REVISION OF EROMANGA BASIN LIMITS

M.J.Wiltshire

Consulting Petroleum Geologist

Wiltshire Geological Services, c/- AMF Inc, P.O. Box 97, GLENSIDE S.A.

Michael Wiltshire studied geology and geophysics at Sydney University and graduated in 1964. He entered the petroleum industry in 1964, working for two years for Cundill, Meyers and Associates before attending A.N.U. for one year in 1966, where he studied politics and applied mathematics. In 1967 he first worked as a freelance consultant, managing drilling operations in Papua. From late 1967 to 1970 he worked with and helped development of Data Analysis Pty Ltd, where his duties included wellsite management and geologic and geophysical software design.

He left Data Analysis in mid-1970 and has worked as a freelance consultant since that time.

In recent years he has endeavoured to spend some time each year on management of drilling operations in rank wildcat or difficult drilling areas, and some time on basin study work. A significant part of the basin study work has involved design and testing of petroleum applications software on a DEC 11/23 system. He is currently working on a review of the Surat Basin.

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INTRODUCTION

Over the past thirty years with increasing frequency references to the Eromanga Basin have appeared in the literature, and a by now quite large volume of material exists. We are gathered for a meeting to discuss the geology of the Eromanga Basin, and one might therefore assume that the basin has by now been clearly defined - that is, its areal extent and stratigraphic lower and upper limits clearly defined.

A search of the literature reveals that this is not so.

Within the stratigraphic code, there is no convention for such definition, and so basin definitions are informal. Consequently, such definitions are somewhat flexible. The difficulty was referred to by Power and Devine (1970) in their paper on the Surat Basin, but no convention has resulted. The currently generally held understanding of the Eromanga Basin sequence was formed in the early 1960s, and is now in need of updating to accomodate knowledge gained in the last 15 years of drilling and geologic investigation.

HISTORICAL SUMMARY

The term "Eromanga Basin" was first used by W.D.Mott in his 1952 review of oil exploration in Queensland. In that paper he defines it as a geographic region extending south from the Euroka Shelf and west from the Eulo Shelf and the Nebine Ridge. The southwestern limits of the basin were undefined. Mott claims that the basin limits in the northwest and east are pre-Permian rocks, implying that the basin's section extended from the base of Permian to the present surface. Hence, by his usage, the Pedirka, Cooper and Galilee basins are all elements of the Eromanga Basin.

The terms "Eromanga Sub-Basin" and "Eromanga Infra-Basin" first appear, without definition, in approximately 1957, and the 1958 Tectonic Map of Queensland contains reference to the "Eromanga Sub-Basin". By 1960 the term was in wide use within the Queensland Geological Survey, and appears in GSQ Publication 299, as well as in Hill and Denmead (1960). From usage, it appears that this term was being used quite generally, if loosely and incorrectly, and had replaced Mott's more correct "Eromanga Basin", though it referred to the same area.

Sprigg in 1961 commented on the use of the term on the then recently published Tectonic Map of Australia in the following manner: "...the term 'Eromanga sub-basin' has appeared on the Australian tectonic map in the position of Whitehouse's 'Thompson sub-basin' ". Sprigg then points out that the term "sub-basin" is itself undefined, and he emphasises the need for definition of terms.

That call was not heeded, and through the 1960s the terms "Eromanga Sub-Basin" and "Eromanga Infra-Basin" were widely and variously used, without definition. The term "Eromanga Basin" reappears in Canaple and Smith (1965) where it is used to refer to "a sub-basin of the Cooper's Creek Basin, having thick Devonian and Carboniferous sediments". This was clearly in conflict with both Mott's 1952 definition and with the 1960 usage of the Queensland Geological Survey, so the 1965 definition only further confused the issue.

In 1966 Williams made a clear and coherent statement of the more general understanding that "the Eromanga Basin .... is a separate depositional and tectonic basin within the limits of the Great Artesian Basin". Further, " ... the Great Artesian Basin is a sedimentary basin which was initiated late in the Triassic period ... the sequence is of Jurassic and Cretaceous age". This differs little from the currently held general view.

The clearest recent statement of basinal relationships within the general region of the Great Artesian Basin is that of Leslie (1976). In this version, the entire Great Artesian Basin sequence is of Jurassic and Cretaceous age, and the Great Artesian Basin is subdivided on structural grounds into three separate regions - the Surat Basin, the Eromanga Basin and the Carpentaria Basin. Several infra-basins occur within the Eromanga Basin.

By 1974 the term "Eromanga Basin" is used without comment as to definition, in BMR Record 1974/178, and in 1978, Senior, Mond and Harrison published BMR Bulletin 167 on the geology of the Eromanga Basin, without reference to a definition of the basin.

