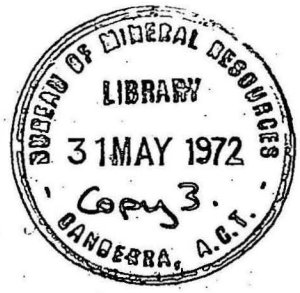

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF
NATIONAL DEVELOPMENT

BUREAU OF MINERAL
RESOURCES, GEOLOGY
AND GEOPHYSICS

Record 1972/37

TECTONIC EVOLUTION OF AUSTRALIA
SUMMARY

by

K.A. Plumb

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FOREWORD

The notes constituting this Record are a summary of a lecture presented by K.A. Plumb to several educational institutions and scientific societies throughout Australia. The summaries are being distributed at these meetings.

The synthesis is a follow-up from Plumb's work as a member of the compiling committee for the Tectonic Map of Australia and New Guinea, 1971, published by the Geological Society of Australia. The views expressed here are entirely those of Plumb and are not to be considered as a joint opinion of either the Tectonic Map Committee or of the Bureau of Mineral Resources.

It is proposed to publish the synthesis at some later date with more detailed maps in colour and full accompanying text.

TECTONIC EVOLUTION OF AUSTRALIA *

SUMMARY

by K.A. Plumb

N.B. (1) Preliminary summary only. Maps and notes subject to amendment.

(2) These notes are not an explanation of the Tectonic Map of Australia and New Guinea - 1971.

Introduction

A series of palaeotectonic maps has been derived from the new Tectonic Map of Australia and New Guinea, 1971. The maps are independent of hypotheses regarding processes or origins of units. Tectonic units are only shown in their present-day positions. No attempts are made to reconstruct positions of blocks which may have been bodily displaced or rotated. Sediments are only shown in areas where they are now preserved. Relationships to other continents are not considered.

The Legend.

The three basic units, orogenic domains, transitional domains, and cratons are as defined on the Tectonic Map of Australia and New Guinea, 1971. Cratons are divided into two main groups; (i) those areas actively undergoing platform cover deposition during the time interval under consideration, simply referred to in the later descriptions as platform cover, and (ii) those areas not actively receiving platform cover sediments simply referred to in the descriptions as craton (these latter cratons may consist of either exposed ancient basment or older, previously deposited, platform cover).

Acknowledgements.

These maps are derived from the Tectonic Map of Australia and New Guinea, 1971. The author is solely responsible where syntheses and interpretations extend beyond those of the Tectonic Map. The work of the many members of the Tectonic Map Committee who contributed data and ideas to, and took part in compilation of the Tectonic Map, is gratefully acknowledged.

THE MAPS

(Figures 1 and 2).

(1) 2200 m.y.

Classic Archaean-Pilbara, Yilgarn Domains. Archaean known Rum Jungle. Widely scattered probable Archaean North Australia and Albany - Fraser Domain. Postulated continental crust developed beneath Gawler Domain.

(2) 2200 - 1900 m.y.

North Australian Orogenic Province, e.g. Pine Creek, Halls Creek, Tennant Creek etc. West Australian Platform Cover, Hamersley Basin - widespread basic volcanics. Probable marginal mobile belt, uncertain age - Ophthalmia - Gascoyne, Paterson Domains. Cratons-Yilgarn, Pilbara. Shelf sediments postulated, Gawler Domain.

(3) 1900-1750 m.y.

North Australian transitional domains - abundant granites, acid volcanics. Deformation and metamorphism Central Australian Orogenic Province - Gawler, (?)Albany-Fraser Domains. Probable continuing orogenic domain - Ophthalmia-Gascoyne, Paterson.

(4) 1750-1600 m.y.

North Australian Platform Cover, widespread basic volcanics, local troughs - e.g. McArthur, Kimberley Basins, Davenport 'Geosyncline' - locally deformed. Marginal mobile belt, Mount Isa - continental tholeiites west, island-arc tholeiites east. Georgetown Domain possibly equivalent. Further deformation, metamorphism - Willyama, Gawler, Musgrave, Albany-Fraser Domains. Probable metamorphism Arunta Domain. Known granite emplacement Ophthalmia - Gascoyne, Paterson Domains.

