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PALAEOGEOGRAPHY

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PLATE-WIDE
PALAEOGEOGRAPHIC
MAPS

BY MARITA BRADSHAW, HEIKE STRUCKMEYER, ANNE
WALLEY & MONICA YEUNG

RECORD 1994/31



AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

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AGSO-APIRA PHANEROZOIC HISTORY OF AUSTRALIA PROJECT (175A)

PLATE-WIDE PALAEOGEOGRAPHIC MAPS

BY

MARITA BRADSHAW, HEIKE STRUCKMEYER, ANNE WALLEY &
MONICA YEUNG

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DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

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CONTENTS

ACCOMPANYING NOTES

INTRODUCTION

DESCRIPTIONS OF TIME SLICE PALAEOGEOGRAPHIES

REFERENCES

TABLES

TABLE 1. LIST OF TIME SLICES

TABLE 2. ENVIRONMENTAL CODES

FIGURES

FIGURE 1. TECTONIC COMPONENTS OF EASTERN INDONESIA (from Struckmeyer et al., 1993).

FIGURE 2. TECTONIC COMPONENTS OF PAPUA NEW GUINEA (from Struckmeyer et al., 1993).

FIGURE 3. PLATE RECONSTRUCTION FOR THE MIDDLE TO LATE TRIASSIC - detail (from Struckmeyer et al., 1993).

FIGURE 4. PLATE RECONSTRUCTIONS FOR THE LATE JURASSIC - 150 Ma

FIGURE 5. PLATE RECONSTRUCTIONS FOR THE CAMPANIAN - 75 Ma

FIGURE 6. PLATE RECONSTRUCTIONS FOR THE LATE MIOCENE - 10 Ma

ENCLOSURES

TIME SLICE PALAEOGEOGRAPHIC MAPS

TIME SLICE TRIASSIC 1/2 - Scythian-Anisian (248 - 239 Ma)

TIME SLICE TRIASSIC 3/4 - latest Anisian-Ladinian (239 - 231 Ma)

TIME SLICE TRIASSIC 5/6 - Carnian-Norian-Rhaetian (231 - 213 Ma)

TIME SLICE JURASSIC 2 - Pliensbachian-Toarcian (200 - 191 Ma)

TIME SLICE JURASSIC 5 - early & mid Bajocian (180 - 177 Ma)

TIME SLICE JURASSIC 8 - Oxfordian-Kimmeridgian (162 - 150 Ma)



TIME SLICE CRETACEOUS 1 - Berriasian-earliest Valanginian (144 - 137 Ma)

TIME SLICE CRETACEOUS 4 - Aptian (119 - 114 Ma)

TIME SLICE CRETACEOUS 8 - latest Albian-Cenomanian (99 - 91 Ma)

TIME SLICE CRETACEOUS 10B - mid Campanian-mid Maastrichtian (78 -70 Ma)

TIME SLICE CAINOZOIC 1 - Paleocene-early Eocene (66.4 -52.0 Ma)

TIME SLICE CAINOZOIC 2B - late Eocene (40.0 - 36.5 Ma)

TIME SLICE CAINOZOIC 4A - late Oligocene-earliest Miocene (30 - 22 Ma)

TIME SLICE CAINOZOIC 4B - early Miocene (22.0 - 15.2 Ma)

TIME SLICE CAINOZOIC 6A - early Pliocene (5 - 3 Ma)

TIME SLICE CAINOZOIC 7 - Quaternary (0 - 1.7 Ma)

PLATE-WIDE PALAEOGEOGRAPHIC MAPS - ACCOMPANYING NOTES

BY MARITA BRADSHAW

INTRODUCTION

The AGSO-APIRA Phanerozoic History of Australia Project was jointly funded by government and the petroleum exploration industry with the aim of producing new syntheses of Australian geology relevant to the search for fossil fuels. The project was carried out at the then, Bureau of Mineral Resources, as part of the Onshore Sedimentary and Petroleum Geology Program. The contribution of industry was co-ordinated through APIRA, the petroleum division of the Australian Mineral Industry Research Association. The project ran from 1988 to first quarter 1992, it involved over 30 man years of effort and was sponsored by nineteen companies.