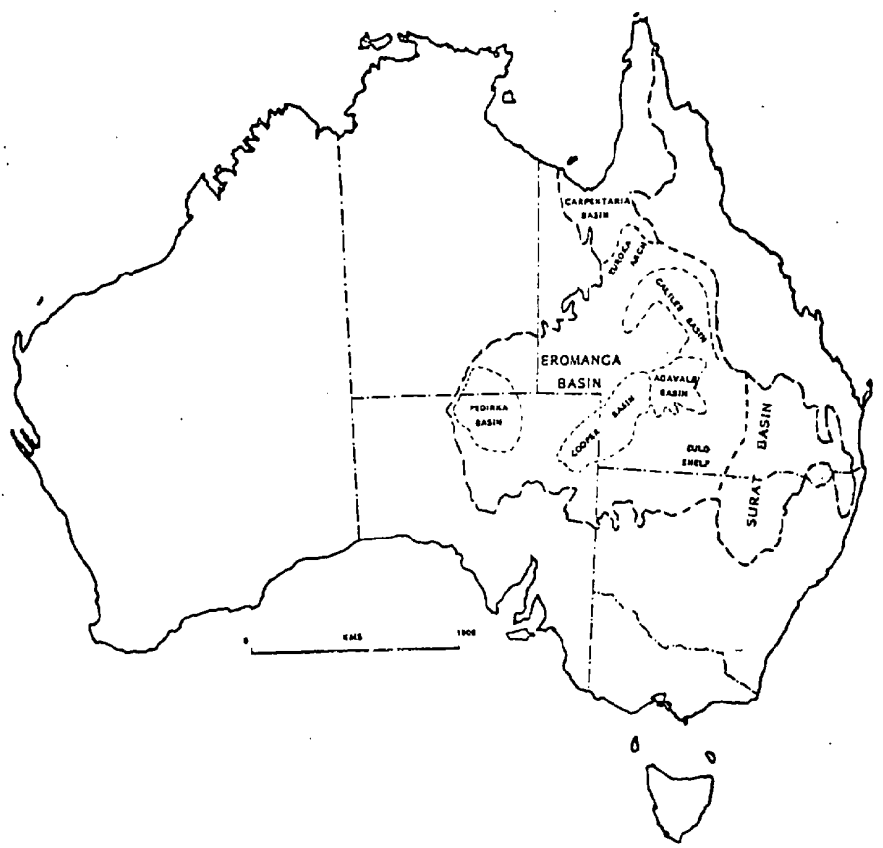


Fig 1 Regions and infra-basins of the Great Artesian Basin

DEFINITION OF TERMS

Sprigg's (1961) observation of need for definition of terms has not previously been addressed.

The term "sub-basin" should not be used in any context. It is not defined in any geologic dictionary or glossary, and if it means anything, the "sub-" term, used as a prefix, could only mean "lying under" (Bates and Jackson, 1980). Wide misusage is not a redeeming feature.

The term "infra-basin" is acceptable, in that it is defined (Bates and Jackson, 1980) and the meaning is explicit.."a sedimentary sequence underlying that of another basin". So, for example, the Cooper Basin is an infra-basin of the Great Artesian Basin.

The term "basin" should refer to a tectonically and depositionally related package of sediments which have accumulated within a limited geographic region.

The presently used meaning of the term "Eromanga Basin" dates from about 1966, and may be stated thus:

> The Eromanga Basin is that region of the larger Great Artesian Basin lying west of the Nebine and Eulo Ridges (at longitude 146° E approximately) and south of the Euroka Arch (at latitude 19° S approximately). In age the sediments range from lowermost Jurassic to the top of the present Cretaceous sequence.

Within this meaning, clearly the terms "sub" and "infra" should not be prefixed to the word "basin" when referring to the Eromanga Basin. And the Cooper Basin is an infra-basin of the Eromanga Basin, while the Eromanga Basin is a region of the larger Great Artesian Basin.

