, where calcareous bands have afforded greater resistance to erosion. The plains country is characterized by calcareous concretions of labile sandstone which form boulders.

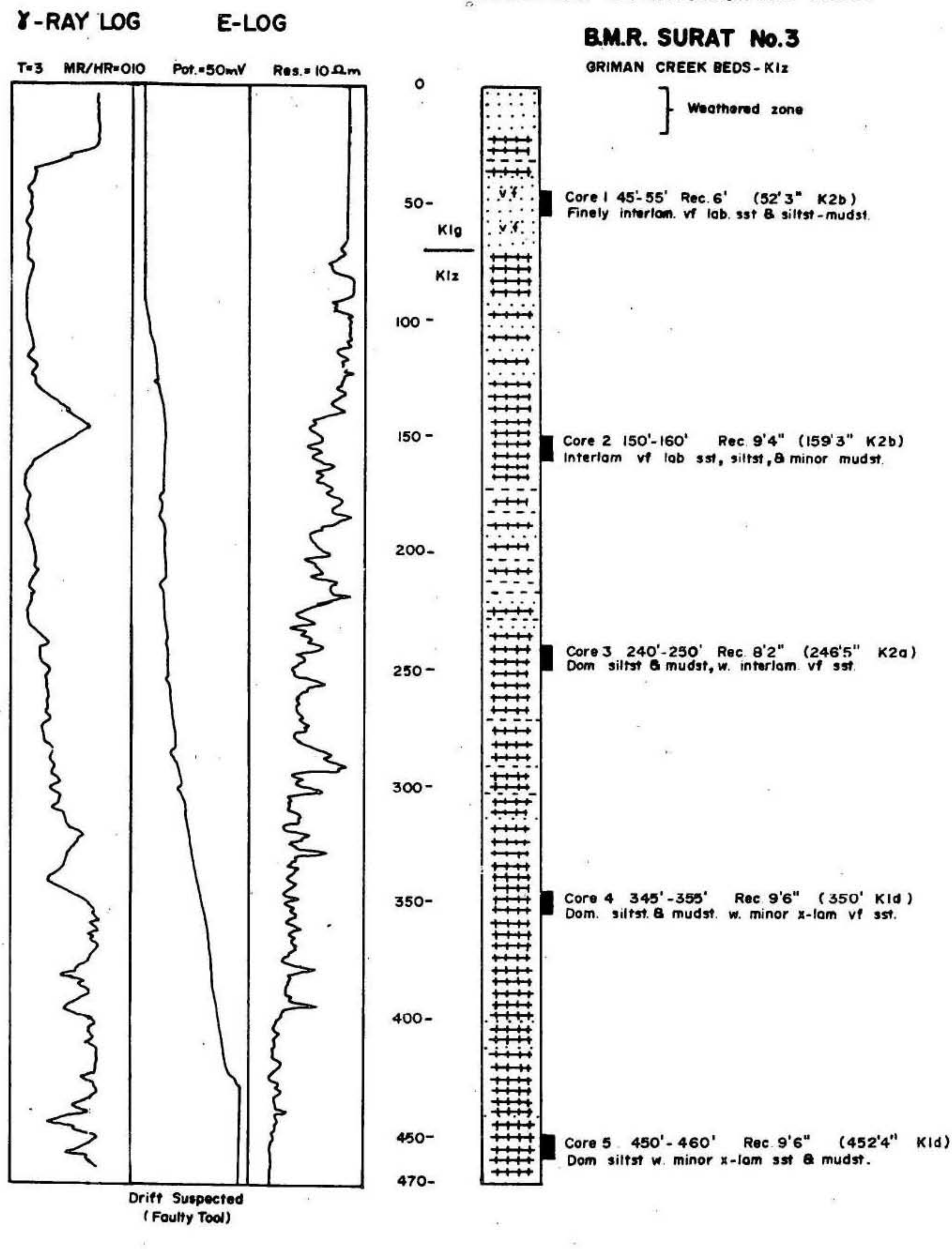
The beds are underlain by the unnamed mudstone Klz; the mudstone does not crop out, so that the boundary can be traced only in the sub-surface. Evidence from U.K.A. Coomrith No. 1 suggests that the Griman Creek Beds are at least 1,000 feet thick; they could be much thicker in the centre of the Mimosa Syncline. No top can be defined for the beds on present information.

The only outcrop material suitable for thin-section examination was from the calcareous boulders; these consisted of glauconitic, calcareous, fine-grained, feldspatho-lithic and lithic arenites. Carbonate cement made up about 20% of the rock; quartz and chert rarely exceed 60% of the rock; lithic fragments (usually porphyritic, with plagioclase phenocrysts in an altered groundmass) range from 5-15% of the rock "Glauconite" forms 5-10% of the rock. "Glauconite" is used here for sandsized, elongate-elliptical pellets, without any real mineralogical implications. Colour varies from yellow-brown to yellow-green, and the mineral is generally much altered to limonite. The pellets show a characteristic deep radial cracking, possibly due to shrinkage). Samples have been separated for X-ray analysis but results are not available yet.

FIG. 10

SHALLOW STRATIGRAPHIC HOLE

B.M.R. SURAT No.3

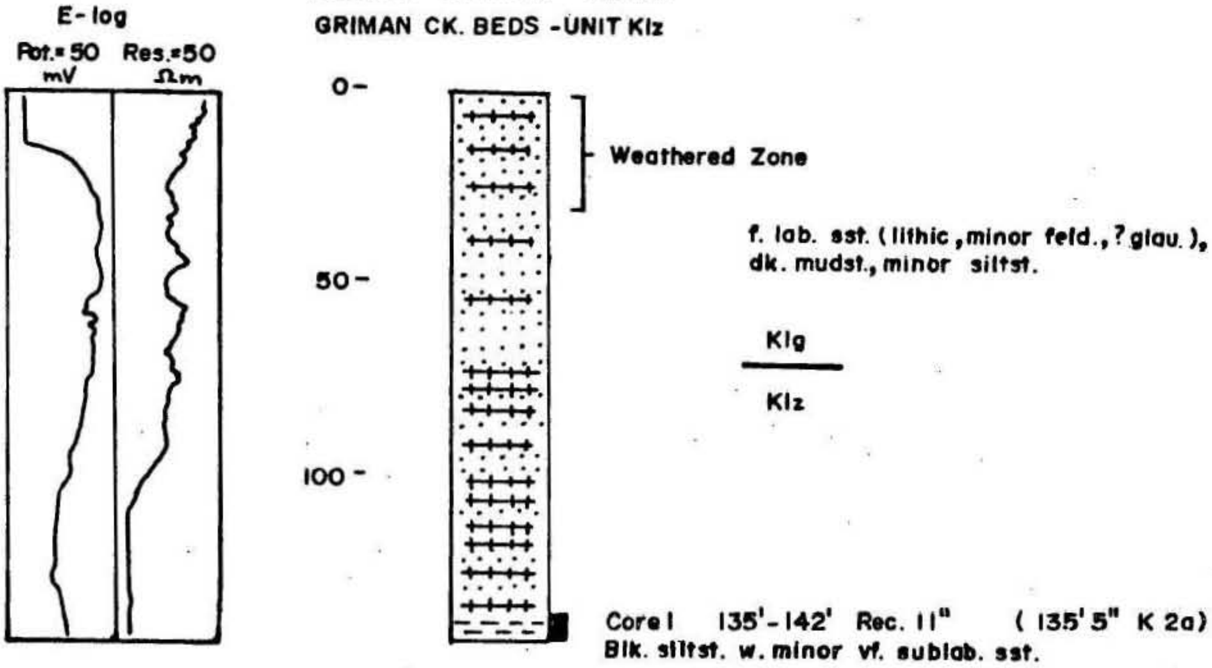


To Accompany Record 1968/56 G55/A16/17

SHALLOW STRATIGRAPHIC HOLES

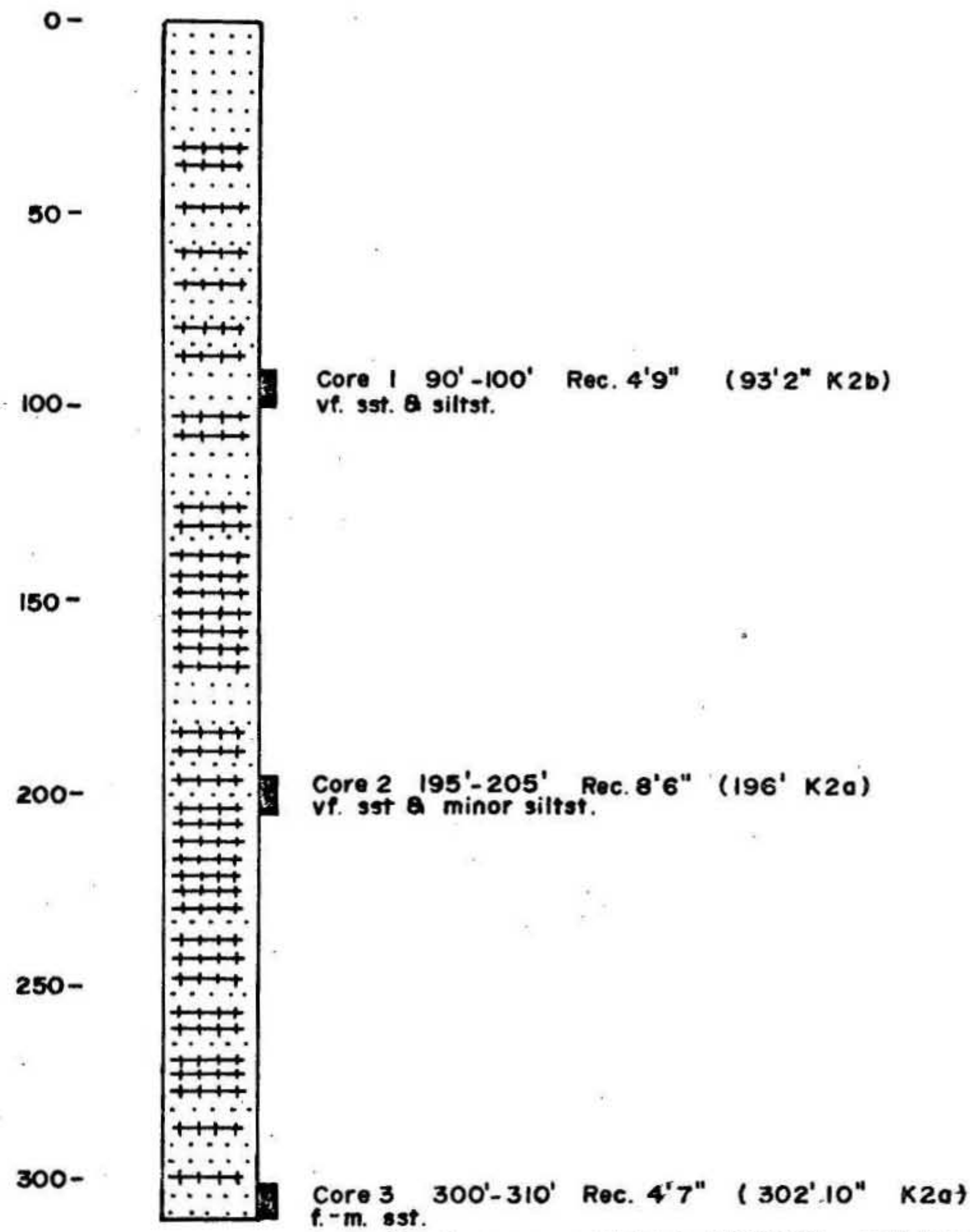
B.M.R. SURAT No. 2

GRIMAN CK. BEDS - UNIT Klz



B.M.R. SURAT No. 4

GRIMAN CREEK BEDS



To Accompany ~~Record~~ 1968/56 G55/A16/15

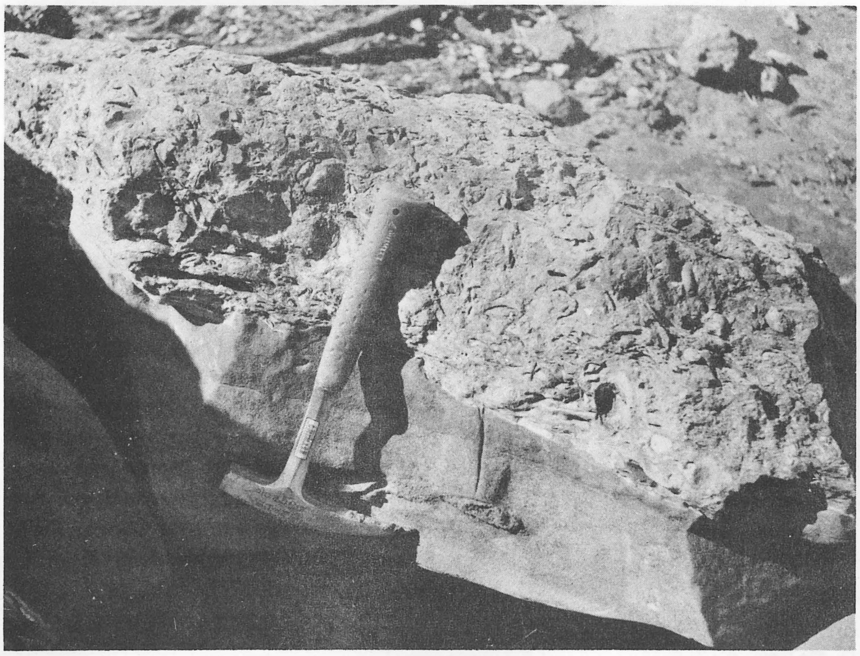
PLATE 5.

