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DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

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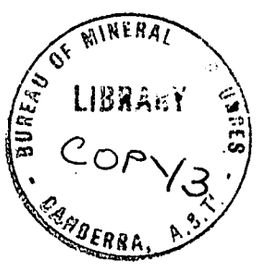

RECENT GEOLOGICAL MAPPING IN THE NORTHERN EROMANGA BASIN QUEENSLAND.

by

R.R. Vine

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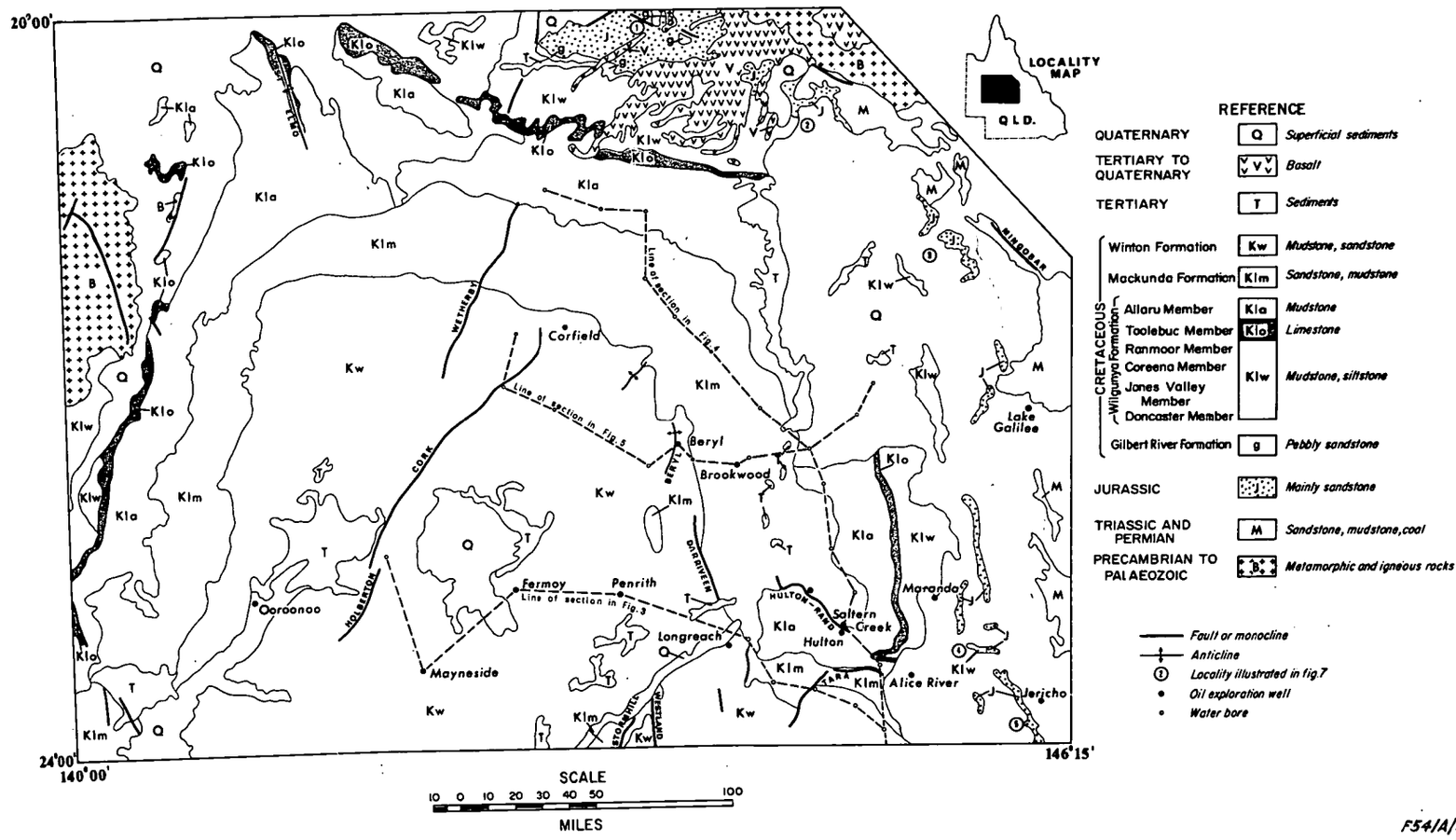

To accompany Record 1966/84

Fig. 1. Generalized geological map - northern Eromanga Basin.