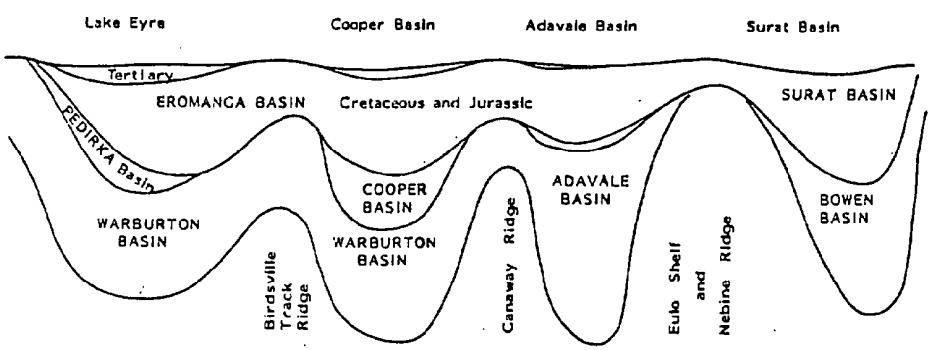


Fig. 2 Diagramatic basin relationships, Great Artesian Basin region

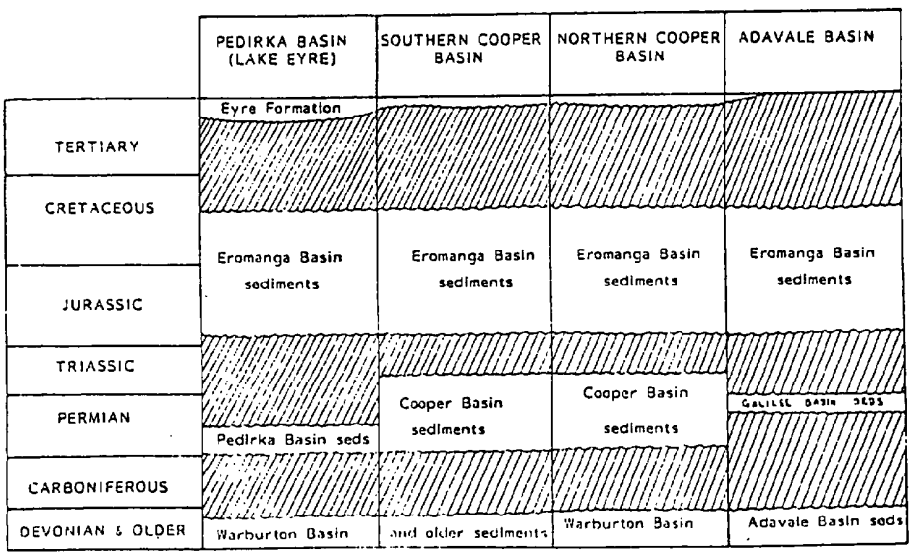
DISCUSSION OF BASINAL RELATIONSHIPS

The Eromanga Basin, in the sense of the current usage outlined above, is the subject of this symposium. Significant Permian and Permo-Triassic infrabasins, the Pedirka Basin, the Cooper Basin and the Galilee Basin underlie parts of the Eromanga Basin, and these Permian and Permo-Triassic basin sequences themselves overlie older Palaeozoic basin sequences (eg. the Warburton Basin and the Adavale Basin). [See figure 2 above.]

The Pedirka Basin as defined by Wopfner (1972) and Youngs (1976) is a Permian basin. The Cooper Basin as defined by Battersby (1976) is a Permo-Triassic basin, with sedimentation ceasing in mid-Triassic time and being followed by uplift, folding and erosion in Middle to Late Triassic time. The uppermost unit of the Cooper Basin, the Nappamerri Formation Unit IV (Papalia, 1969) ranges from Early to Middle Triassic in age (Tr2a to Tr3b). The Galilee Basin is also a Permo-Triassic basin, with the uppermost unit being a redbed sequence which Vine (1976) correlates with the Moolayember Formation. Vine acknowledges some problems with the application of Bowen Basin Triassic nomenclature to the sequence in the Galilee Basin, and describes the Moolayember Formation as a redbed sequence. It is more probably a correlate of the Nappamerri Formation of the Cooper Basin.

A consideration of these definitions and usages implies a period of non-deposition and/or erosion, in which no sedimentary accumulation and preservation occurred, between the termination of early Middle Triassic Nappamerri Formation sedimentation (and the subsequent late Middle to Late Triassic uplift, folding and erosion) and the initiation of Eromanga Basin deposition in early Jurassic time.

Yet sediments of Late Triassic age are known in the area, and have long been known. Canaple and Smith (1965) refer to Upper Triassic sediments in Pandieburra 1. Nugent (1969) recognizes Upper Triassic sediments..."in the Copley-Leigh Creek area and in the Pandieburra/Putamurdie/Betoota area" (my emphasis, both times). But the definitions and established usage of basin limits in the region do not allow incorporation of this Late Triassic sequence into either the Eromanga Basin or the Pedirka/Cooper Basin sequences.



...tion to current usage and definitions

In a private multi-client study, Wiltshire (1979) recognized this Late Triassic unit, and mapped it over a wide area. Barr and Youngs (1981) identify the same unit in Cuttapirrie 1, and state that in this well.."the upper part of the Triassic sequence...can be differentiated (on the basis of lithology and gamma log character) from the underlying unit (8578 to 9000 ft), which is the Nappamerri Formation as defined by Papalia (1969)".