The major products were palaeogeographic maps of the Australian plate for 16 time slices from the Triassic to the Recent, Gondwanan palaeogeographic maps for 5 Permian time slices, and 13 regional cross-sections covering the northern, western and southern margins of Australia (Bradshaw & others, 1993). These were supported by a new regional plate model, detailed reports, correlation charts, data maps and data compilations. Other major outputs included biostratigraphic charts and notes for the ten Phanerozoic time periods (Archbold Dickins, 1989; Balme, 1989; Burger, 1989a & b; Jones, 1989; Shergold, 1989; Strusz, 1989; Truswell & others, 1989; Webby & Nicoll, 1989; & Young, 1989), an Australian inundation curve (Struckmeyer & Brown, 1990) and a fission track data base (Bradshaw & others, 1991).

The aim of the palaeogeographic maps component of the project was to place Australia in its regional context by extending the original Australian maps to the edge of the plate. This required compiling information from eastern Indonesia, Papua New Guinea, the south west Pacific, New Zealand, Antarctica and the Indian Ocean.

Information from published and unpublished reports, maps and exploration, ODP and DSDP wells was synthesised into summary stratigraphic columns showing lithology, thickness, depositional environment, age control and hydrocarbon occurrences. Lithology and thickness were plotted on time slice data maps. Various reports summarise the basic data compiled for the individual areas (see Bradshaw, 1992; Struckmeyer, 1990, 1991a; Walley, 1989, 1991a, 1991b & 1991c; Yeung, 1992). In all, three hundred new data points and 195 summary stratigraphic columns were added to the original palaeogeographic maps data base. The mapping scale was 1:10 m using the circum-Pacific south-west quadrant map as the base for the data maps.

The time slice palaeogeographic maps (see enclosures) were plotted onto reconstructed bases that reflected the plate tectonic history of the region. The TERRA MOBILIS program was used to produce computer reconstructions of the plate model for the required time slices. Over 80 individual tectonic elements in the region were identified (figures 1 & 2) and added to the generalised global model used in this program. Selected reconstructions are provided with this report to assist in identifying environmental boundaries from tectonic element boundaries on the palaeogeographic maps (see figures 1 to 6). Reports and papers by Struckmeyer & others (1991), Struckmeyer (1991b), Struckmeyer & others

(1993) and Walley & Ross (1991) describe the development of the reconstructions and discuss the plate tectonic evolution of the various regions.

The Australian palaeogeographic maps from the first AGSO-APIRA project (BMR Palaeogeographic Group, 1990) were updated and integrated with the new regional interpretations to produce palaeo-environmental maps of the plate for sixteen time slices from the Triassic to the Recent. The New Zealand/Antarctic compilation was restricted to the Cretaceous and Cainozoic and India was not included in scope of the project. The report by Langford (1991) provides palaeogeographic maps of Gondwana for the Permian.

The palaeogeographic maps show the facies and tectonic relationships through time between Australia and the region. Some of the relationships revealed are of relevance to petroleum exploration as they point to the extension of successful plays into new areas and suggest new play concepts. However, it should be remembered that the maps are interpretive and based on reconstructions that represent only one of several plate models that may apply.

Following are short notes to accompany the plate-wide palaeogeographic maps. More detailed descriptions of the palaeogeographic evolution of individual areas are provided in reports by Struckmeyer & Yeung (1991) and Walley (1992a & 1992b).

DESCRIPTIONS OF TIME SLICE PALAEOGEOGRAPHIES

TIME SLICE TRIASSIC 1/2 - Scythian-Anisian (248 - 239 Ma)

In the early Mesozoic Australia was part of Eastern Gondwana linked with Greater India, Antarctica and various continental fragments. There was a passive marine margin on the northwest facing into Tethys and a convergent margin to the east indicated by volcanic activity in New Caledonia.