(a) Calcareous concretions weathering out of exposure of basal Griman Creek Beds in the banks of the Balonne River. (195,632).

(b) Outcrop in earth tank. Much of the mapping relied on material from dam excavations.

PLATE 6.

(a)



(b)

(a) and (b). Coquinites from basal Griman Creek Beds.
Locations SB401 (above) and SB419.

Fossil collections from localities at or near Surat have previously been made by Laing & Allen (1955) Jenkins (1959), and Dickins (1960). Laing & Allen (1955) recorded Professor D. Hill's identification of Peratobelus (Roma fauna, Aptian) and Dimitobelus (Tambo fauna, Albian) from separate localities close to Surat; they equated their Surat Formation (basal Griman Creek Beds) with the basal Tambo Series (the Coreena Member of the Wallumbilla Formation), because these two diagnostic genera had previously been found together only in the basal Tambo Series.

Jenkins' (1960) faunal list comprised:

Peratobelus australis (Phillips)
Pseudomonotis sp. nov.
?Thracia
?Glycimeris
Mytilus rugocostatus Moore
Mytilus inflatus Moore
Natica variabilis Moore
Myacites ? australia Huddleston
? Maccoyella sp.
? Tancredia sp.
Cyrenopsis sp.

Mainly on the occurrence of Peratobelus, Jenkins (1960) assigned an Aptian age to the fauna.

Dickins (1960) recorded the pelecypods Pseudavicula anomala (Moore), Papyracea Etheridge (associated in the Roma type of fauna), Tellina sp. indet., and the gastropod Vanikoropsis sp. nov.. Dickins suggested correlation of the sediments at this locality with those of the "transition beds of the Blythesdale "Group"" (Minmi Member of the Blythesdale Formation) on the basis of lithological and faunal similarities.

Fossils were collected during the present mapping from previously known, and new, localities, both at the base of the sequence around Surat, and near the top of the sequence in the eastern part of the Sheet area. R.W. Day (A.N.U.), who has worked extensively on Roma and Tambo faunas from both the Surat and Eromanga Basins, has made a brief study of the collections, and his preliminary suggestions are summarized below:

1. Most species represented have not previously been described.

2. The occurrence of a single thick shelled belemnite of the genus Peratobelus (SB 416 at Mt. Walpanara, 196 631) could indicate an upper Doncaster-basal Coreena age for the sediments, or it could be reworked from Doncaster deposits to the north.

3. The presence of Peratobelus is the only certain indicator of marine conditions; the remainder of the fauna could have lived in either marine or brackish water conditions.

4. Fossils collected from near the top of the sequence in the east (SB 505 at 281584, and SB 508 at 275582) are almost certainly fresh water forms, reminiscent of the Winton faunas.

Tertiary

Tertiary sediments on the Sheet area are quartzose sandstones which display some degree of consolidation. Use of the term "Tertiary" is purely arbitrary, since there is no evidence to indicate an upper limit to the age of the sediments. Outcrop in general was poor; most exposures were in dam excavations. There are two distinct types of Tertiary:

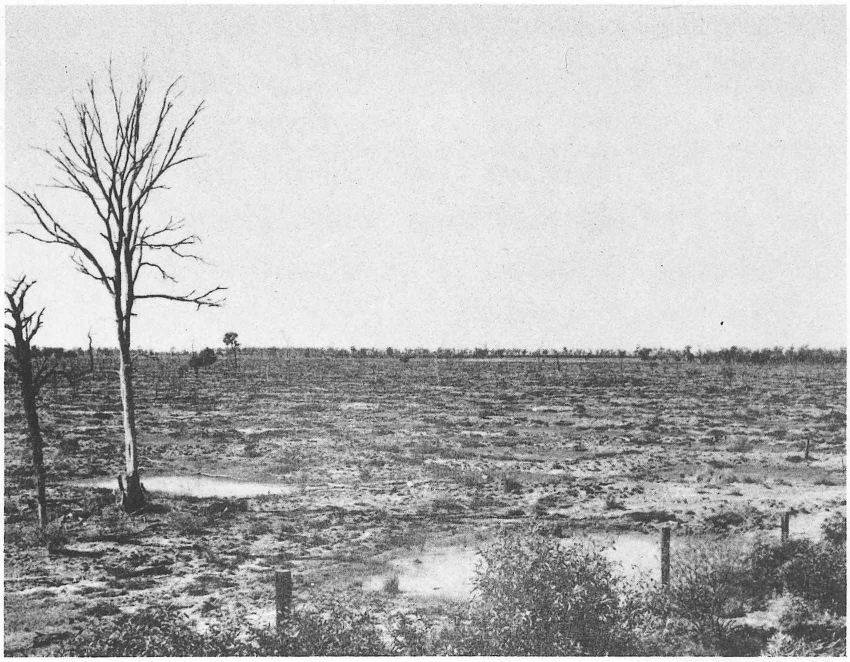
1. A clean-washed, fine-to medium-grained, friable, quartzose sandstone, with conglomeratic beds, which reaches a thickness of 50 feet, and which crops out in the north and north-west;

2. A clayey, fine-to coarse-grained quartzose sandstone, extensively mottled, with some pebble bands; the unit is about 30 feet thick, and crops out in the south-east; it was named the Moonie Formation by Isbell (1957). The name is not used in this report, since the unit is of such small extent.

The two types of sediment are seen as alluvial deposits in older stream channels of the Balonne and Moonie River systems respectively. The clayey, mottled aspect of the latter type probably reflects its more local derivation from deep weathering-profiles in the area of drainage of the Moonie River.

PLATE 7.

(a) Erosion gully in weakly consolidated Quaternary or ?Tertiary sediment (171,646).



(b) "Melon hole" country, after clearing. The "melon holes" are full of water after heavy rain.

Deep weathering-profile

The deep weathering-profile developed in the Surat Sheet area has been regarded by previous workers (Laing & Allen, 1955; Jenkins, 1959) as a distinct formation, separate from the underlying, unaltered Cretaceous units. The profile is here regarded as the weathering product of the underlying units since:

(i) the gross lithology (in terms of grain size and distribution of rock types), as revealed in shallow drill holes, corresponds with that of the unaltered sediments.

(ii) the boundary between altered and unaltered sediments, as cored in B.M.R. Surat No. 1, is gradational, with interbedding of fresh and altered material.

Jenkins (1959) believed that his "Tertiary" Telgazli Formation (the deep weathering-profile) was lithologically distinct from his Griman Creek Formation (as revealed in outcrop). Indeed, most surface evidence supports this view, since the deep weathering-profile contains a much higher proportion of mudstones, and of mud clasts in the sandstone, than most of the outcropping rocks of the unaltered Griman Creek Beds. However, the reason for the apparent difference is that the deep weathering-profile is much more resistant than the unaltered sediment, and hence a representative section of the former, regardless of grain size and bedding characteristics, is more often preserved; the unaltered sediments are normally represented only by calcareous sandstones; the rare outcrops of continuous section of the unaltered material (as in the Balonne River at Surat) show that the proportion of mudstone compares with that in the deep weathering-profile.

The profile developed on the Coreena Member has a depth of 150 feet in B.M.R. Surat No. 1; the Griman Creek profile has maximum thickness of 120 feet as measured in outcrop.

Within the profile, the rocks have been almost completely reconstituted, with complete replacement of feldspar by clay, leaching of calcareous cement, and deposition of interstitial clay. Extensive ironstaining is evident in the mottled zone where a reticulate pattern of white and red to purple blebs has developed. The blebs vary from 3 inches to 12 inches in diameter. The lower leached zone is normally pale pink to pale yellow in colour, grading downward into unaltered sediments. Opal occurs in several places in the Griman Creek profile, just below the mottled zone. Precious opal is very rare.

The profile is sometimes capped by a ferricrete layer 3-5 feet thick, or more generally by an ironstone gravel derived therefrom. The ferricrete consists of sandstone, siltstone, and mudstone, intimately intermingled, apparently through mechanical disaggregation, and recemented by iron compounds; colour varies from brown to deep red. The capping is thought to represent a fossil soil horizon. It is much more resistant than the underlying mottled zone, so that steep scarps and caves below the capping are quite common; that the deeply weathered material itself is more resistant than the unaltered sediment is shown by several hills of weathered material without a ferricrete or gravel capping which remain above a plain developed on the unaltered material.

The deep weathering-profiles developed in the Surat Sheet area are closely comparable with those developed on the Upper Cretaceous Winton Formation in the south-west Eromanga Basin (Senior, Galloway, Ingram & Senior, 1968). The only differences are that the deep weathering in the Winton Formation has penetrated to a much greater depth (300feet cf. 120 feet) and the Winton profile is characterized by bands of procellanite which are absent from the Surat profile.

The great depth and uniformity of the profile over such large areas predicate a prolonged period of tectonic and climatic stability. Earlier workers regarded formation of the deep weathering-profile, and of silcrete, also probably a weathering product, as the results of one great period of peneplanation and chemical weathering. However, numerous examples in both the Surat and Eromanga Basins show that the two weathering products are not genetically or temporally related, the silcretes being conspicuously younger, although not all of the same age.

It is difficult to assess the age of the deep weathering process. So far, only a minimum age can be suggested, and the range in estimates is quite wide. A lower limit to the minimum age of the deep weathering process is suggested in the Eromanga Basin; here, sandstones of the Glendower Formation overlie the truncated deep weathering-profile, and hence post-date its formation. Wopfner (1963) reported the occurrence of Brachiophyllum, a plant genus supposedly confined to the Mesozoic, from a correlate of the Glendower Formation in South Australia; hence, the minimum age here can be tentatively put at Upper Cretaceous. An upper limit to the minimum age for the deep weathering-profile in the Surat Basin is given by post-deep weathering basalts in the Roma area, which average 22 million years (early Miocene) in age (Exon, Langford-Smith, & McDougall, in prep.). Further north, in the Springsure area, there are unlateritized basalts 30 million years old (I. McDougall pers. comm.), which are probably post-deep weathering.

No occurrences of silcrete were found as continuous beds within a layered sequence, nor as cappings, although silcrete boulders were very common. The main "silcrete" occurrences were in several creek beds cut into the upper part of the deep weathering-profile. Here, the rocks had been extensively and strongly cemented by silica; the resultant material is tough and resistant, lacking the typical silcrete conchoidal fracture and hence its typical brittleness; such occurrences emphasize the relatively great mobility of silica in the weathering zone.

Gilgais

A feature of some low-lying areas, in the Qs, and in the Griman Creek deep weathering-profile around Glenmorgan, is the development of gilgais. These are depressions, formed in heavy soils of the grey clay association (Isbell, 1957, p. 47), which alternate with mounds or puffs (see Isbell, 1957, p. 49, and Thomson & Beckmann, 1959, p. 24), to form a more or less complete network. The depressions are roughly circular in plan, up to 15 feet in diameter, and up to 4 feet deep. Isbell (1957) classifies them in the normal or network type of gilgai (within the scheme proposed by Hallsworth, Robertson and Gibbons, 1955), in which puff and depression are equally well developed.

Virgin gilgaied soils of the Surat Sheet area are characterized by almost pure stands of brigalow scrub. A feature of dam excavations examined was the almost invariable presence at shallow depth (6-8') of a pure quartz sand; this feature was not observed by Isbell (1957), probably because there would have been few (if any) dams in this type of country at the time of Isbell's investigation.

The enormous variations in gilgai form and in the chemical and mineralogical characters of the parent clays present problems of nomenclature and classification beyond the scope of this record, since gilgais encountered on the Sheet area appear to be of the one type. The two main problems, then, in the present case, are:

(i) the derivation of the parent clay material
(ii) the mechanics of formation of the actual mound-depression network.

(i) Derivation of the parent clay.

Isbell (1957) has stated that, over wide areas of Queensland, gilgaied clay soils overlie a deep weathering-profile, and certainly, on the Surat Sheet area, this appears to be the case. He noted, however, that the dominantly kaolinitic deep weathering-profile was in marked contrast with the dominantly montmorillonitic gilgaied clays; since the transformation kaolin-montmorillonite would involve the complete breakdown and reconstitution of the kaolin lattice in an acidic environment (in which montmorillonite is thought to be unstable), he concluded that the gilgaied clays were superficial deposits not derived from the underlying material. Later, the same author (Isbell, 1962) recorded some instances of at least apparent gradation from the deep weathering-profile into the gilgaied clay soils.

Isbell (1957) regarded an aeolian origin for these extensive clay sheets as a possible explanation of such a widespread uniform soil type; he quotes the occurrence of sand dunes "indisputably of aeolian origin" (Isbell, 1957, p. 95). One such sand dune was encountered in the south-eastern corner of the Sheet area, on the road into "Turrawira" property; the friable, well rounded, pure quartz sands occur as slight ridges above the generally flat level of the surrounding gilgaied soils, and extend at least several feet down. Isbell relates these "sand dunes" to the clay deposits, but they could prove to be ridges in a buried desert sand, since, as noted earlier, pure quartz sands appear to underlie much of the gilgai country on the sheet.

(ii) Mechanics of formation of gilgais

The most frequently advanced explanation of gilgais invokes the tremendous expansion and contraction of montmorillonite with alternate wetting and drying. The form of the gilgais on the Surat Sheet area suggests relief of pressure through upward buckling in a fairly uniform body of expanding material. While obviously a basic factor, this property does not explain all known features of gilgais, and work by the C.S.I.R.O. Division of Soils suggests that other mechanisms are involved (Dr. G.G. Beckmann, pers. comm.).