(5) 1600-1400 m.y.

First Central Australian transitional tectonism - acid volcanics, granites - Gawler, Willyama, possibly Ophthalmia-Gascoyne Domains. Craton expansion North Australia - only platform cover McArthur, South Nicholson Basins. Main deformation, metamorphism, granites, Mount Isa Domain; possibly Georgetown Domain.

(6) 1400-1200 m.y.

High grade metamorphism Albany-Fraser, Musgrave Domains. New craton, Gawler Block - commencement Central Australian Platform Cover, Adelaide 'Geosyncline' - Willouran sequence with basic volcanics. Craton expansion North Australia; possible commencement new platform cover (Central Australian Platform Cover), Victoria River Basin. Possible transitional tectonism, North Queensland.

(7) 1200-1000 m.y.

Granites, gneisses - Albany-Fraser Domain. Markedly changed structural trends Musgrave Domain. Later transitional tectonism (ca. 1000 m.y.) Musgrave Domain - granites, acid and basic volcanics, basic-ultrabasic Giles Complex intrusives. Postulated hiatus Adelaide 'Geosyncline'. Platform cover, local troughs, Bangemall, Victoria River Basins. Granulites, Northhampton Domain (southwest coast).

(8) 1000 - ca. 700 m.y.

Lack of orogenesis - probably only Tyenna - Rocky Cape Domain, Tasmania. Expansion of Central Australian Platform Cover - Officer (basic volcanics), Amadeus, Arafura Basins; deep troughs, northeasterly sediment sources, Officer Basin, Adelaide 'Geosyncline' (Torrensian). Continuation of Victoria River Basin.

(9) ca. 700 m.y. - Early Cambrian.

Similar pattern to previous map; reversed orientation of sediment thickening Amadeus Basin, Adelaide 'Geosyncline'. Widespread glacials - Sturtian-Marinoan of Adelaide 'Geosyncline'. Craton deformation - Petermann Ranges 'Orogeny' Central Australia, Similar age deformation Kimberleys. Granulites Naturaliste Domain. Australian Precambrian Craton complete.

4

(10). Early Cambrian - Middle Ordovician

First evidence Tasman Geosyncline (East Australian Orogenic Province). Widespread Cambrian basic-ultrabasics. Cambrian andesites Tasmania; Ordovician andesites N.S.W. Delamerian Orogeny Kanmantoo Domain - also deforms adjoining platform cover. Similar age orogenesis northeast of Broken Hill (plus Ordovician transitional tectonism). North Queensland, subsurface of western Queensland, and Tasmania. Expansion Central Australian Platform Cover in north with new Ord, Daly River, Bonaparte Gulf, Canning Basins etc. Early Cambrian plateau basalts - Antrim Plateau Volcanics. Probable platform cover West Irian.

(11) Late Ordovician - Middle Devonian

Complex geosynclinal development and orogenesis Lachlan, North Queensland Domains - Benambran, Bowning, Tabberabberan Orogenies - widespread granites, acid volcanics, some serpentinites. Probably affects New England - Yarrol Domain; spilites Tamworth Trough. Geosynclinal sediments Hodgkinson Domain. Pre-Permian deformed rocks Vogelkop. Limited platform cover on craton; local troughs Carnarvon Basin, Kidson Sub-Basin.

(12) Late Devonian - Carboniferous

Lachlan, North Queensland transitional domains (Du-Cl) - granites, acid volcanics, Kanimblan Orogeny - 'Lambian' sequences, Drummond, Burdekin - Star Basins etc. Early Carboniferous deformation Hodgkinson Domain; followed by late Carboniferous transitional tectonism - acid volcanics, granites, ring dykes, overlapping into older domains. Sedimentation New England - Yarrol Domain, andesites Tamworth Trough. Increased activity on craton - troughs in Bonaparte Gulf, Amadeus, Officer Basins, Fitzroy Trough. Alice Springs 'Orogeny' in Central Australia.