ABSTRACT

The attached map presents the generalized results of five years of systematic regional geological mapping of the northern Eromanga Basin. A new nomenclature based on lithological characteristics now replaces the classic faunal divisions which have been widely used and misused as lithological units.

Gamma-ray logs of many water-bores in the northern Eromanga Basin enable good correlations to be made of the sub-surface Jurassic and Cretaceous sequence over a wide area. Lithological and thickness variations indicated by these correlations are inferred to be related to deeper structure.

High radioactivity, associated with three argillaceous units within the Jurassic sequence, possibly indicates marine incursions. Also the presence of glauconite and acritarchs suggest marine conditions during deposition of the three units.

Correlation of the sub-surface Jurassic units with the exposed sequence is questionable. However, it is evident that only an attenuated sequence is preserved at the present basin margin and that, at the margin, periods of non-deposition or erosion were common.

INTRODUCTION

This paper presents progress results of regional geological mapping, supplemented by subsurface studies, of the northern part of the Eromanga Basin between 1961 and 1964 by joint geological field parties of the Bureau of Mineral Resources and the Geological Survey of Queensland. The area is a large pedimented surface, and apparently almost featureless geologically. Preliminary editions of several geological maps at the scale of 1:250,000 have been distributed during the course of the survey; four First (colour) Editions have also been published and others are in preparation. The preliminary editions have been revised for a regional map at 1:1,000,000 which will be available shortly; Fig. 1 is a generalized version of this map.

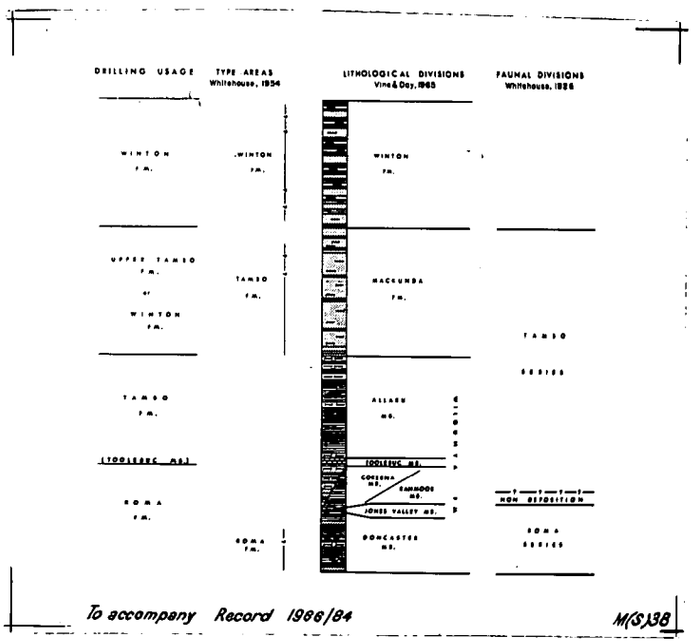

Fig.2. Comparison of nomenclatures.

NOMENCLATURE

Most of the nomenclature of the Cretaceous sequence used during the mapping (and used in Fig. 1) was given by Vine and Day (1965). Briefly, a threefold division was made into -

(a) the argillaceous Wilgunya Formation, overlain by
(b) the Mackunda Formation, sandstone and mudstone characterized by marine fossils, and overlain in turn by
(c) the Winton Formation, mudstone and siltstone characterized by coal seams.

The Wilgunya Formation was further divided into five members (Fig. 2) based on more subtle lithological differences. The Coreena Member was recognized in the Longreach area subsequently. It is a correlate of the Ranmoor Member but contains many beds of sandstone or coarse siltstone.