The early Triassic was a transgressive marine phase. Most of Argo Land was submerged and a seaway is indicated through the Carnarvon Basin and Greater India to the Perth Basin. Marine shales deposited by this transgression provide the seal and source for small gas and oil occurrences in the Perth Basin and similar potential may also exist along the margin to the north.

TIME SLICE TRIASSIC 3/4 - latest Anisian-Ladinian (239 - 231 Ma)

During this phase of the Triassic there was little sedimentation in onshore Australia and most of Eastern Gondwana was emergent, perhaps in response to increased heatflow as a prelude to later rifting. There was no longer a marine connection to the Perth Basin and much of Argo Land was emergent providing a source for sands in Timor and on the outer margins of the North West Shelf. Fluvial sediments were deposited in restricted rift basins in northeastern Australia and New Guinea. A volcanic margin was still active to the east.

TIME SLICE TRIASSIC 5/6 - Carnian-Norian-Rhaetian (231 - 213 Ma)

In comparison to the previous time slice this was a time of high sea level. Large volumes of clastic sediments were deposited on the North West Shelf in fluvial to paralic environments. These sands now act as reservoirs for major oil and gas accumulations. Seaward of the marginal marine environments a reef tract occurred which provides a potential exploration target. Reefal material has been collected from ODP drilling and dredging on the northern edge of the Exmouth Plateau. Reefs probably also extended further north along the margin as indicated on the map (Exon & others, 1991). Rift volcanism was active in eastern New Guinea.

TIME SLICE JURASSIC 2 - Pliensbachian-Toarcian (200 - 191 Ma)

During this time slice there was further transgression across the North West Shelf and an expansion of terrestrial deposition in Australia. A large fluvio-lacustrine system was established that generally flowed eastwards to an interpreted shoreline located on Lord Howe Rise.

TIME SLICE JURASSIC 5 - early & mid Bajocian (180 - 177 Ma)

A seaway was re-established between the Perth Basin and Tethys. Deep marine embayments in eastern New Guinea were the site of source rock accumulation.

TIME SLICE JURASSIC 8 - Oxfordian-Kimmeridgian (162 - 150 Ma)

Argo Land separated from the North West Shelf as sea-floor spreading commenced in the Argo Abyssal Plain. Source rocks accumulated in deep marine troughs in the Carnarvon and Bonaparte basins and in similar environments across New Guinea. Rift valley sedimentation may have commenced on the Queensland Plateau prior to the formation of the Coral Sea. Other sections of the eastern margin were still convergent as indicated by volcanic activity on New Caledonia and the significant volcanic component in Eromanga and Surat basin sediments.

Fluvial and lacustrine environments with potential for source and reservoir facies, occupied the rift valley between Australia and Antarctica. An area of highlands is interpreted across Antarctica and into Tasmania related to dolerite intrusion which preceded continental break-up in the Cretaceous.

TIME SLICE CRETACEOUS 1 - Berriasian-earliest Valanginian (144 - 137 Ma)

Reservoir sands were deposited in deltaic environments in the Carnarvon and pauan basins. Final terrane convergence was underway in the New Zealand area to the southeast of Antarctica.

TIME SLICE CRETACEOUS 4 - Aptian (119 - 114 Ma)

This was the period of maximum marine transgression on onshore Australia since the Ordovician. Seaways intruded into the centre of the continent from the north, east, south and west. Sea-floor spreading in the Perth, Gascoyne and Cuvier abyssal plains separated Greater India from Australia and marine environments occupied the western end of the Australian/Antarctic rift. Several areas of emergent land are interpreted in New Guinea and the associated continental fragments as a prelude to break-up and sea-floor spreading later in the Cretaceous and Paleocene.