(13) Permian - Triassic

Final orogenesis of New England - Yarrol Orogenic Domain during Permian-granites, metamorphism, serpentinites. New England - Yarrol transitional domain during Triassic - andesites, acid volcanics, granites. Latest Permian - earliest Triassic granites intrude metamorphics Kubor Orogenic Domain. Trans-Australian Platform Cover commenced early Permian; early Permian andesites Bowen Basin, Permian alkali basalts Sydney Basin. Deep troughs Perth, Carnarvon Basins, Fitzroy Trough. Permian-Triassic foredeep Sydney-Bowen Basins adjacent to New England-Yarrol Domain. Permian cratonic granites Hodgkinson Domain. Andesites and geosynclinal sediments New Guinea Orogenic Province - oldest known rocks.

(14) Jurassic-Early Cretaceous

Continuing sedimentation with andesites New Guinea Orogenic Province. Marked stability main continent. Widespread transgression Trans-Australian Platform Cover. Thick troughs marginal to continent - Perth, North Carnarvon, offshore Canning, Browse, offshore Bonaparte Gulf, Maryborough, Otway-Gippsland, Duntroon Basins; Kutubu Trough. Alkali basalts Ashmore Reef, Oxley Basin; alkali gabbro-syenite intrusives southeast Australia; dolerite-granophyre sills Tasmania, basic volcanics south of Perth; andesites Maryborough Basin; granites intrude Bowen Basin, Connors Arch.

(15) Late Cretaceous - Early Miocene

Orogenesis Highlands Orogenic Domain - andesites, metamorphism, ultrabasics - Papuan Ultramafic Belt. Main continent stable, platform cover only marginal to continent. Thick troughs Otway-Gippsland, Browse Basins. Alkali basalt - trachytes eastern Australia.

(16) Early Miocene - Recent.

Similar pattern to previous map on continent. Uplift of highlands in eastern Australia. Further alkali basalts. Extensive faulting, uplift of Highlands Orogenic Domain; accompanying deformation of adjoining platform cover with Pliocene foredeep immediately to south. Sedimentation and andesites North New Guinea and Aure Orogenic Domains with late local uplift. Quaternary New Britain Volcanic Arc - complex suites and Quaternary shoshonites on cratonized parts of New Guinea.

Discussion - Figure 3.

The continent can be divided into a number of fundamental crustal blocks, each possessing its own particular history of evolution, character or tectonic style, age, and structural pattern. The blocks appear to have evolved independently of each other until they had reached, at least, quite advanced stages of their evolution.

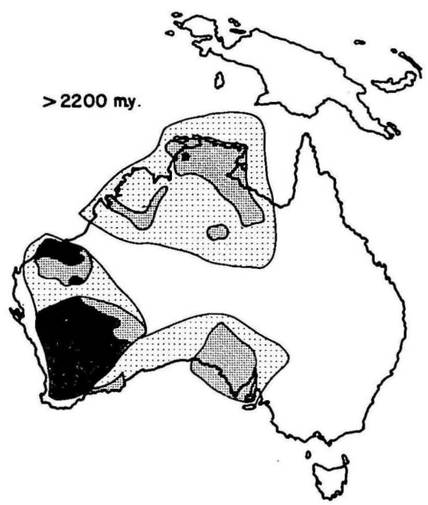
The commonly postulated concept of a pattern of mobile belts surrounding cratonic nucleii appears to be substantiated. What is the origin of the mobile belts?

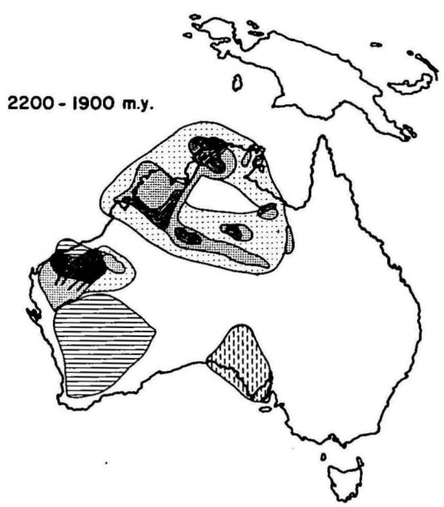
Some authors relate mobile belts to fragmentation of continent along very old, fundamental fractures. Caution is needed in interpreting the existence of a continent-wide fracture system. There are significant differences in patterns between blocks. Major structures appear to be related to block margins. Various explanations are possible.