Whitehouse's (1954) nomenclature for the Cretaceous sequence in the Great Artesian Basin, viz: Roma, Tambo and Winton Formations, was simply an attempt to make pre-existing terms conform to the then Australian Code of Stratigraphic Nomenclature. When Whitehouse first divided the Cretaceous sequence it was into Roma and Tambo Series, identified purely by their faunas (Whitehouse, 1926), and overlain by Dunstan's (1916) freshwater Winton Series. Whitehouse's (1954, p.10) formal definitions of Roma and Tambo Formations differ from each other only in the nominated type areas (near Roma in the Surat Basin and near Tambo in the Eromanga Basin) and in the contained faunas. He also stated (op.cit., p.10) 'From the Roma to the Winton there is a most uniform lithology in outcrop', but further in the same paragraph 'In bore logs it is not difficult to draw the line between Tambo and Winton by the increase in sandstone members and the incoming of coal seams.' Our recent lithological mapping (Exon, Galloway, Casey & Kirkegaard, in prep.) shows that the sequence in the type area of the "Tambo Formation" is actually stratigraphically above the 'increase in sandstone members'.

I maintain that the Roma and Tambo Formations as defined by Whitehouse are not valid rock units, and cannot be used in lithological mapping. However the terms have good stratigraphic value if they are used purely as biostratigraphic units. They have been, and are being, so used by R.W. Day (Australian National University, formerly G.S.Q.) in the palaeontological studies which have been proceeding concurrently with the lithological mapping.

Throughout, the Winton Formation has been consistently described as an interbedded freshwater sequence of mudstone and sandstone, containing coal seams. This has been found to be a mappable lithological unit and as such is a valid formation.