TIME SLICE CRETACEOUS 8 - latest Albian-Cenomanian (99 - 91 Ma)

In the mid Cretaceous the eastern Australian margin changed from a Chilean-type to a Mariana-type convergent margin with the resulting formation of a number of back arc basins - Tasman Sea, New Caledonia Basin and Coral Sea (Veevers, 1991). The map shows a complex of rift valley environments and restricted marine basins in the southeast Australia/Antarctica/New Zealand region. Prolific non-marine source rocks were deposited in the Gippsland and Taranaki basins at around this time and the palaeogeographic reconstruction suggests petroleum potential in deep water on the Lord Howe Rise and Norfolk Ridge.

The eastern Indonesian continental fragments were detached from northeastern Australia by oblique extension. The Ontong Java Plateau appears on the far right of the map, the first of a series of oceanic plateaux and island arcs moving westwards on the Pacific plate that eventually are accreted to the Australian Plate.

TIME SLICE CRETACEOUS 10B - mid Campanian-mid Maastrichtian (78 -70 Ma)

In the late Cretaceous there was little sedimentation in onshore Australia and carbonates were deposited on the western margin. Sea-floor spreading between Australia and Antarctica had progressed eastwards to Tasmania. The Eastern Highlands were established as a continuous upland bordering the newly forming Tasman Sea Basin.

TIME SLICE CAINOZOIC 1 - Paleocene-early Eocene (66.4 -52.0 Ma)

Continued sea-floor spreading in the Tasman Sea further separated the Lord Howe Rise/Norfolk Ridge and the New Zealand fragments from Australia and Antarctica. The formation of the Coral Sea resulted in the intrusion of deep water environments between the Queensland Plateau and the Papuan Peninsula and uplift and erosion through much of the Papuan Basin.

TIME SLICE CAINOZOIC 2B - late Eocene (40.0 - 36.5 Ma)

The mid Eocene was a period of major plate reorganisation. India docked with Asia, the rate of sea-floor spreading between Australia and Antarctica increased and the movement direction of the Pacific Plate changed from northwards to westwards. As a result there was increasing convergence on the eastern margin of the Australian Plate as marked by a chain of island arcs from New Guinea to Tonga. An alternative arrangement of island arcs in the southwest Pacific at this time is proposed in Falvey & others (1991).

The eastern Indonesian continental fragments detached from northeastern Australia in the Cretaceous, continued their transit westwards, towards Asian continental fragments which appear in the northwest sector of the map. Marine environments and carbonate deposition held sway over most of the map area. It was a period of relatively high sea level as indicated by the flooding of the Eucla Basin in southern Australia.

TIME SLICE CAINOZOIC 4A - late Oligocene-earliest Miocene (30 - 22 Ma)

This was generally a period of high sea level following the major mid-Oligocene unconformity. Hot spot activity in the Tasman Sea produced sea mounts. The Three Kings Rise may have been active as an island arc. The Solomons, New Hebrides and Fiji all have igneous activity related to the subduction of the Pacific Plate. By this time deep ocean existed between Australia and Antarctica and the circum-Antarctic current was established leading to the beginnings of glaciation.

Carbonate platform and reef environments predominated in New Guinea providing important reservoir facies for hydrocarbons sourced from Mesozoic and possibly Pliocene shales. The first collision along Australia's northern margin occurred in the mid-Oligocene resulting in initiation of foreland basin deposition in the northern-most Papuan Basin. At the same time, arc volcanism occurred to the north and north east with associated volcanics and volcanoclastics accumulating in mostly marine environments.

TIME SLICE CAINOZOIC 4B - early Miocene (22.0 - 15.2 Ma)

This was a major reef building period in the south-west Pacific. Potential reefal reservoirs accumulated in the Loyalty Islands, Tonga, Fiji, Vanuatu (Ora Limestone on Espiritu Santo), the Solomons (Tina Calcarenite, Mbetilonga Limestone on Gaudalcanal), Bougainville, New Ireland, New Britain and New Guinea. Vanuatu and Fiji were part of same island chain along the Vitiaz Arc.