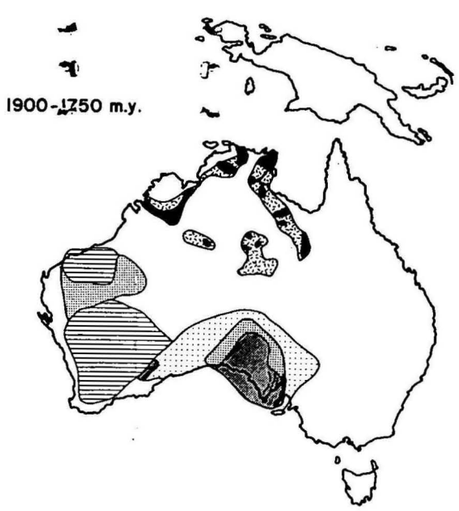
The blocks may be plates welded together at various times during periods of ancient continental drift. This hypothesis is attractive and explains many apparent anomalies, and is consistent with much of the data so far available. It is very difficult to find conclusive evidence for the process however, and it may be impossible to prove in individual cases. The concept should be considered and tested.

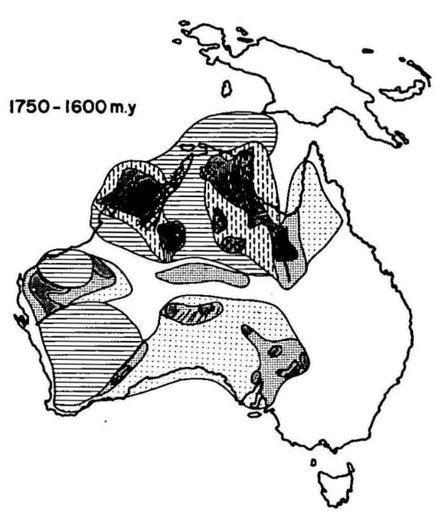
* Presented with the permission of the Director, Bureau of Mineral Resources.

FIG. 1





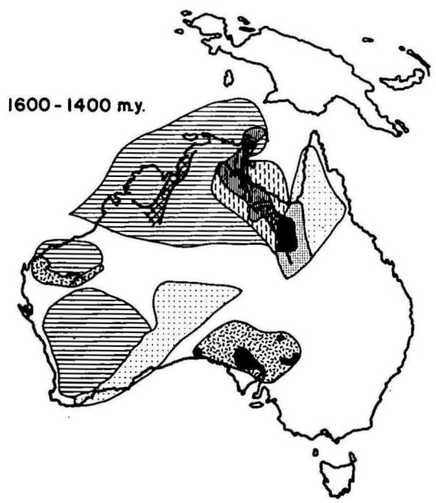


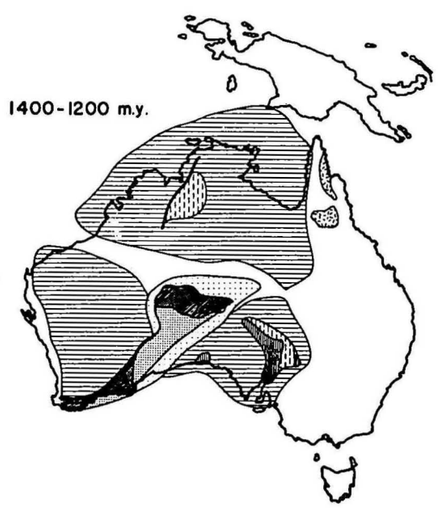


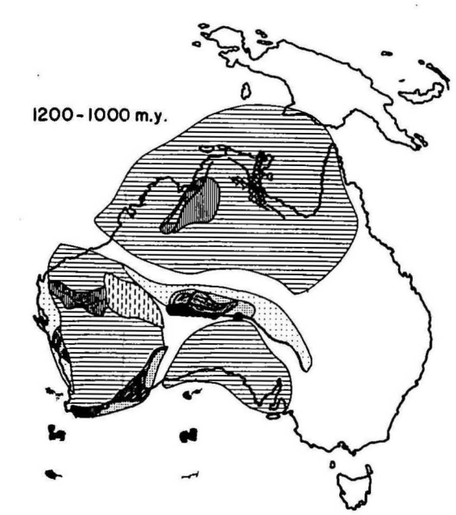
OROGENIC DOMAIN
- Known
- Probable
- Possible