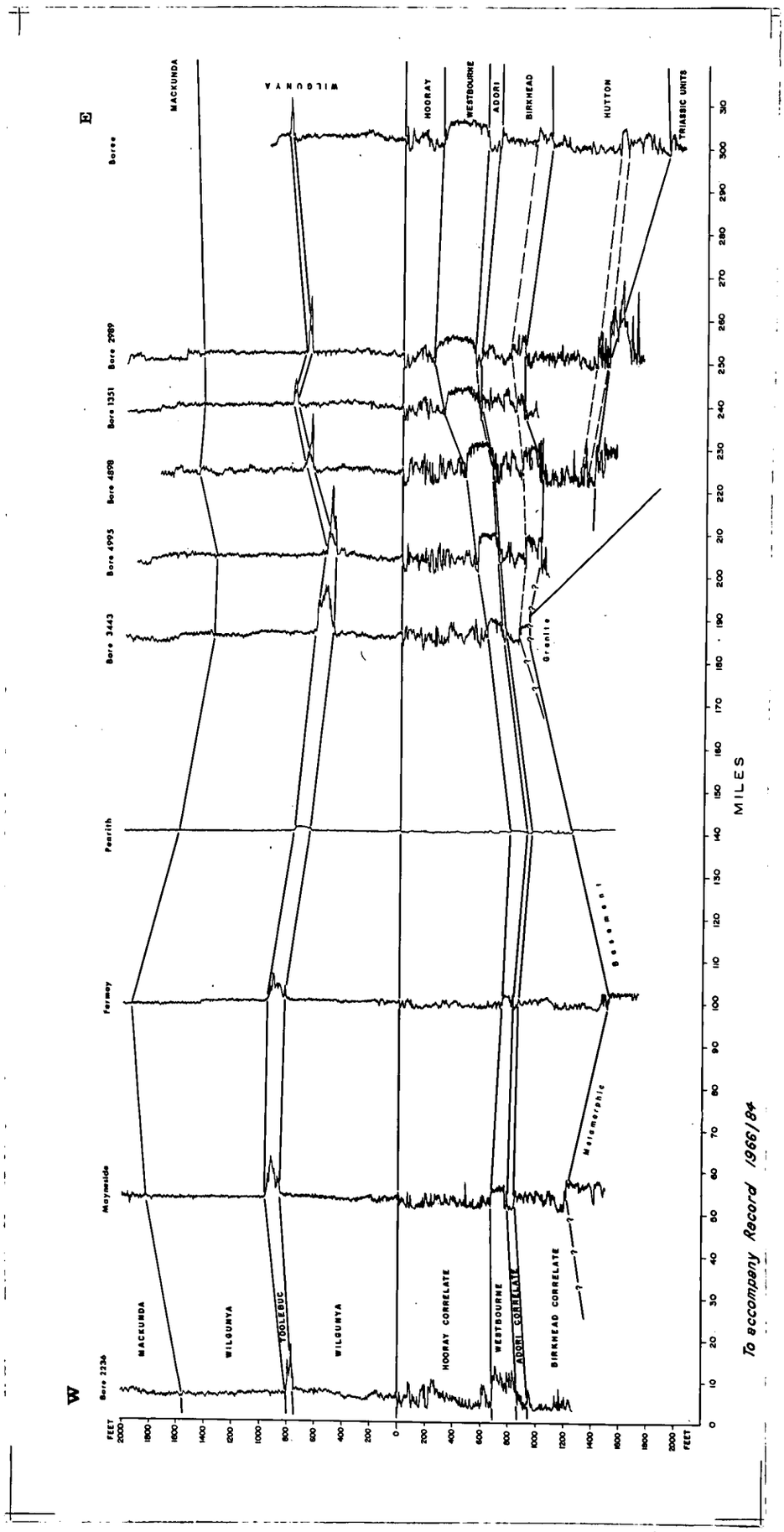

Fig.3. Gamma-ray log correlations.

A comparison of nomenclatures is given in Fig. 2. The main misconceptions implicit in the application of Whitehouse's nomenclature to strictly lithological units encountered during drilling are:

(a) "Tambo Formation", as usually used for the argillaceous sequence above the Toolebuc Member, is only the middle part of Whitehouse's 'Tambo Series' and is below the "Tambo Formation" of Whitehouse's type area. Some company reports refer to this argillaceous sequence as 'Lower Tambo' and use 'Upper Tambo' for the Mackunda Formation.

(b) Roma Formation is used for the whole of the argillaceous sequence below the Toolebuc Member, whereas the upper half (approximately) of this has a Tambo fauna.

STRUCTURAL INTERPRETATION OF MAPPING

Resolution of the Cretaceous sequence into fairly small stratigraphic rock units has resulted in the recognition of surface structure. Particular examples are:

(a) The Beryl Anticline (discovered by a seismic survey - Associated Australian Oilfields, 1963). This is part of an elongated fold evidenced to north and south, respectively, by a lobe and an inlier of Mackunda Formation within the Winton Formation. The fold is probably the surface expression of a major basement ridge which possibly was the western limit of the main Permian and Triassic sedimentation in the Galilee Basin.

(b) The Hulton-Rand Structure. Part of this was discovered by seismic surveys (Longreach Oil Limited, 1963, 1964). It was also identified and extended by the surface geological mapping. Later stratigraphic drilling showed that this was the effective south-western margin of the Galilee Basin.

(c) The Tara Structure. This has a similar surface expression to the Hulton-Rand Structure, and probably had an analagous geological history. The ridge between the Tara and Hulton-Rand Structures is named the Barcaldine Ridge.

(d) Several major faults (e.g. Darriveen Fault, Stormhill Fault, Westland Structure) were mapped where distribution of stratigraphic units indicates displacements of many hundreds of feet.

Where seismic results are available there is good correspondence with the structures shown by the surface mapping. While there is no suggestion that all seismic surveys could have been avoided, clearly if systematic geological mapping had been done first seismic programmes could have been better planned, and exploration costs reduced accordingly.