Quaternary

Unconsolidated sands, gravels, and clays deposited in the flood plains of present-day rivers are considered to be Quaternary alluvium (Qa). The symbol Qs is used for deposits on older terraces of present rivers and for general soil cover.

SHALLOW STRATIGRAPHIC DRILLING

During 1967, four shallow stratigraphic wells were drilled on the Surat Sheet area (B.M.R. Surat Nos 1-4) and one on the southern part of the Roma Sheet area (B.M.R. Roma No. 9). The lithological sequences and stratigraphy are summarized in Figures 8-11.

B.M.R. Surat No. 1 and B.M.R. Roma 9 were sited to provide correlation from the Roma succession to the Surat Sheet area. B.M.R. Surat No. 2 was drilled to provide palynological and lithological reference for the faunas collected around Surat township. B.M.R. Surat No. 3 was drilled in the type area of Jenkins' "Griman Creek Group", and Surat No. 4 was placed to test the thickness of the Griman Creek sediments in the Mimosa Syncline. Other data utilized are from U.K.A. Coomrith No. 1 and U.K.A. Cabawin No. 1 wells.

The palynological determinations of Burger (in prep.) are noted on the lithological logs (Figs. 8-11). Figure 12 presents the results, plotted on the assumption that the top of the Kld zone is a time line; the position of the line is only approximate (± 50').

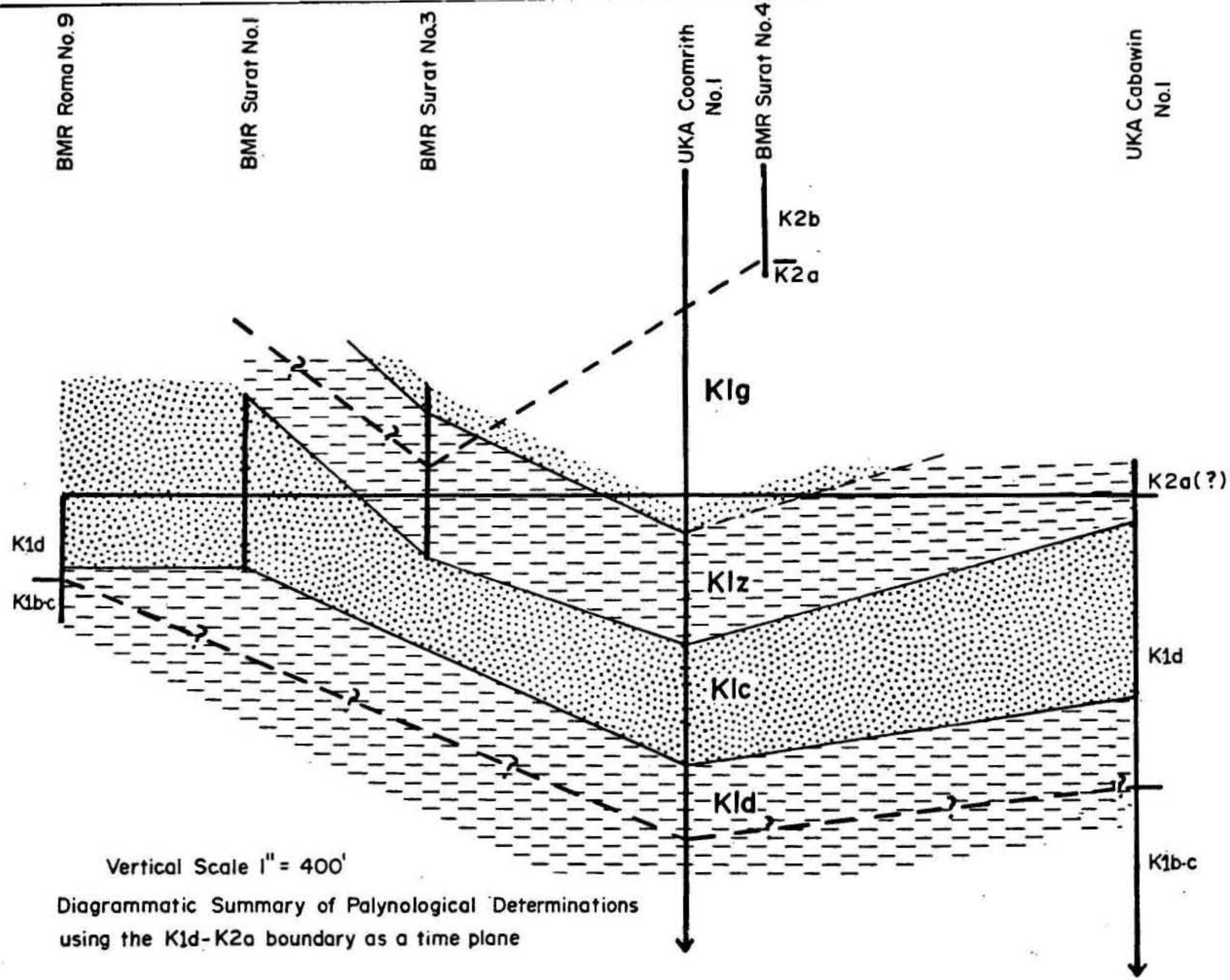
Microfossils were obtained by Dr. Terpstra from all wells except B.M.R. Surat No. 4. In general there were a few poorly preserved forms:

B.M.R. Surat No. 1 Core 5 (Klc)	
	Textularia sp.
	Fish tooth
	Ostracods
	Megaspores
B.M.R. Surat No. 2 Core 1 (Klz)	Textularia sp.
	Ostracods
B.M.R. Surat No. 3 Core 3 (Klz)	Megaspores
B.M.R. Roma No. 9 Core 1 (Klc)	Lenticulian warregoensis
	Valvulineria cf. crespinae
	Trochammina sp.
	Nodosaria sp.
	Ostracods

For Core 1, B.M.R. Roma No. 9, Dr. Terpstra has suggested an age near the Aptian - Albian boundary. The same core yielded the belemnite Peratobelus oxys (identified by R.W. Day) which has been found in the Upper Doncaster - Middle Coreena, but Day regards the latter specimen as having been derived and hence favours an Upper Aptian age. P.J. Jones has described the ostracods (one good specimen and several fragments) from Core 5, B.M.R. Surat No. 1, and suggests a lower Albian age for the forms. These findings agree well with Burger's age determinations.

Burger (pers. comm.) has noted that the unnamed mudstone Klz contains the only appreciable proportion of microplankton in the cores studies, suggesting that this unit might be a marine, or at least a brackish water deposit.

FIG. I



Vertical Scale 1" = 400'

Diagrammatic Summary of Palynological Determinations using the K1d-K2a boundary as a time plane

To Accompany Record 1968/56 G55/A16/3

The information available from the drilling provides little on which to base a discussion of the milieu of deposition of the Klz and Griman Creek units. There appears to have been, however, some form of cyclical or repetitive sedimentation, in the sequence: Minmi Member (of the Blythesdale Formation), Doncaster Member, Coreena Member (of the Wallumbilla Formation), Klz, and Griman Creek Beds; if this is assumed, then some tentative conclusions can be reached.

There is close similarity between the Minmi, the basal Coreena and the basal Griman Creek Beds, in lithology, faunas, and sedimentary structures. The Minmi and basal Coreena are regarded as marine beach or near-shore deposits. Day (1967) quotes the evidence of Exon et al., (1966) for the basal Coreena: worm burrows, coquinas of marine pelecypods, intraformational conglomerate, and cross-bedding with random foreset directions; the same features are evident in the basal Griman Creek Beds.

Considering the close correspondence of the three sandstone units, it is tempting to conclude that the unnamed mudstone Klz is a direct analogue of the Doncaster, in terms of environment of deposition, and fauna, as the Allaru is in the Eromanga Basin (Exon et al., 1966). Klz has yielded little of palaeoecological significance, apart from the microplankton mentioned above; certainly, there is nothing to conflict with the idea of a marine environment of deposition.

One of the problems presented by the macrofossils of the basal Griman Creek Beds is the presence of a specimen of the "Doncaster" belemnite Peratobelus, which R.W. Day (pers. comm.) considers to be reworked. If there is a macrofauna in the Klz unit, it might prove to be similar to the Doncaster fauna, possibly to the extent that the genus Peratobelus is represented. If the Griman Creek Beds were deposited in an environment where the underlying Klz muds were being reworked, then it is possible that specimens of Peratobelus could have been reburied in the basal Griman Creek sediments.

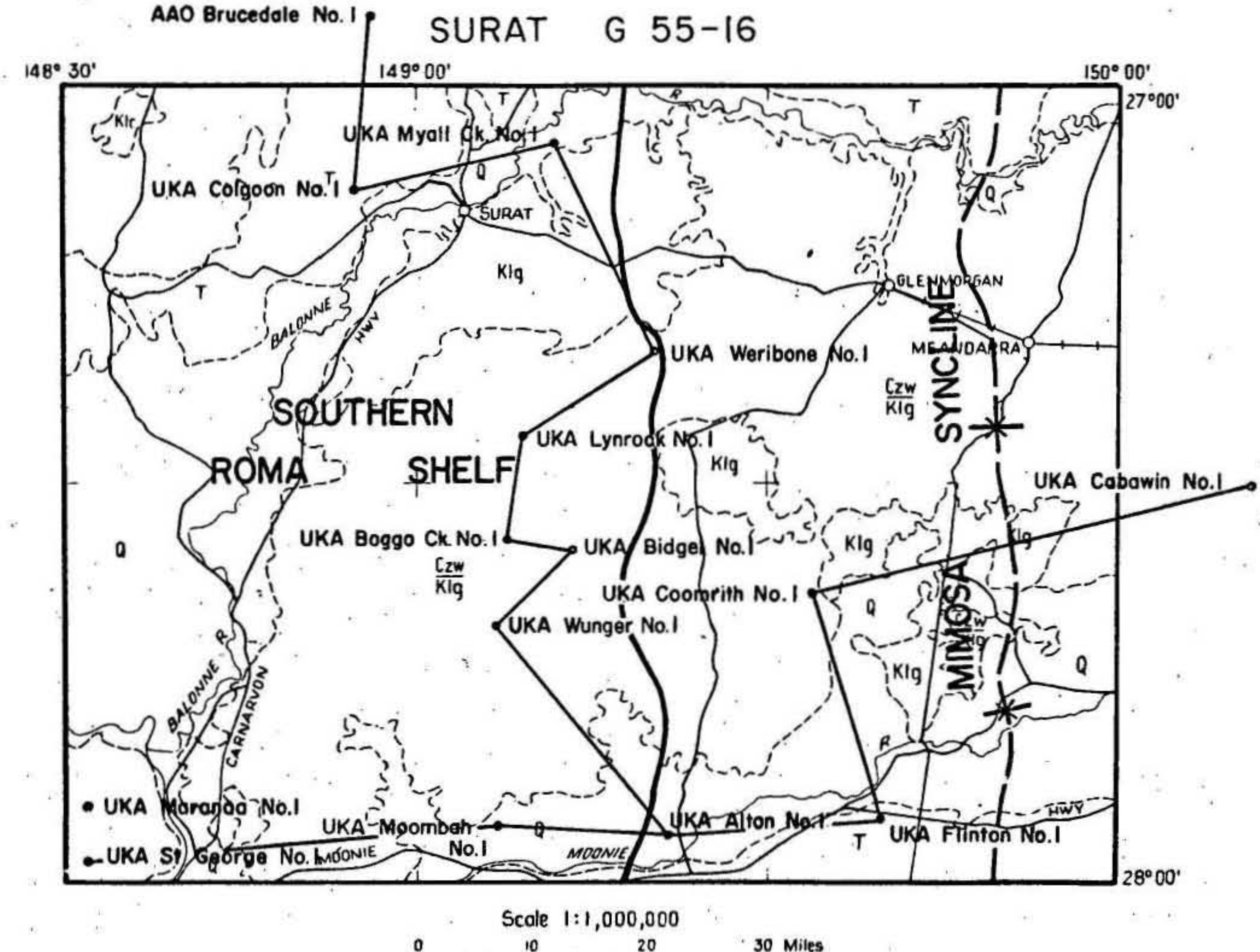
The results of the palynology suggest that the Coreena Member, Klz, and the Griman Creek Beds are all time-transgressive within the region of the Mimosa Syncline. While this is to be expected in a synclinal zone, it is difficult to reconcile, in detail, the rock record with the time relationships proposed.

Ecological considerations suggest that the Griman Creek Beds were laid down initially as strand line deposits of a sea regressing across Klz muds, and the palynology generally supports this hypothesis. However, determinations in U.K.A. Coomrith No. 1 place the basal Griman Creek Beds in the same zone (K1d) as parts of the Coreena and of Klz, indicating that the three units were being deposited simultaneously; this is very difficult to envisage, and it is felt that insufficient control over sampling has led to anomalous results. Further drilling and palynological work are needed before any definite conclusions can be drawn.

STRUCTURE

The Surat Sheet area lies close to the axis of the Surat Basin. The structure of the area is quite simple and can be divided into two major elements, the Mimosa Syncline and the Southern Roma Shelf. (see Fig. 13). In the eastern half of the Sheet area lies the Mimosa Syncline, a north-trending trough containing about 15,000 feet of Permian and younger sediment. The syncline is deepest in the north of the Sheet area, and shallows considerably southwards. To the west, the pre-Permian basement gradually rises forming a gently sloping shelf area (Southern Roma Shelf) covered by 4,000 to 7,000 feet of mainly Mesozoic sediment. In this area the shelf is composed of regional metamorphics (Timbury Hills Formation) with minor intrusive granite.