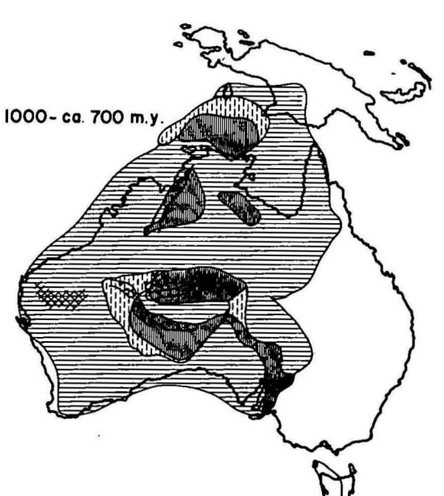
TRANSITIONAL DOMAIN
- Known
- Possible

CRATON
- No active platform cover
- Active platform cover deposition
  - Known
  - Possible
- Foredeep
- Craton deformation







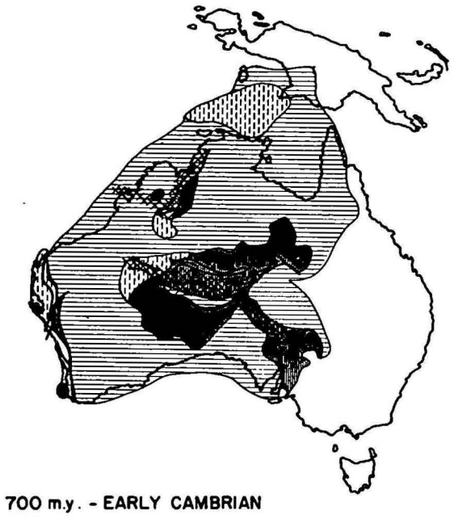


- Orogenic structural trend
- Major fault or flexure
- Upwarp affecting platform
- Downwarp affecting platform cover