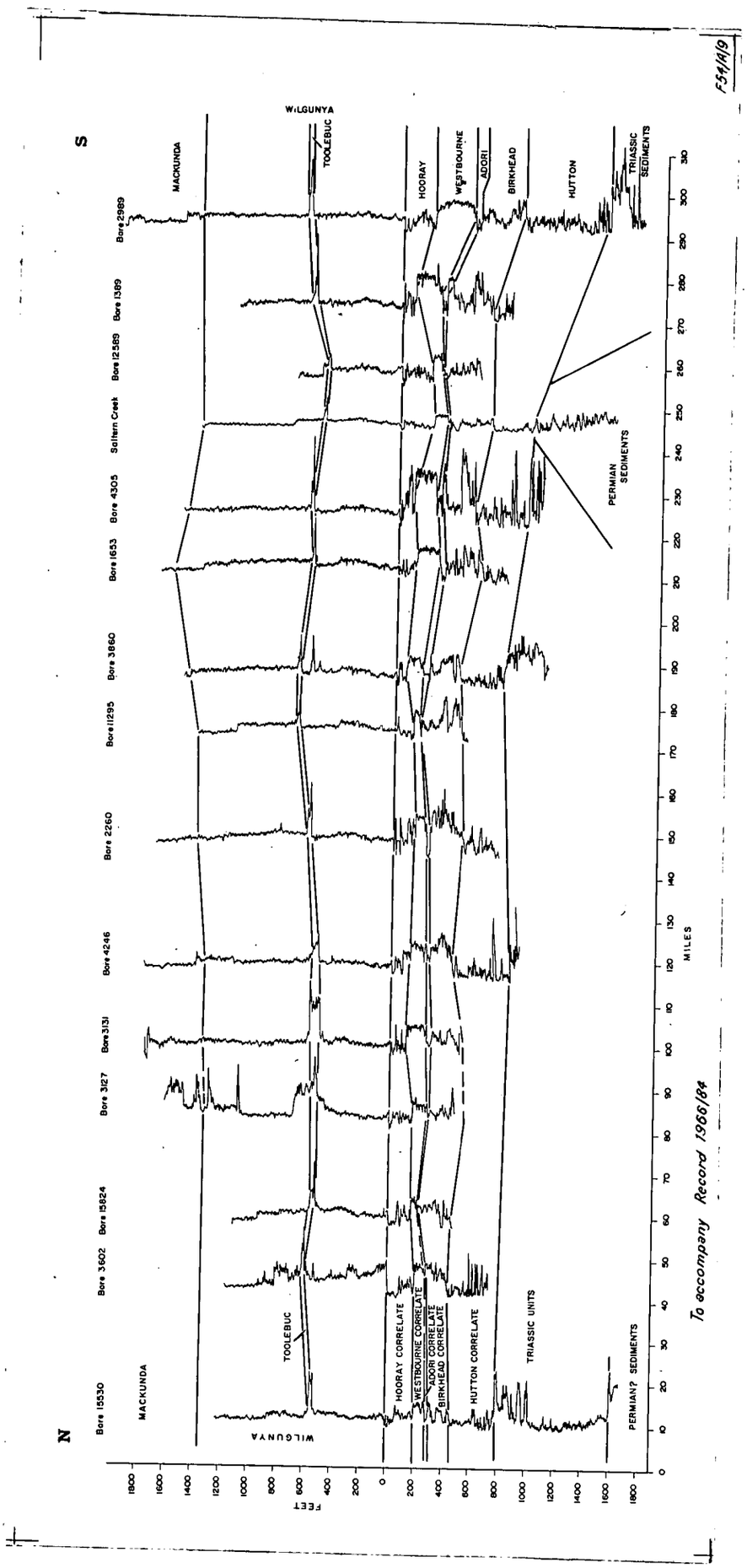

Fig.4. Gamma-ray log correlations.

GAMMA-RAY LOGGING OF WATER BORES

A programme of systematic gamma-ray logging of the widespread water bores in the northern Eromanga Basin to supplement the surface mapping was started in 1964. Logging in 1964 was carried out by the B.M.R., but was curtailed by the loss of a probe in a bore. In 1965 the work was carried out by Schlumberger under contract to the B.M.R. The logging programme is continuing in 1966.

Good log correlations can be made between most of the bores, the logs are available for independent interpretation. For illustration, three long cross-sections are presented in Figures 3, 4 & 5 showing Jurassic and Cretaceous log correlations across the area (section locations are shown on Fig. 1). The nomenclature of the Jurassic sequence is based on that given by Exon (1966) for the Tambo area; the nomenclature and the related palynological divisions (Evans, 1966) are shown in Fig. 6.

The good markers for correlation are:

(a) The high radioactivity of the Toolebuc Member.

(b) The sharp drop in radioactivity at the base of the Wilgunya Formation.

(c) The generally uniformly high radioactivity of the Westbourne Formation.

(d) The generally uniformly low radioactivity of the Hutton Sandstone.

The main features evident from these correlations are:

(a) The marked thinning of the "Hooray Sandstone" on to the Barcaldine Ridge, and the westward thickening through the Longreach area.

(b) Thickening of the sequence in a probable graben between Beryl No. 1 and Brookwood No. 1; in particular, additional section in the basal part of the Hutton Sandstone is evident below a well-defined argillaceous interval.

(c) Confirmatory evidence for regional unconformity near the base of the Wilgunya Formation; other evidence for this has already been given in unpublished B.M.R. Records (Vine, Casey & Johnson, 1964; Vine, Jauncey, Casey & Galloway, 1965).