Typically the unit is characterized by dark shales with preserved organic matter, some coals, and clean white to grey-brown sandstones. The depositional environment is that of low energy streams and shallow freshwater lakes. Redbeds and oxidized sediments are generally absent, except at the very base of the unit.

This Late Triassic unit is in fact widely distributed, being present in the eastern part of the Cooper Basin, where the upper part of the Triassic sequence in wells such as Tanbar 1 does not conform to Papalia's 1969 definition of the Nappamerri Formation. Thin basin margin equivalents are recognized in wells as far west as Colson 1, so it is clear that there is a widespread occurrence of a Late Triassic unit which is unclassifiable in terms of established basin definitions and usage.

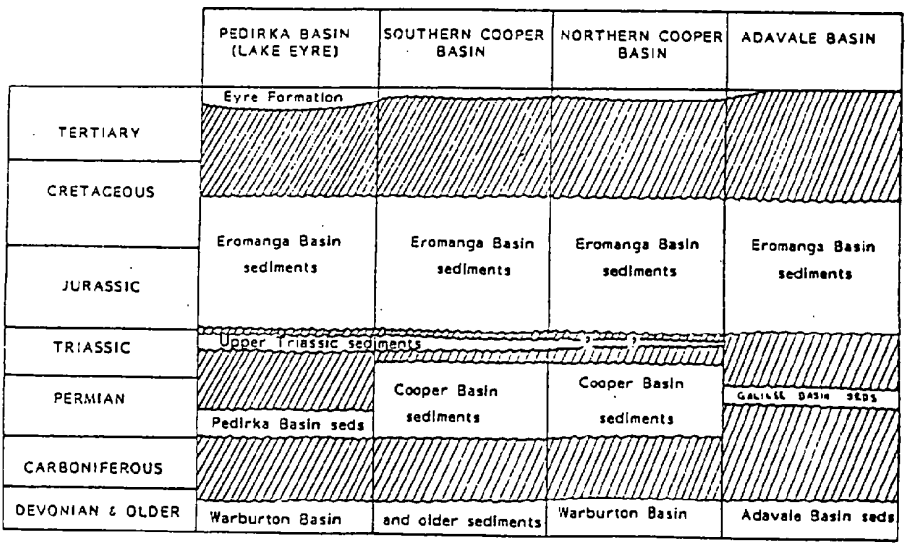


Fig. 4 Position of late Middle to Upper Triassic sediments in various basin sequences

The wide distribution and potential economic significance of the unit justifies its recognition, and the formal extension of basin limits to incorporate the section ito the established basinal framework.

The question then arises: should it become part of the Eromanga Basin sequence, or part of the older basin sequences ?

The unit is present over an area much larger than the range of the Nappamerri Formation, and should not by default be incorporated within that formation in the Cooper Basin or elsewhere. The point was recognized but not resolved by Barr and Youngs (1981). Whilst an outlier of these Late Triassic sediments is known (the Leigh Creek - Copley occurrence) the unit is otherwise generally restricted to underlying the Jurassic Eromanga Basin sequence. In fact, the thickest indicated developments of the unit generally are in areas where only

Jurassic sediments are also thick - that is, this Late Triassic sedimentation was apparently a precursor of early Eromanga Basin Jurassic sedimentation.

Further, the upper unit of the Nappamerri Formation as defined by Papalia (1969) does not include dark shales with good preservation of organic matter. It is a sequence of oxidized sediments, mostly red siltstones and shales.

So on the basis of log character and lithology the unit is separately mappable, and in terms of lithology, log character and area of distribution has much greater affinity to the overlying Jurassic Eromanga Basin sequence than to the underlying Permian, Permo-Triassic and older basin sequences.

This then is the rationale for re-definition of the Eromanga Basin sequence, to incorporate the Late Triassic sedimentary package.

DEFINITION OF THE EROMANGA BASIN

The established areal subdivision of the Great Artesian Basin into three smaller units is logical and convenient, and need not be varied. (The use of the term "sub-basin" to describe these units should be avoided.) The Eromanga Basin extends from the Euroka Arch in the north, and the Eulo and Nebine Ridges in the east, southwest to the outcrop limits of sediments of the Cretaceous and Jurassic Great Artesian Basin supergroup.

This definition of the areal extent of the basin is somewhat arbitrary and imprecise, but is the established usage. The Late Triassic sediments are not generally recognized on the outcrop edges of the basin, and will not significantly vary the area so defined.

In stratigraphic range, current usage explicitly precludes all sediments of pre-Jurassic age from incorporation. This definition is here modified. The Eromanga Basin stratigraphic range is here re-defined to include the widespread organic-rich Late Triassic sediments. These sediments show more general conformity with the overlying sequence than with the underlying older basin sequences.

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