In the Mimosa Syncline there is at least 4,000 feet of Permian and Triassic sediment related to the development of the Bowen Basin, which is overlain unconformably by the Jurassic and Cretaceous sequence of the Great Artesian Basin. Basement in the Mimosa Syncline, where known, is a dominantly volcanic sequence probably of Carboniferous age. On the Southern Roma Shelf the Bowen Basin sequence is either absent, or present as a thin veneer overlying basement.



QUATERNARY	Q	Soil and sand cover, alluvium
TERTIARY	T	Quartzose sandstone
	Czw	Deep weathering profile
CRETACEOUS Griman Creek Beds	Klg	Labile sandstone, siltstone, minor mudstone
Coreena Member (Wallumbilla Formation)	Klc	Siltstone, labile sandstone, carbonaceous mudstone

STRUCTURAL ELEMENTS

Subsidized Oil Wells

Section Line

(See Pls. 1 & 2)

Aeromagnetic work (Aero Service Ltd., 1963) has suggested that the Mimosa Syncline is defined by major north-south fault lines, but subsequent seismic work has failed to support this interpretation, at least in the Surat Sheet area. There is seismic evidence that further north (Exon et al., 1968) on Chinchilla Sheet, the eastern margin of the Mimosa Syncline is fault-bounded. On the Southern Roma Shelf (Fig. 6), seismic work has shown small block-faulted basement highs; the sediments over some of these have been drilled unsuccessfully for oil.

No evidence of the existence of the Mimosa Syncline or of any faulting was observed in the surface mapping of this area due to the paucity of outcrop and the masking effect of the deep weathering-profile; any reflection of Permian faulting in the Cretaceous sediments would probably be of small amplitude in any case. No accurate surface dip readings were possible because of the shallow dip and widespread occurrence of cross-bedding where there was good exposure. Structure contours from oil well logs have been drawn for two sharply defined horizons - top of Birkhead Formation (Fig. 14) and top of Evergreen Formation (Fig. 15). The results are in close agreement with geophysical evidence (Fig. 5) and show that the Jurassic sequence on the Southern Roma Shelf strikes north-eastwards and has a regional dip of $0^{o}18'$ to the south east (measured between U.K.A. Colgoon No. 1 and U.K.A. Alton No. 1 on Birkhead Formation).

The structural high in the Evergreen horizon in the northwest of the Sheet area (Fig. 15) is produced by a granite body intruding the Timbury Hills Formation. This intrusion is reflected also in gravity (Fig. 2) and aeromagnetic (Figs. 3 and 4) results.

The faults marked on the Surat 1:250,000 Sheet are from seismic (United Geophysical Corporation, 1965) data and are those which affect both the basement and "G" (? top Evergreen Formation) reflectors. The axis of the Mimosa Syncline is taken from the contour map of the "G" horizon in the Surat Shelf Seismic Survey (United Geophysical Corporation, 1965).

GEOLOGICAL HISTORY

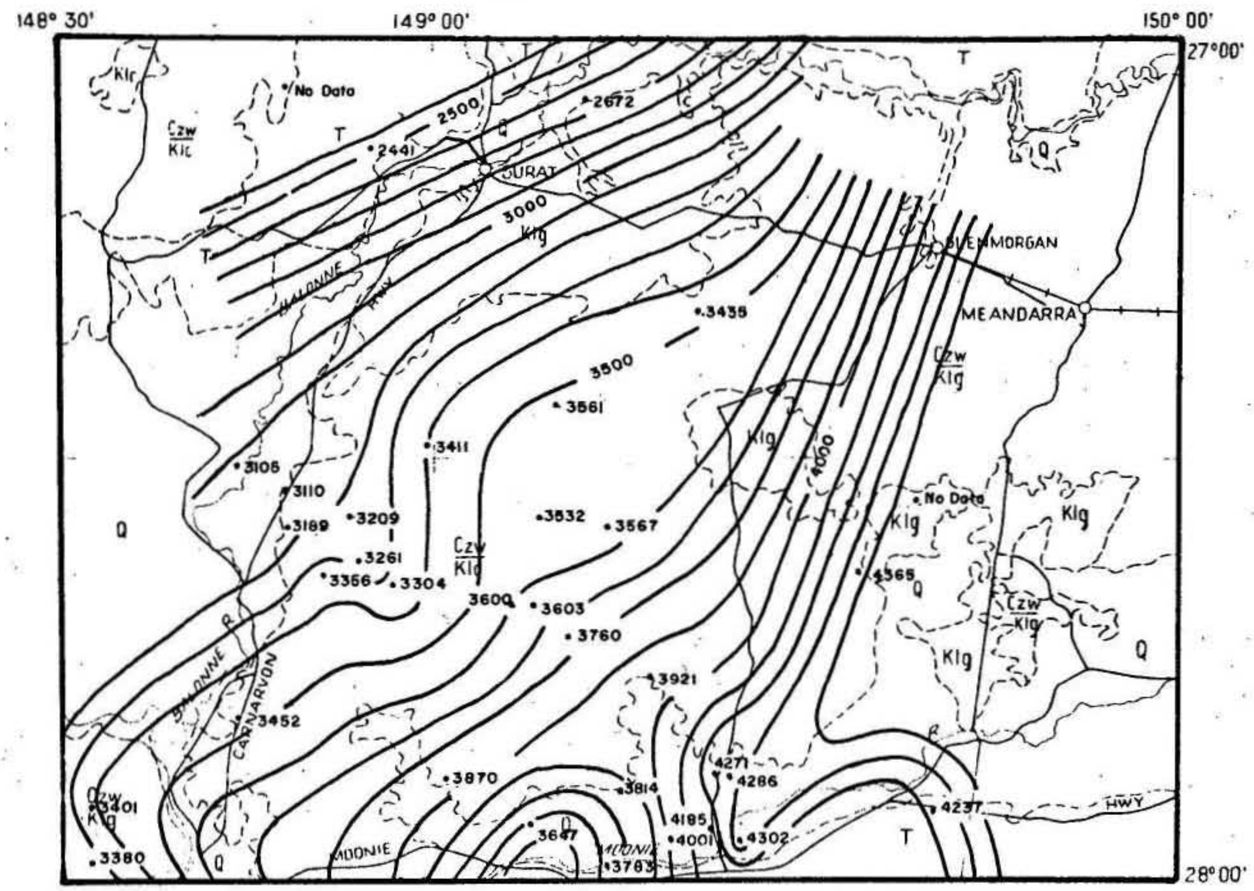
During the Devonian Period, a sequence of sand, silt and mud which is poorly known, was deposited. By the end of the Carboniferous the sediments had been regionally metamorphosed (Timbury Hills Formation) and, in some areas, intruded by granite. In the east of the Surat Sheet area, a volcanic sequence of Carboniferous or Lower Permian age was extruded (Kuttung Formation).

In late Carboniferous or early Permian times faulting and folding produced the Mimosa Syncline. 2,500 feet of Permian section, consisting of a basal sequence of marine mud and tuffaceous sediment (Black Creek Group) grading upwards to a paludal, coaly interval (Blackwater Group), was deposited in this broad downwarp which sank continuously during deposition. Triassic sediments of total thickness 4,000 feet, which overlie the Permian with probable unconformity, appear to be mainly non marine in origin. In the Lower Triassic there was a period of red-bed sedimentation which produced a multicoloured sequence of mudstone sandstone, tuff and conglomerate (Rewan Formation). After a period of erosion, the fluviatile, lacustrine and brackish sediment of the Wandoan Formation was deposited. In general the lower part of the unit is predominantly sandy stream sediment while the upper part contains a large proportion of lacustrine mudstone and siltstone. Some minor marine incursions may have occurred during the Upper Triassic. Whereas Permian and Lower Triassic (Rewan) sedimentation was restricted largely to the Mimosa Syncline, the Wandoan Formation covered much of the Southern Roma Shelf (see Fig. 7) and is found in many of the oil wells immediately overlying Timbury Hills Formation.

During the Permian and Triassic, subsidence and sedimentation reached their maximum in the Mimosa Syncline. At the end of the Triassic, a period of erosion and base-levelling set in.

Sedimentation resumed in the Lower Jurassic with the deposition of a thin veneer of stream sands (Precipice Sandstone) followed by a period of dominantly lacustrine and deltaic sedimentation (Evergreen Formation).

SURAT G 55-16



Scale 1:1,000,000

0 10 20 30 Miles

QUATERNARY		Q	Soil and sand cover, alluvium
TERTIARY		T	Quartzose sandstone
		Czw	Deep weathering profile
CRETACEOUS	Griman Creek Beds	Klg	Labile sandstone, siltstone, minor mudstone
	Coreena Member, Wallumbilla Formation	Klc	Siltstone, labile sandstone, carbonaceous mudstone

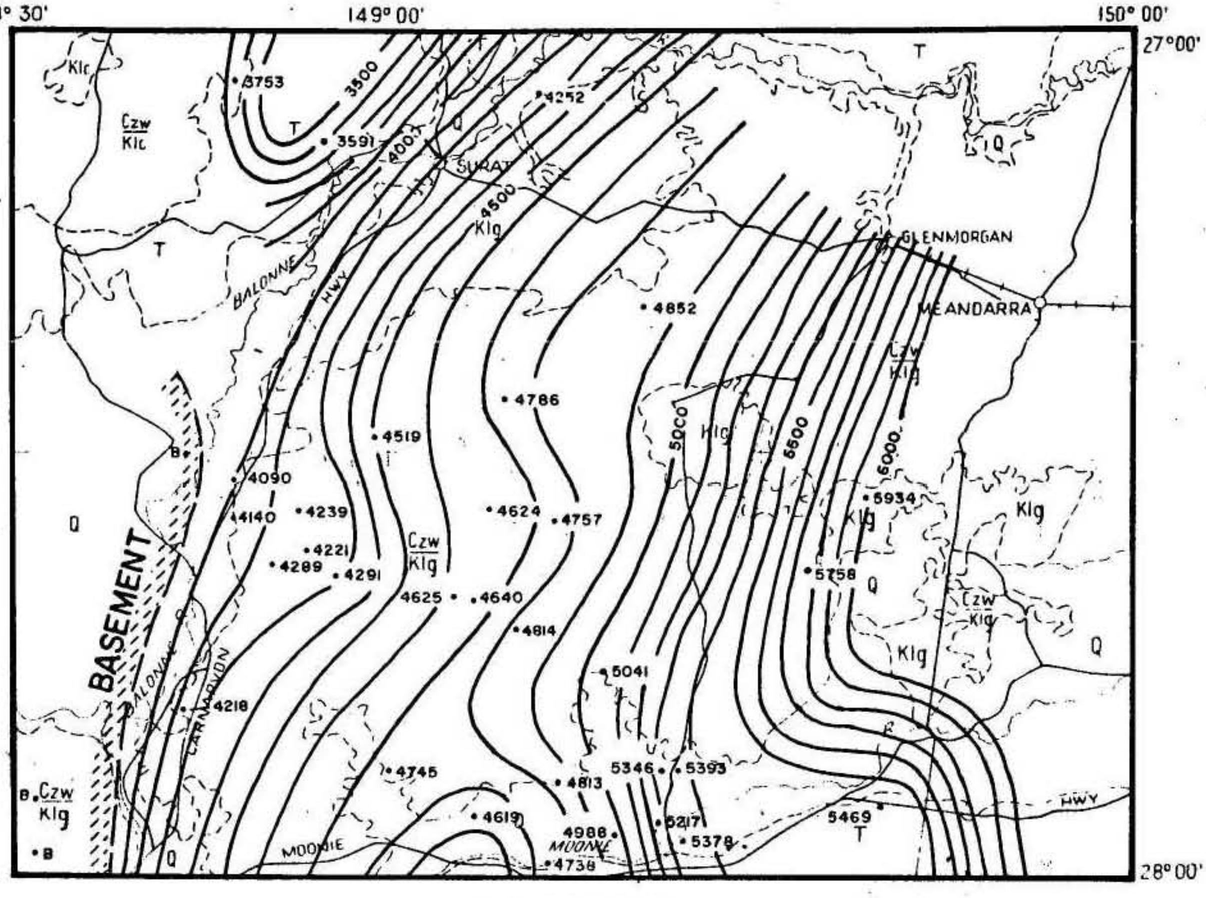
STRUCTURE CONTOURS - TOP BIRKHEAD

Based on Oil Well Data

3500 **Feet below S.L.**

•3532 **Oil Well**

SURAT G 55-16



Scale 1:1,000,000

0 10 20 30 Miles

QUATERNARY	Q	*Soil and sand cover, alluvium*
TERTIARY	T	*Quartzose sandstone*
	Czw	*Deep weathering profile*
CRETACEOUS Grimán Creek Beds	Klg	*Labile sandstone, siltstone, minor mudstone*
Coreena Member (Wallumbilla Formation	Klc	*Siltstone, labile sandstone, carbonaceous mudstone*

STRUCTURE CONTOURS - TOP EVERGREEN

Based on Oil Well Data

Feet below S.L.