Four main zones of high radioactivity can be recognized consistently on the logs. In the youngest zone, corresponding to the Toolebuc Member, the radioactivity is believed to be due to small amounts of an uranium mineral on fish scales. The other three zones correspond to the Westbourne Formation, beds near the base of the Birkhead Formation (the most variable in amount), and beds near the base of the Hutton Sandstone. These three zones are within a sequence which is widely believed to have been deposited in freshwater environments (e.g. Whitehouse, 1954; Hill & Denmead, 1960). However limited experimental work (Russell, 1944) has

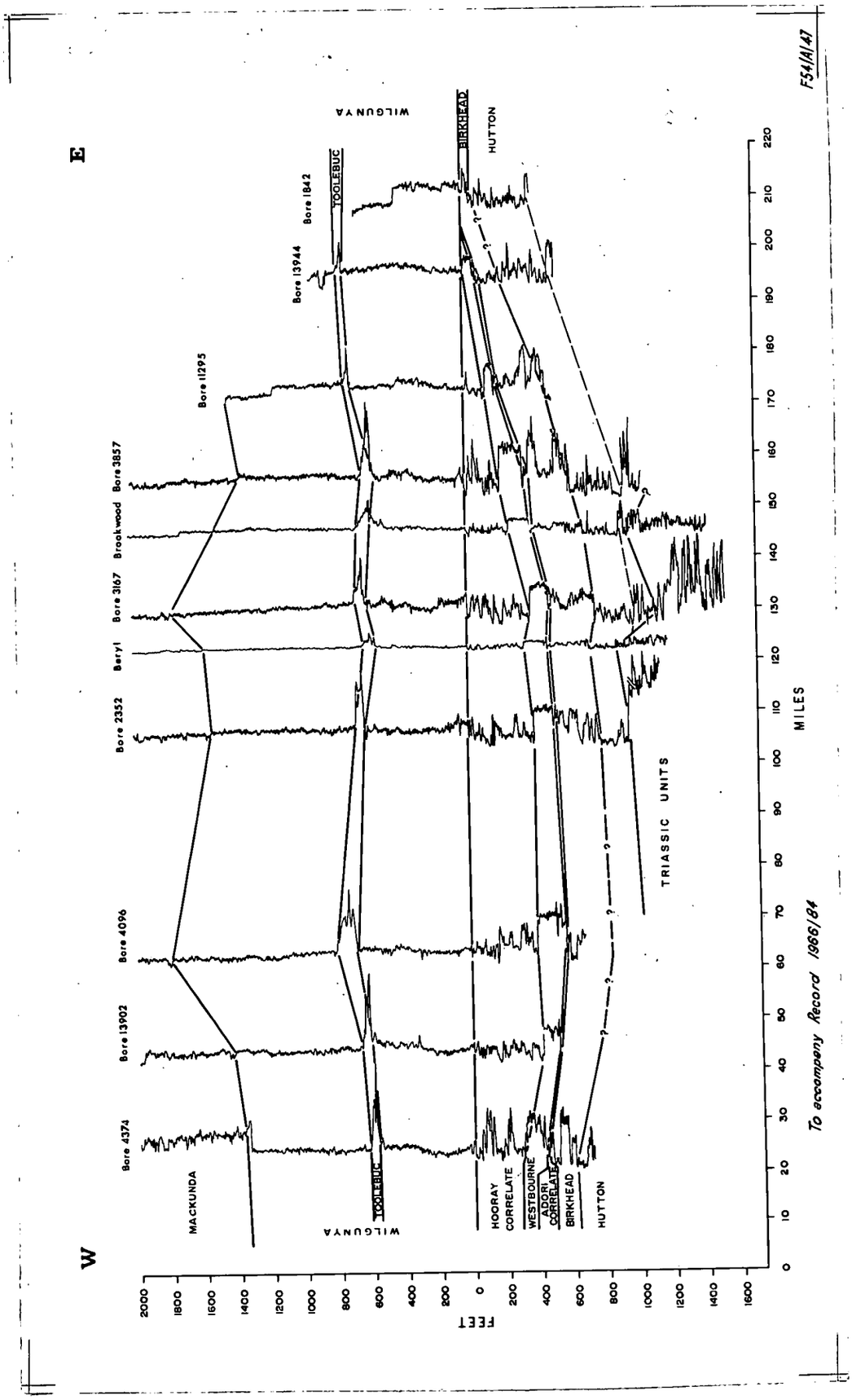

Fig.5. Gamma-ray log correlations.

shown that high gamma-ray readings are generally associated with marine shales, and attributed to the presence of radioactive potassium. (The possibility of beds of potash are excluded from this discussion).