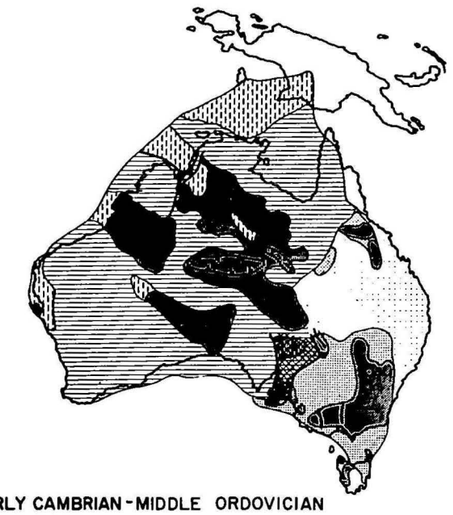
M(L)77

8 Y

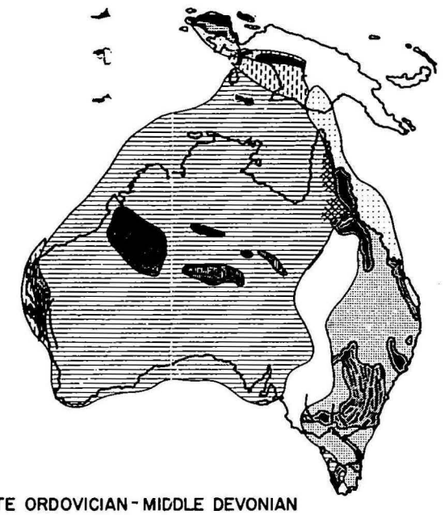
FIG. 2



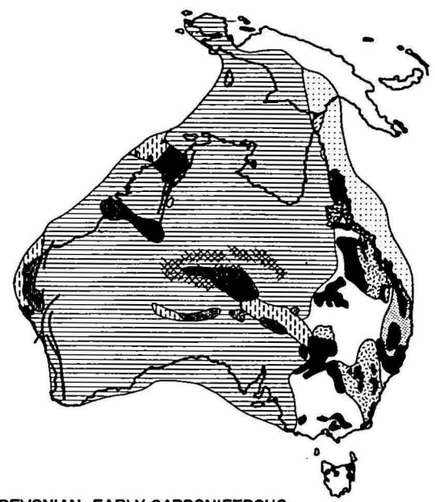
ca. 700 m.y. - EARLY CAMBRIAN



EARLY CAMBRIAN - MIDDLE ORDOVICIAN



LATE ORDOVICIAN - MIDDLE DEVONIAN



LATE DEVONIAN - EARLY CARBONIFEROUS

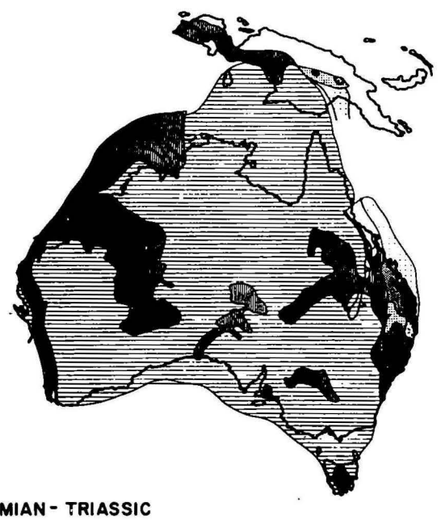
Late Carboniferous transitional domains

OROGENIC DOMAIN
- Known
- Probable
- Possible

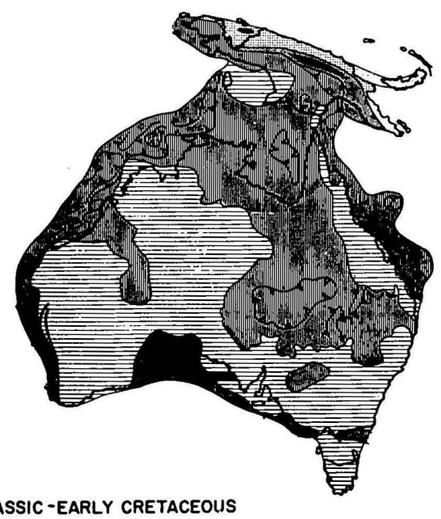
TRANSITIONAL DOMAIN
- Known
- Possible

CRATON
- No active platform cover
- Active platform cover deposition
  - Known
  - Possible
- Foredeep
- Craton deformation

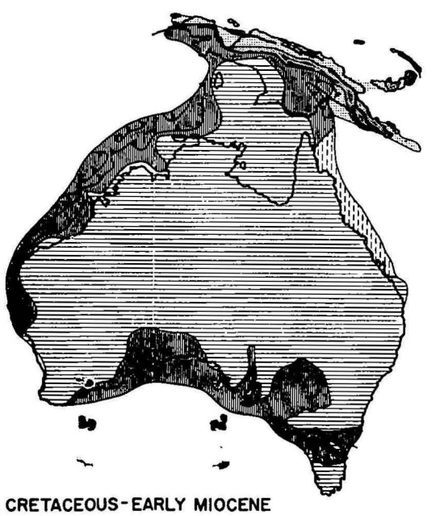
- Orogenic structural trend
- Major fault or flexure
- Upwarp affecting platform
- Downwarp affecting platform cover