Evergreen - Basement onlap

Oil Well

A few thin fluviatile horizons occur within the Evergreen Formation (Boxvale Sandstone Member) equivalents and the presence of oolites and acritarchs suggests marine influence, at least for a few brief periods. Marine muds within the Evergreen Formation have been suggested as the source of petroleum now found in the Precipice and Boxvale Sandstones.

The clean quartzose sand of the Hutton Sandstone marks a return to generally fluviatile conditions. The Precipice-Evergreen-Hutton sequence onlaps progressively higher on to the Southern Roma Shelf. On the western boundary of the Sheet area, the Hutton Sandstone rests unconformably on the Timbury Hills Formation. The transition upwards to the Middle Jurassic Birkhead Formation varies from transitional (in the far north of the Sheet area) to abrupt. This formation consists mainly of lacustrine mudstone and coal. The post-Birkhead sediments of the Injune Creek Group are a mixture of fresh water deltaic, lacustrine and fluviatile sandstone, siltstone and mudstone. Non-marine deposition continued in the Upper Jurassic with the coarse quartzose Gubberamunda Sandstone which is typically fluviatile. It is succeeded by the Orallo Formation, a unit formed in conditions varying from fluviatile and deltaic to lacustrine and paludal. The apparently conformable Lower Cretaceous began with a period of stream sedimentation (Mooga Sandstone Member of the Blythesdale Formation) grading upwards to mixed fluviatile and lacustrine conditions (Kingull Member, Nullawurt Sandstone Member). Marine horizons occur in the uppermost Blythesdale Formation (Minmi Member), marking the beginning of a major transgression. Shallow marine conditions were fully established over a large area during Doncaster times.

The deposition of the Doncaster mudstones was probably initiated by the falling off of the supply of coarser grained detritus in a low-energy shallow marine basin. The basal part of the Coreena Member is seen as the regressive phase of the marine inundation, with the establishment of brackish or freshwater conditions during deposition of the uppermost Coreena sediments; the coarser grain size probably indicates minor uplift in the source areas. The Klz - Griman Creek succession is regarded as being directly analagous to the preceding Doncaster - Coreena sequence although the evidence (see "Shallow Stratigraphic Drilling") is much less certain.

Deposition of the Griman Creek Beds was followed by a long period of stability in ?Upper Cretaceous times, when peneplanation of the land surface and deep weathering of surface sediments occurred; following the deep weathering phase and slight regional tilting to the southeast, the main features of the present drainage system were established, and Tertiary alluvia were deposited. Deposition of the Quaternary sediments in the valleys of present streams followed.

Phases of volcanism occurred during the Permian, Triassic and Upper Jurassic (Orallo Formation).

Table 3 summarizes the stratigraphic succession in the Surat Sheet area.

ECONOMIC GEOLOGY

Oil and Gas

In spite of an intensive drilling programme in the Surat Sheet area, significant finds of hydrocarbons are restricted to the eight oil wells of the Alton field, and U.K.A. Major No. 1 (gas well). Traces and shows of oil or gas have been found in many of the other exploratory wells. Occurrences of hydrocarbons are restricted to a few horizons.

The Wandoan Formation commonly gives traces or shows of oil or gas in this area (Table 2). In particular the basal section of this formation seems to be the most common reservoir. The basal sands of the Wandoan Formation on Roma Sheet have been correlated on the basis of detailed petrological work by Bastian and Arman (1965) with the Clematis Sandstone, which crops out on the northern margin of the Surat Basin. From lithological and wrieline logs alone it has not been possible to distinguish the Moolayember Formation and the Clematis Sandstone everywhere in the Surat Sheet area. Consequently, U.K.A.'s nomenclature (Wandoan Formation) is retained (see "Subsurface Units").

Shows of oil and gas have been found in the Triassic Rewan Formation (U.K.A. Kinkabilla No. 1, U.K.A. Myall Creek No. 1) and in the Permian sequence (U.K.A. Myall Creek No. 1, U.K.A. Alton East No. 1). The Precipice Sandstone, the main reservoir of the Moonie oilfield, is very thin in the Surat Sheet area. A gas show was recorded at this level in U.K.A. Colgoon No. 1. A trace of gas from the Hutton Sandstone was recorded in U.K.A. Balonne No. 1.

The oil sand of the Alton field is possibly a correlate of the Boxvale Sandstone Member, a sandy interval of the Evergreen Formation. It is also possible that this is the Precipice Sandstone, as both units contain similar microfloras. Gas flowed at the rate of 1.8 MMcf/day from the basal Wandoan Formation in U.K.A. Major No. 1. A summary of hydrocarbon occurrences and their stratigraphic level is included in Table 2.

The most likely source of hydrocarbons in the Surat Basin is regarded as the Evergreen Formation, although there is no conclusive evidence that this is a marine unit. De Jersey (1965) has extracted spores typical of the upper Evergreen Formation from Moonie oil, which is found in the Precipice Sandstone, suggesting downwards migration of fluids. The marine Back Creek Group is also a possible source for petroleum. A show of hydrocarbons was recorded at this level in U.K.A. Alton East No. 1.

Exploratory drilling in the Surat Sheet area has been restricted largely to structural highs on the southern Roma Shelf. The Mimosa Syncline, in the east of the Sheet area, is largely unexplored, although three wells (U.K.A. Flinton No. 1, U.K.A. Coomrith No. 1, U.K.A. Kinkabilla No. 1) have been drilled on the western flank of this structure. Flows of gas at 0.01 MMcf/day and 0.05 MMcf/day were recorded from the Rewan Formation in U.K.A. Kinkabilla No. 1. Oil has also been found in the Mimosa Syncline on Roma Sheet area (U.K.A. Conloi No. 1).

The Precipice Sandstone, a major reservoir in oilfields to the north and east of the Surat Sheet area, is greatly reduced in thickness on the southern Roma Shelf. In the various subsidized well completion reports, Union Oil Development Corporation geologists did not distinguish the Precipice Sandstone. Detailed study of cores and cuttings by Fehr (1965) showed that the unit was present in all wells studied by him (U.K.A. Weribone No. 1, U.K.A. Wunger No. 1, U.K.A. Coomrith No. 1., U.K.A. Flinton No. 1) although in places it was as thin as 12 feet. Although no further petrological work has been done, electric log correlation of subsidized wells in this report suggests that the unit is present on the Southern Roma Shelf, although everwhere less than 100 feet thick. No significant finds of hydrocarbons have been made in the Precipice Sandstone in the Surat Sheet area.

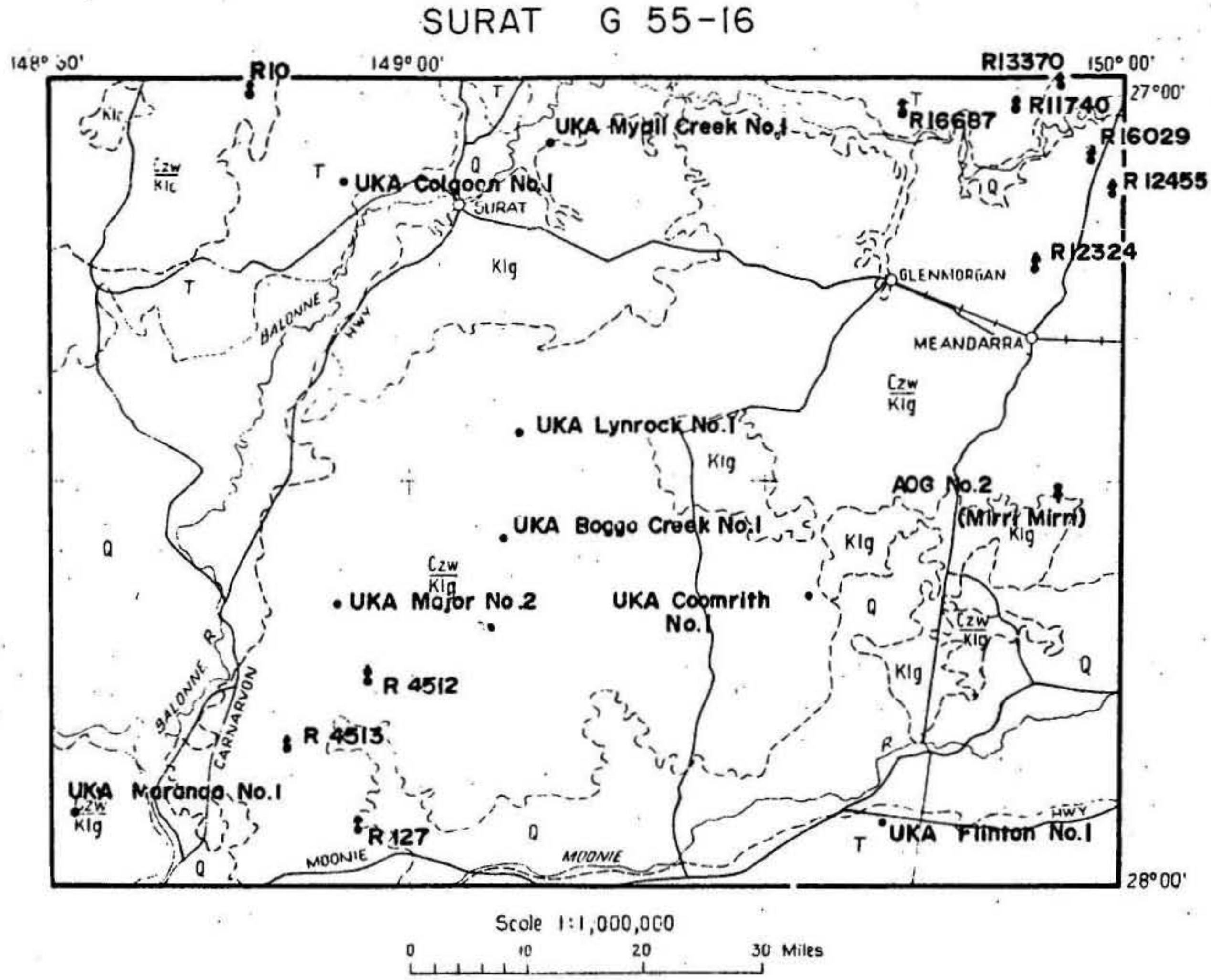
Water

Surface water supplies on the Surat Sheet area are generally inadequate, especially when rainfall is below average; the Balonne - Condamine River system is a reliable local source of water for stock watering, but lacks the volume to support large-scale irrigation.

Underground water reserves in the area have been tapped by numerous water bores, which fall into two categories: shallow bores (depth less than 1,000'), generally of small capacity, rarely flowing at the surface, tapping aquifers of purely local extent; deep bores (depth greater than 1,000'), generally flowing bores of large capacity which penetrate aquifers of basin-wide significance.

(a) Shallow bores

The stratigraphic level of aquifers encountered in shallow bores can only be located approximately on general structural considerations, since little reliance can be placed on the drillers' logs.



QUATERNARY		Q	*Soil and sand cover, alluvium*
TERTIARY		T	*Quartzose sandstone*
		Czw	*Deep weathering profile*
CRETACEOUS	Griman Creek Beds	Klg	*Labile sandstone, siltstone, minor mudstone*
	Coreena Member Wallumbilla Formation	Klc	*Siltstone, labile sandstone, carbonaceous mudstone*

WATER BORES DEEPER THAN 1000 FEET

and selected oil wells

(see Pl. 4)

Sixty wells were studied. The positions of the wells were plotted on the Surat 1:250,000 Sheet; wells which lay along lines approximately parallel to the regional strike were treated as separate groups, and depths at which water was struck were plotted on a graph for each group, using sea level as datum. Fifty of the sixty wells are located in the north-western corner of the Sheet area around Surat; of these, thirty draw water from a common aquifer in the basal Griman Creek Beds, seven from various strata in the basal Coreena Member, and thirteen from within the unnamed mudstone Klz. In the south-east the remaining wells produce from the Griman Creek Beds, but the occurrences are more scattered, suggesting local developments of porosity and permeability in the probably finer and dirtier sediments of the syncline,

Rate of flow from these wells is generally of the order of several hundred gallons per hour; quality varies widely, from fresh to quite salt, but the supplies are generally usable for stock watering.

(b) Deep bores

Thirteen deep bores produce water in the Surat Sheet area; several oil bores have been selected to facilitate correlation of the water-bearing strata; positions of both water and oil bores considered are plotted on Figure 16; depths to water in the water bores and the known stratigraphic successions in the oil bores, are shown on Plate 4, using sea level as datum.

The bores fall into five geographical and stratigraphical groups:

(i) those in the north-east (R12324, R12455, R16029, R13370, R11740 and R16687), which do not exceed 3,000 feet in depth, and tap aquifers in the Minmi-Mooga interval;

(ii) those in the south-west (R4512, R4513, R127, and the oil bore U.K.A. Maranoa No. 1, now plugged to produce water); these bores are up to 5,000 feet deep and draw water from the Mooga - Gubberamunda interval;

(iii) the converted oil bores, A.O.G. No. 2 (Mirri-Mirri) and U.K.A. Flinton No. 1; Mirri-Mirri, on the eastern edge of the Sheet area, near the wells of group (i), produces both from the upper Minmi-Mooga interval, and from the middle Orallo-Gubberamunda interval; flow from the upper level is much less than that from wells in group (i), suggesting that the upper aquifers have become tighter to the south; U.K.A. Flinton No. 1 was plugged in the upper Westbourne Formation, probably drawing its water from the same strata which supply the main flow in Mirri-Mirri; these lower aquifers are probably those which supply water for wells in group (ii).