Additional support for considering these three Jurassic zones of high radioactivity as indicative of marine environments is afforded by:

(a) Acritarchs in the Westbourne Formation and the lower part of the Birkhead Formation in B.M.R. shallow stratigraphic drill holes (Evans, in prep.), from the lower part of the Birkhead Formation in Magellan Corfield No. 1 (Evans, 1962), and in an argillaceous part of the Hutton Sandstone in a water bore about 20 miles south of Richmond (Evans, 1964).

(b) Glauconite in the lower part of the Birkhead Formation in Corfield No. 1 (Fehr, in Evans, 1962) and in the Westbourne Formation in B.M.R. shallow stratigraphic drill holes.

Thus at least three marine incursions into the northern Eromanga Basin during Jurassic times are inferred from mutually supporting, independent, indications.

Gamma-ray log correlations have been used in an attempt to identify and relate the presumed Jurassic and Lower Cretaceous arenitic sequences outcropping around the north-eastern margin of the Eromanga Basin. In mapping it has been necessary to give different names or symbols to the sequences in each area as the sequences are not lithologically comparable. Possible relationships are shown in Fig. 7.

The Gilbert River Formation (see Fig. 7) is pebbly sandstone and conglomerate, overlying the other units with regional unconformity. Units 'a' and 'b', of the Cambridge Creek area, and the Blantyre Sandstone of the Flinders River area are easily definable units in areas of good outcrop. To the south-east, however, the poor outcrop makes it necessary to use the general name Ronlo Beds for the whole sequence which lies between the belts of outcrops of the Triassic Moolayember Formation and Lower Cretaceous Wilgunya Formation.

The continuation of the Westbourne Formation northwards towards the Cambridge Creek area is evident from the gamma-ray log correlations. Possibly it is represented in outcrop by unit 'b', which is mainly siltstone and very fine-grained sandstone, and has a photo pattern similar to that of the Westbourne Formation of the Tambo area. If so, unit 'a' may include correlates of parts of the sequence Hutton Sandstone to Adori Sandstone. Photo-interpretation indicates that unit 'b' wedges out eastwards, a situation directly comparable with the Westbourne Formation subsurface.

Palynological evidence (Evans, 1964) indicates that the top, at least, of the Blantyre Sandstone is Upper Jurassic. It can probably be best correlated with the "Hooray Sandstone" rather than with older parts of the sequence. (/

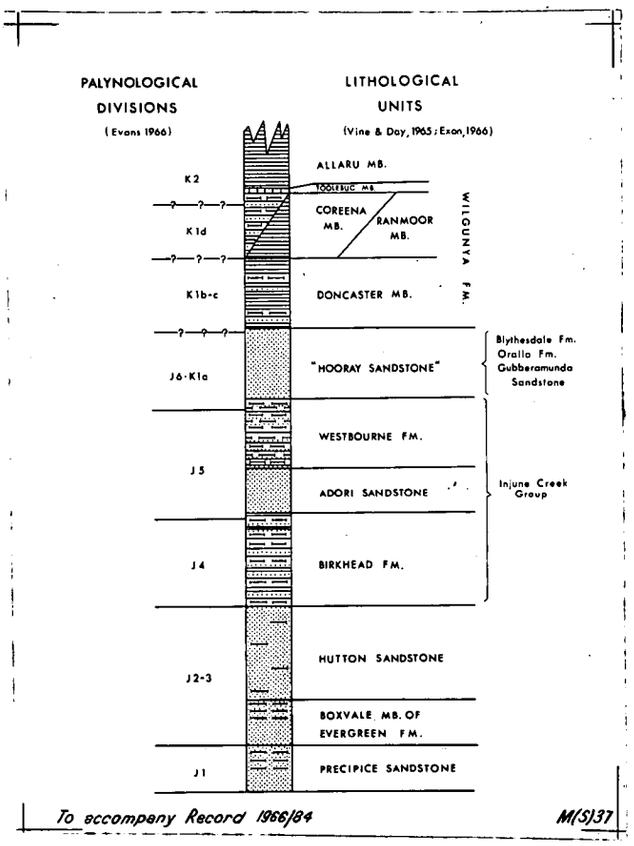

Fig.6. Stratigraphic sequence.