PERMIAN - TRIASSIC



JURASSIC - EARLY CRETACEOUS



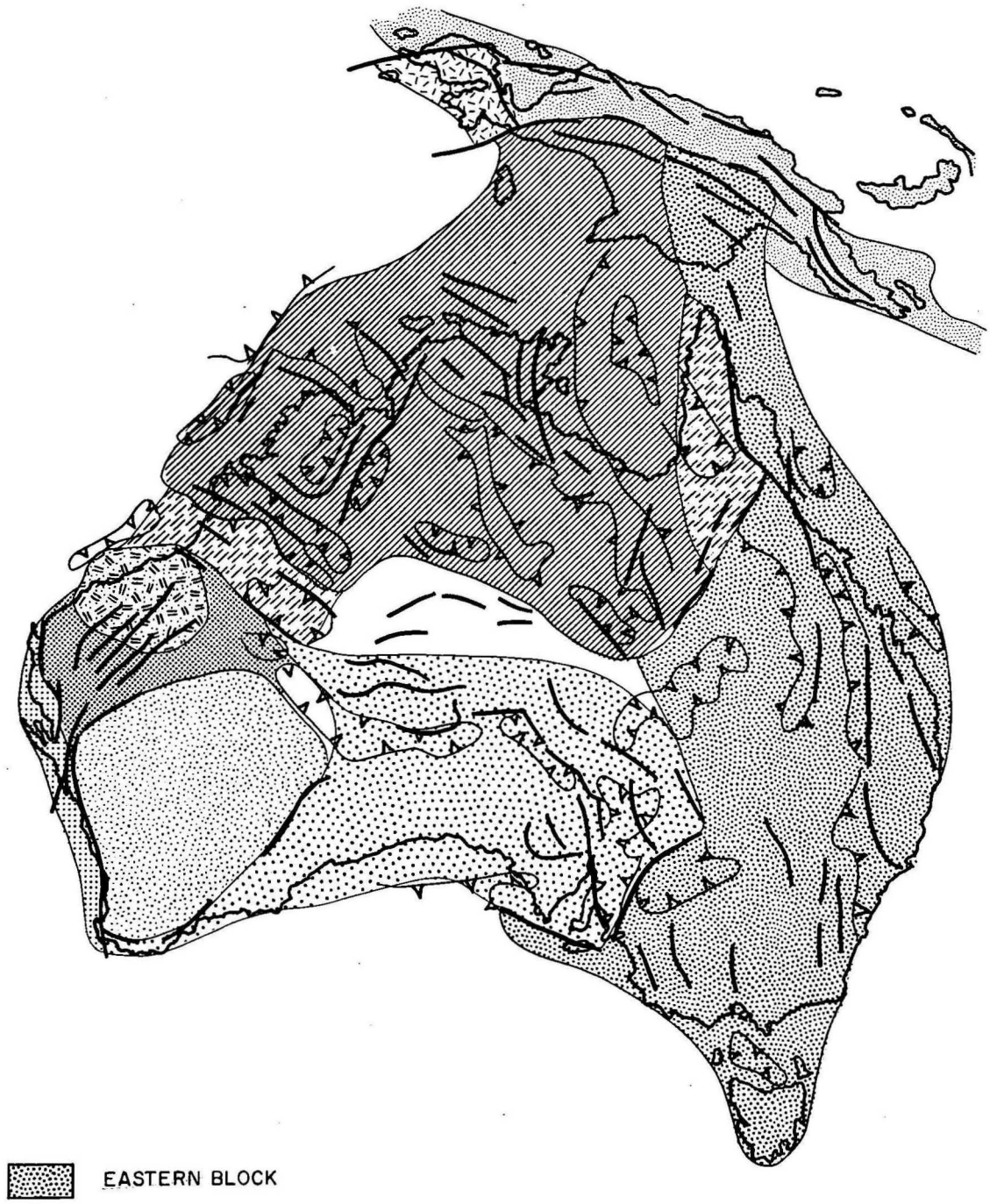
LATE CRETACEOUS - EARLY MIOCENE

EARLY MIOCENE - PRESENT

9x

M(L) 78

FIG. 3


EASTERN BLOCK
NEW GUINEA BLOCK
NORTHERN BLOCK
OPHTHALMIA - GASCOYNE BLOCK
PILBARA BLOCK
SOUTHERN BLOCK
VOGELKOP BLOCK
WESTERN BLOCK
YILGARN BLOCK

M/L179