(iv) one well, R. 10 (Borah Trust) which was drilled in the north-west, in the area of the most numerous successful shallow wells on the Sheet area; minor flows were struck in the Coreena Member of the Wallumbilla Formation and in the Minmi Member of the Blythesdale Formation; the main flow in this well is from lower Birkhead-? Eurombah interval;

(v) the converted oil well U.K.A. Major No. 1, the deepest water bore on the Sheet area, which produces from the Wandoan Formation.

Construction Material

There is a general dearth of good road metal in the Surat area. The Warroo Shire Council is forced to buy gravel and basalt aggregate from quarries to the north on Roma Sheet.

Quaternary and ?Tertiary gravel is quarried along Yalebone Creek, north-west of Surat township. Along the Carnarvon Highway about 20 miles north of St. George, gravel pits have been opened in the ironstone capping which is commonly found overlying the deep weathering-profile. This disaggregated ferruginous rubble is only two to three feet thick and may be a fossil soil horizon. A sample analyzed by D.W. Bennett of the B.M.R. chemical laboratory gave the following results -

SiO_2	36.4%
Fe_2O_3	34.3%
Al_2O_3	19.3%
Loss at $1000^{o}c$	9.4%

Road-building material is quarried from the mottled and leached zones of the deeply weathered Griman Creek Beds on Mount Walpanara (near Surat) and other similar ridges of altered sediment.

Opal

Opal Mining was carried out in the Griman Creek deep weathering-profile on two properties in the centre of the Sheet area, during the early years of the century. No official record of the mining exists, and local information suggests that little opal of commercial value was obtained.

Quite extensive diggings are to be seen on "Mamaree" station (about ten shafts, some with adits), while several shafts and adits were dug on what is now "Beechwood" station. Most of the opal is concentrated near the base of the deep weathering-profile; precious opal generally occurs as minute specks, in ironstone concretions or infillings of cracks; individual pockets of common opal attain larger dimensions and have a much wider occurrence in this basal zone of the profile.

ACKNOWLEDGMENTS

The authors wish to thank various geologists for helpful discussions. Special mention must be made of the geologists of Union Oil Development Corporation who provided us with data and ideas. Also of Mr. R.W. Day (palaeontologist, Australian National University) and Mr. D. Burger (palynologist, Bureau of Mineral Resources). Messrs. N.F. Exon, R.R. Vine and W.J. Perry of the Bureau of Mineral Resources helped us to classify our ideas.

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APPENDIX I.

SHALLOW STRATIGRAPHIC DRILLING, SURAT SHEET AREA, 1967.

by

B.M. Thomas

During the 1967 field season a total of 4 stratigraphic holes were sited on the Surat Sheet area (B.M.R. Surat Nos. 1-4), and an additional one in the far south-west of Romas Sheet area (B.M.R. Roma No. 9) was drilled to aid in correlation between the two areas. A Mayhew 1000 rig from the Petroleum Technology section of the B.M.R.was used. The drilling party was equipped with 500 feet of pipe and a 10 foot core barrel. Although a number of faults developed during the season, four of the holes were electrically logged with a Widco Portalogger, and in B.M.R. Surat No. 3 a gamma ray log was also obtained. No log was made of B.M.R. Surat No. 4 as the logger was not working. The holes were drilled to obtain lithological and palynological information on the poorly exposed Cretaceous section of the Surat Sheet area. Subsequent work has shown that the sequence drilled is stratigraphically higher than that of the Roma Sheet area, and two new units have been distinguished.

Cores and cuttings were re-examined by binocular microscope in Canberra and described. Logs of the holes are in the body of this record. Material from each of the 18 cores was examined for microfossils. Palynological results are contained in Burger (in prep.). A few foraminifera and ostracoda recovered from cores are described in Appendix III and Appendix V.

Hole	Total Depth	Drilling	Coring	No. of cores	Core Recovery Feet	%
B.M.R. Roma No. 9	357'	317'	40'	4	32' 2"	80
B.M.R. Surat No. 1	430'	380'	50'	5	39' 8"	79
B.M.R. Surat No. 2	142'	135'	7'	1	0'11"	13
B.M.R. Surat No. 3	465'	415'	50'	5	42' 6"	85
B.M.R. Surat No. 4	310'	280'	30'	3	17'10"	60
Total	1704'	1527'	177'	18	133'	75

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APPENDIX II

PALYNOLOGICAL EXAMINATION OF THREE LOWER CRETACEOUS SAMPLES FROM U.K.A. COOMRITH NO. 1. WELL

by

D. Burger

Three samples from cuttings, age marine Lower Cretaceous, were examined for spores, pollen grains and microplankton to obtain a detailed micro-floral age determination within the marine Lower Cretaceous portion of the penetrated sequence.

The lithology in the 800-2250 feet interval is predominantly clayey and silty, while sandy intercalations occur in the 820-1000 feet and 1450-1700 feet intervals. The samples were taken from the following intervals and are regarded as belonging to the Wallumbilla Formation.

Sample No. (MFP)	Depth intervals
4631	900-910 feet
4632	1100-1110 "
4633	1480-1490 "

All three microfloras contained Cicatricosisporites australiensis and Crybelosporites striatus, so that they belong to spore unit K 1d. The presence of Trilobosporites trioreticulosus and Laevigatosporites ovatus in sample 4631 may indicate an upper K 1 d age, while the absence of Coptospora paradoxa excludes the possibility of a younger age for this assemblage.

L. ovatus and T. trioreticulosus also occur in the (poorly preserved) microflora of sample 4633, together with Osmundacidites cf. mollis, which is mainly known from K 1b-c and K 1d microfloras in the Surat and Eromanga Basins. T. trioreticulosus was previously reported from post K 1d microfloras only, but has recently been recovered from samples collected in the Surat Basin that yielded K 1d microfloras.

Microplankton was recovered from every sample, the richest assemblages occurring in samples 4633 and 4632. Both assemblages contained Muderongia tetracantha, Odontochitina operculata, Goniaulax edwardsii, while sample 4633 yielded Muderongia mcwhaei. This combination is typical of the M. tetracantha/O. operculata Dinoflagellate Zone. The fraction of microplankton in the microfloras decreases from 8% in sample 4633 to about 1% in sample 4631. This has also been noticed from other localities in the Surat Basin, mainly in the upper part of the Zone, and seems to be connected with gradually reducing marine influences during sedimentation.

Spore unit K 1d is widely known from the Coreena Member in the Surat and eastern Eromanga Basins. As microfloras of K2a age have been found in uppermost Coreena strata, it may be accepted that the range of K1d lies within the Member.

The <u>M. tetr./O. op</u>. Dinoflagellate Zone is also known from the Coreena Member, while the overlying Toolebuc Limestone is known to yield microplankton belonging to the <u>O. operculata</u> Zone. Recent investigations in the Eromanga Basin confirm the close identify of the range of K 1d and the <u>M. tetr./O.op</u>. Zone.

Samples from cuttings are usually contaminated with rock fragments from various depths and the microfloras extracted contain elements foreign to the studied depth interval. Casing of the Coomrith hole down to 800 feet, before the drilling was resumed and the cuttings in question were collected, considerably diminished the risk of contamination. The microfloras discussed do not show signs of significant contamination, so that age determination is considered as reliable. According to the evidence, the samples can be attributed to the Coreena Member. Various indications pointing to the upper part of both spore and microplankton units increase the probability that at least sample 4631, maybe all three samples, should be regarded as upper Coreena.

APPENDIX III

LOWER CRETACEOUS (ALBIAN) OSTRACODA IN BMR SCOUT BORE NO 1, SURAT, SURAT BASIN, QUEENSLAND

by

P.J. Jones

Ostracods found by Dr G.R.J. Terpstra in BMR Scout Bore 1 (Surat), core 5 (423 feet 8 inches - 428 feet 3 inches), have been examined and determined as a species belonging to the broad group related to "Cythere" concentrica Reuss, 1846. Recent studies of this group (Mertens, 1956; Ellermann, 1962; Kaye, 1963, 1964) have demonstrated its value for Cretaceous stratigraphy.

The forms studied in core 5, BMR Scout Bore 1 (Surat), have a hinge structure similar to that of Neocythere Mertens, 1956, and an ornamentation close to that of "Cythere" semi - concentrica Mertens, 1956. This species has been previously described from the middle Albian of northwestern Germany (Mertens, 1956); whether it indicates this age in the Surat Basin, however, depends on its stratigraphical range in Australia.

The specimens may be conspecific with a species found in Karumba AAO No. 8 well, core 2 (2191-2194 feet 5 inches), which on palynological evidence is close to the Aptian/Albian boundary (Evans, 1966; Terpstra & Evans, 1962). The Karumba specimens are larger, and probably represent a more mature stage of the same species. Details of its hinge-structure and contact margin are lacking, as it is known only from whole carapaces.

The Surat specimens are quite distinct from those found in the Albian of Ooroonoo No. 1 core 6 (1252-1262 feet), which probably belongs to a new species and subgenus of Neocythere. Also, the BMR Scout Bore 1 specimens can be distinguished from Upper Cretaceous species of the concentrica - group in Port Campbell No. 1 (4850-4860 feet), Turonian?, Otway Basin, Victoria, in the Gingin Chalk (Santonian) of the Perth Basin (Chapman, 1917), and in the Toolonga Calcilutite (Santonian) of the Murchison River area, Western Australia (Belford, 1960).

Summarising, the ostracod specimens found in BMR Scout Bore 1 (Surat) are determined as Neocythere sp. cf. "Cythere" semiconcentrica Mertens, 1956, which by correlation with Germany suggests a middle Albian age. Interbasinal correlation in Australia, based on palynological evidence however, opens the possibility of an age close to the Aptian/Albian boundary. Thus, an early to middle Albian age is suggested. A freshwater environment can be excluded.

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APPENDIX IV by P.G. DUFF

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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. ROMA (BMR SCOUT) NO. 9 DATE ANALYSIS COMPLETED 9th MAY 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	Stratigraphic unit
	From	To			V	H	Dry Bulk	Apparent Grain	Water	Oil				
1	97' 1"	97' 7"	Shale	29	N.D.	N.D.	1.84	2.68	N.D.	N.D.	N.D.	Neg.	Nil.	Coreena Member
2	197' 4"	197'10"	"	21	"	"	2.05	2.69	"	"	"	"	"	" "
3	260' 1"	260' 8"	"	21	"	"	2.03	2.65	"	"	"	"	"	Doncaster Member
4	353' 4"	353'10"	Sandstone	32	42	120	1.82	2.71	"	"	"	"	"	" "

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 (B.M.R.) SCOUT No.1

DATE ANALYSIS COMPLETED 12th August, 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	FORMATION NAME
	From	To			V	H	Dry Bulk	Apparent Grain	Water	Oil				
1A	18'6"	19'1"	silty claystone	34	N.D.	N.D.	1.83	2.78	N.D.	N.D.	N.D.	Neg.	Nil	Coreena Member, Wallumbilla Formation.
1B	23'7"	2'4"	"	36	N.D.	1.2	1.71	2.68	N.D.	N.D.	N.D.	Neg.	Nil	" "
2	63'6	63'10	clayey sandstone	43	N.D.	N.D.	1.52	2.67	N.D.	N.D	N.D.	Neg	Nil	" "
3A	137'	137'4"	silty claystone	41	N.D.	103*	1.71	2.91	N.D.	N.D.	N.D.	Neg	Nil	" "
3B	143'	143'7"	clayey sandstone	39	N.D.	N.D.	1.72	2.82	N.D.	N.D.	N.D.	Neg.	Nil	" "
4A	213'11	214'7"	silty sandstone	39	N.D.	26	1.78	2.93	N.D.	N.D.	N.D.	Neg.	Nil	" "
4B	216'10	217'3"	"	36	N.D.	57	1.79	2.81	N.D.	N.D.	N.D.	Neg.	Nil	" "
5A	421'1"	421'8"	clayey siltstone	34	N.D.	N.D.	1.74	2.72	N.D.	N.D.	N.D.	Neg.	Nil	Doncaster Member, Wallumbilla Formation.

Remarks: - * Fractured.

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 (B.M.R.) SCOUT No.1 and No.2

DATE ANALYSIS COMPLETED 12th August, 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	FORMATION NAME
	From	To			V	H	Dry Bulk	Apparent Grain	Water	Oil				
5B	426'2"	426'7"	silty claystone	34	N.D.	N.D.	1.83	2.85	N.D.	N.D.	N.D.	Neg.	Nil	Doncaster Member, Wallumbilla Formation.
					SURAT	(B.M.R.)	SCOUT	No.2.						
1	135'6"	135'11"	silty claystone	36	N.D.	N.D.	1.89	2.96*	N.D.	N.D.	N.D.	Neg.	Nil	Unnamed Mudstone, Klz.

Remarks: - * Fractured

Internal File No. [illegible]
Well File No.

APPENDIX V

MICROPALAEONTOLOGICAL EXAMINATION OF SAMPLES FROM THE SURAT AREA

SUBMITTED BY B.M. THOMAS

by

G.R.J. Terpstra

B.M.R. Scout Bore Surat No. 1 (Queensland)

Core 1	23' 1"	-	25 feet	No foraminifera
Core 2	60'	-	64' 3"	No foraminifera
Core 3	135'	-	140' 7"	No foraminifera
Core 3	142' 6"	-	144'	No foraminifera-Megaspores-(Lower Cretaceous)
Core 4	210'	-	220' 5"	No foraminifera
Core 5	420'	-	428' 3"	*Textularia* sp. Fish tooth, ostracods, shell fragments, megaspores (Lower Cretaceous). Shallow marine deposits.