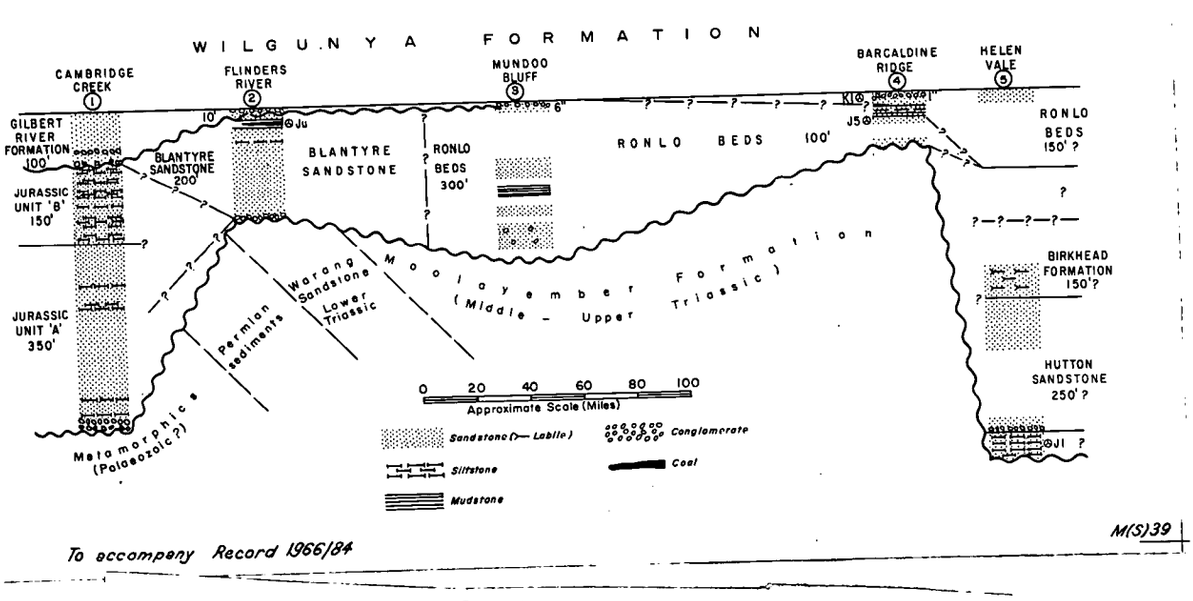

Fig.7. Comparison of outcropping Jurassic sections.

Gamma-ray log correlations (Fig. 5) along a line extending towards Mundoo Bluff indicate truncation of the Jurassic sequence. In this area the Ronlo Beds and the Hutton Sandstone are possibly the same.

Spores of palynological division K1 of Lower Cretaceous age were obtained from the very top of the Ronlo Beds on the Barcaldine Ridge (Evans, in prep.). However, only about 50 feet below (Fig. 6) spores of palynological division J5 (Middle to Upper Jurassic) were obtained. Thus either the sequence Adori Sandstone-Westbourne Formation-"Hooray Sandstone" is only about 50 feet thick in this area or, more likely, there has been appreciable erosion late in Jurassic or early in Cretaceous time. Such erosion is compatible with that suggested by the correlation shown in Fig. 5.

Southwards, near Helen Vale, is a thicker Jurassic sequence which is directly comparable with that in the Tambo area.

If these interpretations are correct it is evident that previous maps of the area are over-simplifications. It is hoped to check the interpretations by shallow stratigraphic drilling during 1966.

CONCLUSIONS

The recent work in the northern Eromanga Basin has shown conclusively that systematic field work in pedimented areas which are apparently featureless geologically can produce valuable information. Geological field work on a similar basis is recommended for similar large pedimented epeiric basins as a precursor to seismic investigations. The programme of regional geological mapping in the Queensland portion of the Great Artesian Basin will continue.

The results already obtained from the systematic gamma-ray logging of water bores shows that this is a valuable, but relatively inexpensive, exploration technique (the total cost of logging by contract approximately 100 bores in 1965 was approximately $100,000). More widespread use of this technique is fully justified.

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