B.M.R. Scout Bore, Surat No. 2 (Queensland)

Core 1	135'	-	135'11"	*Textularia* sp. shell fragments, ostracods, (Lower Cretaceous). Shallow marine deposits.

B.M.R. Scout Bore Surat No. 3 (Queensland).

Core 3	246' 9"	-	246'10"	Megaspores. No foraminifera.
Core 4	351'11"	-	352'	No foraminifera. (Lower Cretaceous)

B.M.R. Scout Bore, Roma No. 9 (Queensland)

Core 1	101' 5"	-	101' 6"	*Lenticulina warregoensis* Crespin *Valvulineria* cf. *crespinae* Ludbrook *Trochaminna* sp. *Nodosaria* sp. Ostracods

(Lower Cretaceous probably near the Albian - Aptian boundary)

Marine deposits.

APPENDIX 6 FORMATION TOPS (SUBSIDIZED WELLS) - AUTHORS' PICKS

UNIT	A.A.O. Brucedale 1		U.K.A. Colgoon 1		U.K.A. Myall Ck 1		U.K.A. Weribone 1		U.K.A. Lynrock 1		U.K.A. Boggo Ck.1		U.K.A. Bidgel 1		U.K.A. Wunger 1	
	Tops	Thickness	Tops	Thickness	Tops	Thickness	Tops	Thickness	Tops	Thickness	Tops	Thickness	Tops	Thickness	Tops	Thickness
Griman Creek Beds											-	700	-	780	-	890
Unit Klz											700	465	780	480	890	440
Coreena Member	+ 60	380					1090	350	1160	340	1165	220	1260	205	1330	230
Doncaster Member	440	272	540	480	830	240	1440	400	1500	340	1385	465	1465	545	1560	440
Minmi Member	712	198	1030	225	1070	310	1840	180	1840	280	1850	340	2010	200	2000	340
Nullawurt Member	910	35	1255	45	1380	60	2020	50	2120	55	2190	85	2210	40	2340	120
Kingull Member	945	169	1300	115	1440	90	2070	220	2175	150	?2275	70	2250	70	2460	220
Mooga Sandstone Member	1114	494	1415	560	1530	510	2290	690	2325	610	2345	670	2320	795	2680	510
Orallo Formation	1608	435	1975	330	2040	540	2980	430	2935	460	3015	220	3115	170	3190	230
Gubberamunda Sandstone	2043	293	2305	575	2580	360	3410	560	3395	665	3235	785	3285	895	3420	760
Westbourne Formation	2336	254	2880	235	2940)	550	3970	260	4060)	455	4020	215	4180)	510	4180	250
Springbok Sst. Member	2590	380	3115	155	N.R.)		4230	320	N.R.)		4235	265	N.R.)		4430	180
Birkhead Formation	2970	698	3270	645	3490	850	4550	740	4515	690	4500	650	4690	610	4610	618
Eurombah Beds	3668	77	3915	40	4340	80	N.R.		N.R.		N.R.		N.R.		N.R.	
Hutton Sandstone	3745	530	3955	465	4420	650	5290	650	5205	535	5150	442	5300	580	5228	419
Evergreen Formation	*4500	268	4420	275	5070	570	5940	340	5740	260	5592	218	5880	197	5647	195
Boxvale Sandstone Member	N.R.		4575-4610	35	5410-5440	30	6070-6090	20	5870-5910	40	5740-5760	20	N.R.		N.R.	
Precipice Sandstone	4768	10	4695	25	5640	55	6280	12	6000	15	5810	30	6077	83	5842	77
Wandoan Formation	4778	332	4720	105	5695	405	6292	857	6015	615	5840	400	6160	355	5919	387
Rewan Formation	N.P.		N.P.		6100	285	7149	297	N.P.		N.P.		N.P.		N.P.	
Blackwater Group	N.P.		N.P.		6385	710	7446	314	6630	180	N.P.		N.P.		N.P.	
Back Creek Group	N.P.		N.P.		N.P.		N.P.		N.P.		N.P.		N.P.		N.P.	
Kuttung Formation	N.P.		N.P.		N.P.		N.P.		N.P.		N.P.		N.P.		N.P.	
Granite	5110	-	4825	-												
Timbury Hills Fm.					7095	-	7760	-	6810	-	6240	-	6515	-	6306	-
	TD = 5255		TD = 4873		TD = 7159		TD = 7995		TD = 6869		TD = 6257		TD = 6525		TD = 6337	
	KB = 976		KB = 829		KB = 818		KB = 1115		KB = 954		KB = 968		KB = 1123		KB = 1007	

UNIT	U.K.A. Alton 1		U.K.A. Flinton 1		U.K.A. Coomrith 1		U.K.A. St George 1		U.K.A. Maranoa 1		U.K.A. Moombah 1		U.K.A. Cabawin 1	
	Tops	Thickness	Tops	Thickness	Tops	Thickness	Tops	Thickness	Tops	Thickness	Tops	Thickness	Tops	Thickness
Griman Creek Beds	-	1090					-	945	-	970	-	720		
Unit Klz	1090	310			1000	310	945	225	970	320	720	345		
Coreena Member	1400	390	1070	420	1310	320	1170	360	1290	205	1065	250	170	485
Doncaster Member	1790	345	1490	570	1630	550	1530	205	1495	225	1315	450	655	880
Minmi Member	2135	355	2060	360	2180	330	1735	240	1720	210	1765	435	1535	105
Nullawurt Member	2490	80	2420	90	2510	50	1975	65	1930	70	2200	70	1640	80
Kingull Member	2570	110	2510	340	2560	210	2040	200	2000	225	2270	255	1720	160
Mooga Sandstone Member	2680	665	2850	750	2770	700	2240	650	2225	405	2525	535	1880	165
Orallo Formation	3345	260	3600	260	3470	490	2890	110	2630	85	3060	80	2045	820
Gubberamunda Sandstone	3605	800	3860	620	3960	640	3000	630	2715	965	3140	825	2865	480
Westbourne Formation	4405)	505	4480)	590	4600)	640	3630)	440	3680)	420	3965	210	3345)	855
Springbok Sst. Member	N.R.)		N.R.)		N:R.)		N.R.)		N.R.)		4175	185	N.R.)	
Birkhead Formation	4910	542	5070	667	5240	758	4070	378	4100	300	4360	500	4200	1245
Eurombah Beds	N.R.		N.R.		N.R.		N.R.		N.R.		N.R.		N.R.	
Hutton Sandstone	5452	490	5737	565	5998	635	4448	136	4400	310	4860	470	5445	650
Evergreen Formation	5942	268	6302	345	6633	345	N.P.		N.P.		5330	120	6095	596
Boxvale Sandstone Member	6060-6125	65	6440-6510	70	6810-6820	10	N.P.		N.P.		N.R.		6270-6300	30
Precipice Sandstone	6210	15	6647	58	6978	78	N.P.		N.P.		5450	95	6691	334
Wandoan Formation	6225	630	6705	1205	7056	1356	N.P.		N.P.		5545	218	7025	615
Rewan Formation	N.P.		7910	390	8412	-	N.P.		N.P.		N.P.		7640	2195
Blackwater Group	6855	207	8300	565	N.P.		N.P.		N.P.		N.P.		9835	520
Back Creek Group	7062	165	8865	165	N.P.		N.P.		N.P.		N.P.		10355	1310
Kuttung Formation	7227	-	9030	-	N.P.		N.P.		N.P.		N.P.		11665	-
Granite														
Timbury Hills Fm.							4584	-	4710	-	5763	-		
	TD = 7328		TD = 9123		TD = 8426		TD = 4695		TD = 4739		TD = 5863		TD =12035	
	KB = 725		KB = 833		KB = 875		KB = 690		KB = 699		KB = 713		KB = 968.2	

Brucedale 1:
+ Tertiary 0-60
* Gabbro 4275-4500

N.R. = Not Recognised, i.e. unit cannot be distinguished. No break in the record is implied.

N.P. = Not Present, i.e. unit either not deposited or eroded after deposition.

APPENDIX 7. FORMATION TOPS (UNSUBSIDIZED WELLS) - COMPANY & G.S.Q. PICKS

UNIT	U.K.A. Balonne 1	U.K.A. Katoota 1	U.K.A. Kincora1	U.K.A. Donga 1	U.K.A. Warroo 1	U.K.A. Elgin 1	U.K.A. Moullit 1	U.K.A. Major 1	U.K.A. Wanganui1	U.K.A. Glenearn1	U.K.A. Goulamain1	U.K.A. Thomby 1	U.K.A. Yoorooga1	U.K.A. Altonvale1	U.K.A. Tralee1	U.K.A. Dalkeith1	U.K.A. Alton W.1	U.K.A. Kooroon1	U.K.A. Kooroon2	U.K.A. Alton E.1	U.K.A. Kinkabilla 1
Griman Creek Beds																					
Unit Klz																					
Coreena Member																					
Doncaster Member																					
Minmi Member			1220																		2245
Nullawurt Member																					
Kingull Member																					
Mooga Sandstone Member	2145	2366		2080	2150	2261	2067	2141	2320	2356	2707	2650	2640	2540	2541	2630	2655	2873	2880	2881	
Orallo Formation			2156																		3253
Gubberamunda Sandstone			2516																		4020
Westbourne Formation			2953																		4676
Springbok Sandstone																					
Birkhead Formation	3880	4167		3869	3957	4135	4083	4142	4179	4308	4663	4578	4640	4487	4561	4730	4713	5035	5047	5024	
Eurombah Beds																					
Hutton Sandstone	4284	4603	3928	4360	4456	4550	4607	4585	4592	4968	5093	5058	5194	4998	5062	5302	5235	5565	5617	5530	6260
Evergreen Formation		4933	4544	4849	4908	5068	5113	5102	5166	5416	5538	5603	5694	5442	5560	5850	5700	6110	6154	6100	6952
Boxvale Sandstone Member																					
Precipice Sandstone			4804																		7313
Wandoan Formation			4812	5082	5140	5310	5330	5314	5389	5684	5758	5872	5965	5684	5840	6116	5977	6427	6472	6375	7423
Rewan Formation																					7168
Blackwater Group													6376				6496	7120	7210	7112	10093
Black Creek Group																		7377			10556
Kuttung Formation														5904							11710
Granite																					
Timbury Hills Formation	4944	5023	4880	5193	5177	5441	5561	5546	5561	5934	5986	6233	6421		6120	6573	6682	7558		7554	
	TD=5004 KB= 775	TD=5072 KB= 715	TD=4896 KB= 791	TD=5236 KB =759	TD=5251 KB= 768	TD=5445 KB= 779	TD=5638 KB= 874	TD=5576 KB= 881	TD=5631 KB= 875	TD=5954 KB= 897	TD=6014 KB= 793	TD=6271 KB= 978	TD=6475 KB= 880	TD=5931 KB =704	TD=6159 KB= 747	TD=6678 KB =809	TD=6882 KB= 712	TD=7602 KB= 764	TD=7238 KB= 761	TD=7596 KB= 722	TD=11752 KB=1018

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

SURAT
QUEENSLAND

SHEET SG 55-16

Reference

CAINOZOIC	QUATERNARY		Qa	*Alluvium*
			Qs	*Unconsolidated sand, soil*
	UNDIFFERENTIATED		Czw	*Deep weathering profile*
	TERTIARY ?		T	*Quartzose sandstone, conglomerate, some clayey ferruginous sandstone*
MESOZOIC	LOWER CRETACEOUS	Rolling Downs Group: Grimon Creek Beds	Klg	*Labile sandstone, siltstone, minor mudstone, commonly glauconitic and calcareous. Shelly fossils, plant remains*
			Klz	*Carbonaceous mudstone and siltstone, commonly glauconitic and calcareous, minor sandstone. Plant remains* (Section only)
		Wallumbilla Formation: Coreena Member	Klc	*Siltstone and labile sandstone, commonly glauconitic and calcareous, carbonaceous mudstone. Shelly fossils*
		Doncaster Member	Kld	*Carbonaceous mudstone; minor siltstone and sandstone*
		Blythesdale Formation	Klb	*Quartzose to sublabile sandstone, in part glauconitic; siltstone, mudstone*
		Mooga Sandstone Member	Klm	*Quartzose sandstone, minor siltstone and mudstone*
	MIDDLE TO UPPER JURASSIC	Orallo Formation	Juo	*Sandstone, white clay matrix, minor siltstone, mudstone, and pebbly beds*
		Gubberamunda Sandstone	Jug	*Quartzose sandstone*
		Injune Creek Group	Ji	*Lithic to lithic-sublabile clayey sandstone, siltstone, minor mudstone*
		Birkhead Formation	Jmb	*Carbonaceous mudstone, coal, minor siltstone and lithic sandstone. Plant remains*
	LOWER JURASSIC	Hutton Sandstone	Jlh	*Quartzose sandstone, minor siltstone and mudstone*
		Evergreen Formation	Jle	*Carbonaceous mudstone and siltstone, minor sandstone and coal. Plant remains*
		Precipice Sandstone	Jlp	*Quartzose sandstone, minor siltstone and mudstone*
	TRIASSIC	Wandoan Formation	Rw	*Quartzose to lithic sandstone, siltstone, mudstone*
		Rewan Formation	Rlr	*Carbonaceous mudstone, green lithic sandstone, tuff*
PALAEOZOIC	UPPER PERMIAN	Blackwater Group	Puw	*Carbonaceous mudstone, tuff, coal*

(Kld to Puw: Section only)

Geological boundary, position approximate; where inferred, queried
Syncline, position approximate
Syncline, concealed
Fault, position approximate
Fault, concealed

SB411 *Macrofossil locality, with reference number*
Plant fossil locality

Dry hole, abandoned
Oil well
Abandoned well with show of oil
Gas well
Abandoned well with show of oil and gas
St *Stratigraphic hole*

Bore
R4419 *Abandoned bore, with I W S registered number*
Artesian bore, flowing
Sub-artesian bore
Well
E *Earth tank*
Dam on stream
WH *Waterhole*

Highway
Road
Vehicle track
Railway
Landing ground
"Janal" *Homestead;* OS, *outstation*
Building
Yd *Yard*
Town
Trigonometrical station
750 *Topographic form line in feet*

Compiled 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. David Fairbairn, Minister for National Development. Base map compiled by the B.M.R. from material supplied by the Royal Australian Survey Corps. Commonwealth aerial photography; complete vertical coverage at 1:85,000 scale
Transverse Mercator Projection

INDEX TO ADJOINING SHEETS
Showing Magnetic Declination

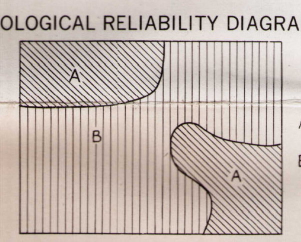
AUGATHELLA SG 55-6	EDDYSTONE SG 55-7	TAROOM SG 55-8	MUNDUBBERA SG 56-5	MARYBOROUGH SG 56-6
CHARLEVILLE SG 55-10	MITCHELL SG 55-11	ROMA SG 55-12	CHINCHILLA SG 56-9	GYMPIE SG 56-10
WYANDRA SG 55-14	HOMEBOIN SG 55-15	SURAT SG 55-16	DALBY SG 56-13	IPSWICH SG 56-14
CUNNAMULLA SH 55-2	DIRRANBANDI SH 55-3	SAINT GEORGE SH 55-4	GOONDIWINDI SH 56-1	WARWICK SH 56-2
ENNGONIA SH 55-6	ANGLEDOOL SH 55-7	MOREE SH 55-8	INVERELL SH 56-5	GRAFTON SH 56-6

ANNUAL CHANGE 2' E

Scale 1:250,000

5 0 5 10 15 MILES
5 0 5 10 15 20 25 KILOMETRES

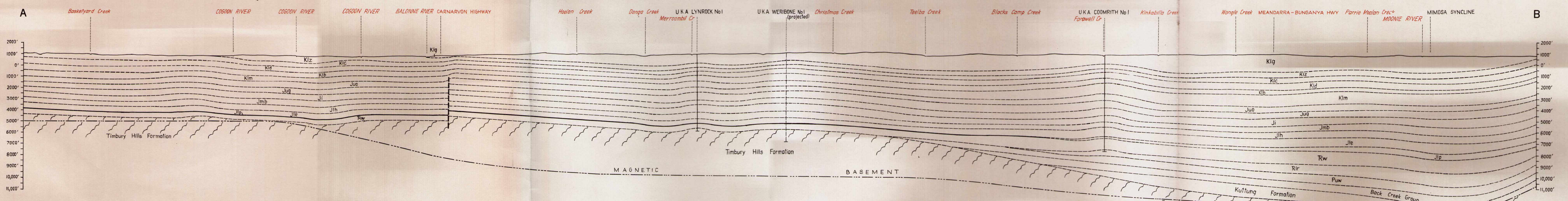
GEOLOGICAL RELIABILITY DIAGRAM



A Detailed reconnaissance
B General reconnaissance

Geology and compilation, 1967, by: B.M. Thomas (B M R) and R.F. Reiser (G S Q)
Cartography by: Geological Branch B M R
Drawn by: D.M. Pillinger

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



PRELIMINARY EDITION, 1968
SUBJECT TO AMENDMENT

SURAT
SHEET SG 55-16

Complimentary

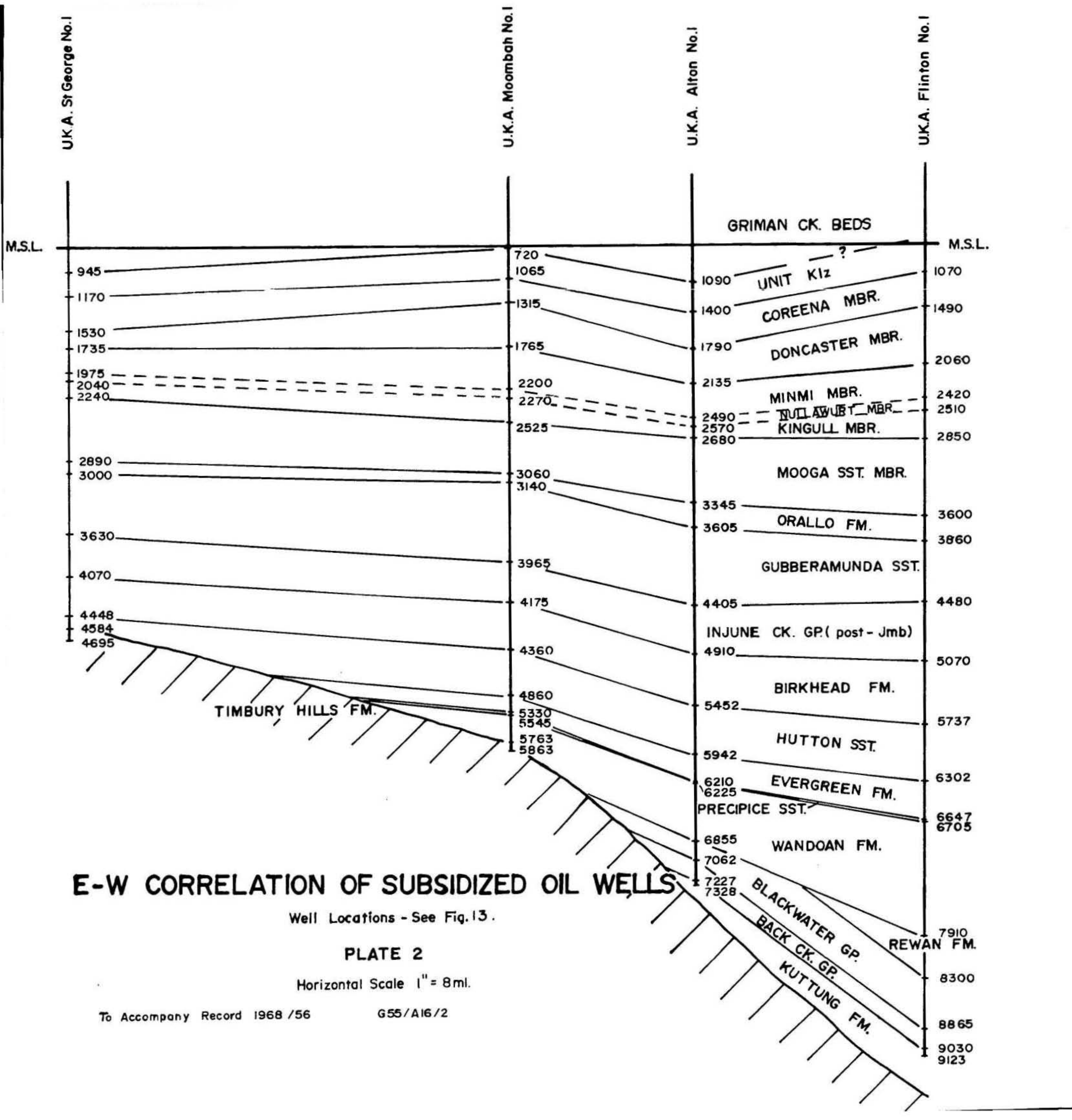
CORRELATION OF SUBSIDIZED OIL WELLS

Well Locations - See Fig. 13

Horizontal Scale 1"=8ml.

PLATE I

To Accompany Record 1968/56 G55/A16/19



E-W CORRELATION OF SUBSIDIZED OIL WELLS

Well Locations - See Fig. 13.

PLATE 2

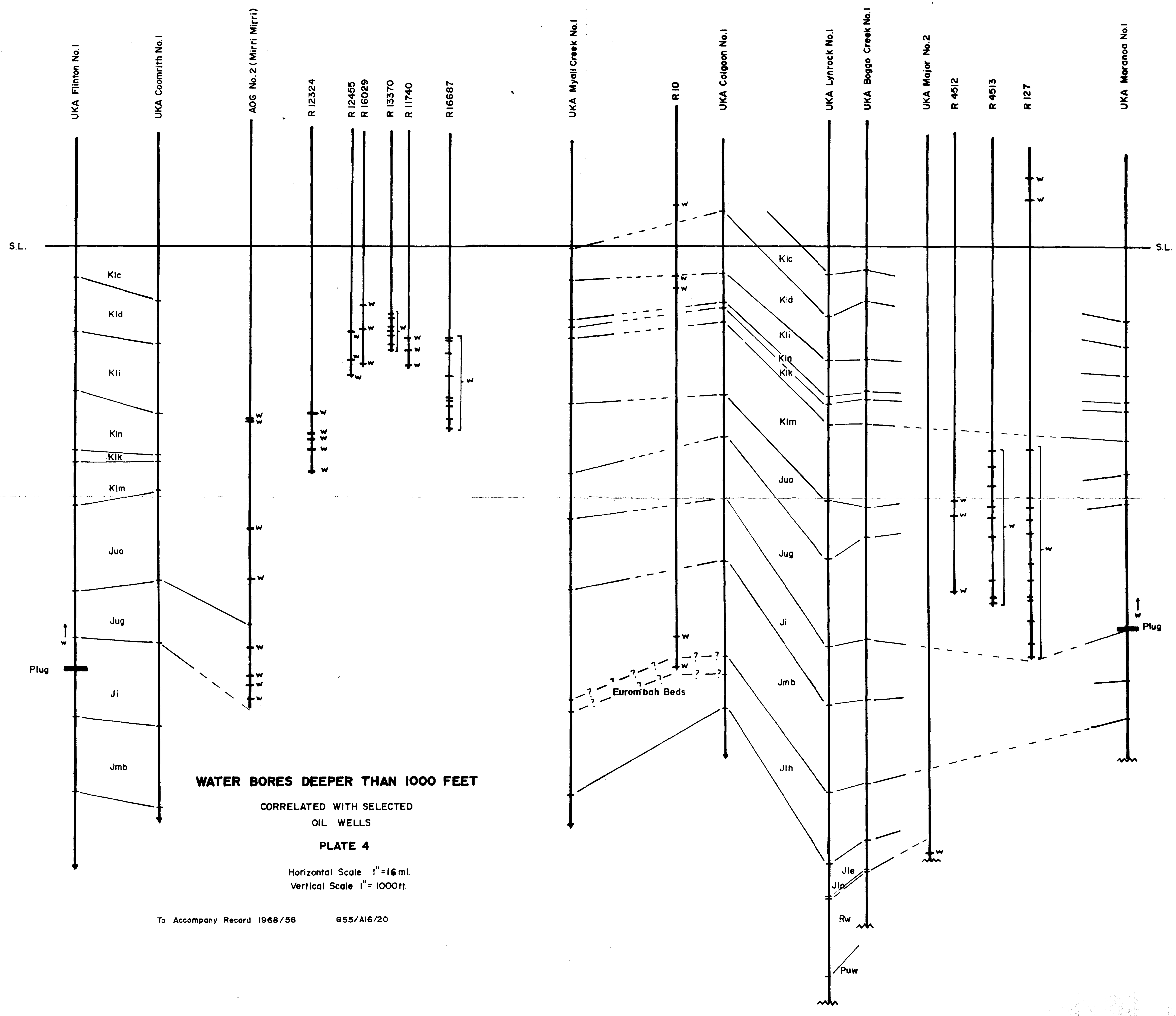
Horizontal Scale 1" = 8 mi.

To Accompany Record 1968/56 G55/A16/2

PLATE 3

TYPICAL ELECTRIC LOGS WITH FORMATION PICKS

To Accompany Record 1968/56 G55/A16/21



WATER BORES DEEPER THAN 1000 FEET

CORRELATED WITH SELECTED
OIL WELLS

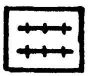
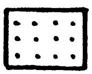
PLATE 4

Horizontal Scale 1" = 16 ml.
Vertical Scale 1" = 1000 ft.

To Accompany Record 1968/56 G55/A16/20

ABBREVIATIONS

FIGS 8-II
PLATE 4

	Mudstone (mudst.)
	Siltstone (siltst.)
	Sandstone (sandst.)

Klc	Coreena Member
Kld	Doncaster Member
Kli	Minmi Member
Kln	Nullawurt Member
Klk	Kingull Member
Klm	Mooga Sandstone Member
Juo	Orallo Formation
Jug	Gubberamunda Sandstone
Ji	Injune Ck. Group (post-Birkhead)
Jmb	Birkhead Formation
Jlh	Hutton Sandstone
Jle	Evergreen Formation
Jlp	Precipice Sandstone
Rw	Wandoan Formation
Puw	Blackwater Group

gy	grey
blk	black
lam	laminated
x-lam	crosslaminated
interlam	interlaminated
(sub)lab	(sub)labile
w	with
Fe	ferruginous
vf	very fine
f	fine
m	medium
c	coarse
glau	glauconite
dom	dominantly

PLATE 8 To Accompany Record 1968/56 G55/AI6/22