In the reconstructions the younger southern half of New Hebrides chain is deleted, Fiji moved to be along side the main islands of Vanuatu and rotated as indicated by palaeomagnetic data. The palaeogeographic trends for the early Miocene plot neatly across this reconstruction. A chain of sea mounts formed in the Tasman Sea due to hot spot activity, and a volcanic arc developed in the North Island, New Zealand.

Collision between the Australian and Pacific plates produced a linear zone of uplift, folding and metamorphism in Irian Jaya. Carbonate platform and reef environments persisted behind the foldbelt and in the greater part of the Papuan Basin. In Australia there was a Miocene compressive phase of structuring in the Eromanga Basin producing folding and wrench faulting. It has been related to collision in New Guinea and resultant compressive forces set up in Australian craton.

TIME SLICE CAINOZOIC 6A - early Pliocene (5 - 3 Ma)

This was a time of major tectonic activity in the region and a period of eustatic sea level fall according to Haq & others (1987). In New Zealand there was uplift of the Southern Alps and the formation of massive gravel plains. The North Fiji Basin opened, rotating the New Hebrides arc to the east and shifting Fiji from an island arc position on the plate boundary to an oceanic island group. In the Bismarck arcs there was block faulting and graben formation and the Manus and Woodlark basins opened around 3.5 million years ago. The Timor Trough subsided in the Late Pliocene.

In the Papuan Basin a thick sequence of mostly fine-grained sediments accumulated in a foreland basin setting, providing a regional seal for Miocene limestones. New Guinea was characterised by continuing collisional events, regional uplift and the formation of the Papuan/Irian Jaya Fold Belt with associated trap formation.

On mainland Australia there was also tectonism. There were vast outpourings of basalt in western Victoria related to hot spot activity. In the Gippsland Basin, compressive structuring during Pliocene to Recent reactivated older structures and there was the onset of freshwater influx to reservoirs.

TIME SLICE CAINOZOIC 7 - Quaternary (0 - 1.7 Ma)

This map depicts the peak of the last glaciation when sea level was depressed by around 130 m. This time has been chosen as representative of most of Quaternary time. The fall in sea level and the emergence of islands resulted in aeolinite deposition, karstic weathering of limestones, deposition of sands in offshore areas, and influx of fresh water below present day sea level. Similar patterns during past low sea level phases have relevance for petroleum - low stand fan reservoirs, karstic porosity, contamination and flushing of hydrocarbon reservoirs.

The late Quaternary was also characterised by the expansion of ice cover. Glaciers occurred in Tasmania, south-eastern Australia, New Zealand, New Guinea and Borneo.

Expansion of the ice sheet in Antarctica was limited by a narrow continental shelf. Grounded ice filled the Ross and Weddell seas which are today floating ice shelves. There was a northward shift in the limit of iceberg activity as recorded in sediments from DSDP drilling.

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PALAEOGEOGRAPHIC MAPS OF THE AUSTRALIAN PLATE

LIST OF TIME SLICES

CAINOZOIC

Quaternary Cz7	0 - 1.7 Ma
Early Pliocene Cz6a	3.0 - 5.0 Ma
Early Miocene Cz4b	15.2 - 22.0 Ma
Earliest Miocene-Late Oligocene Cz4a	22.0 - 30.0 Ma
Late Eocene Cz2b	36.5 - 40.0Ma
Early Eocene-Paleocene Cz1	52.0 - 66.4Ma

CRETACEOUS

Mid Maast-Mid Campanian K10b	70.0 - 78.0Ma
Cenomanian-Latest Albian K8	91.0 - 99.0Ma
Aptian K4	114.0 - 119.0Ma
Earliest Valanginian-Berriasian K1	137.0 - 144.0Ma

JURASSIC

Kimmeridgian-Oxfordian J8	150.0 - 162.0Ma
Early & Mid Bajocian J5	177.0 - 180.0Ma
Toarcian-Pliensbachian J2	191.0 - 200.0Ma

TRIASSIC

Rhaetian-Norian-Carnian T5/6	213.0 - 231.0Ma
Ladinian-latest Anisian T3/4	231.0 - 239.0Ma
Anisian-Scythian T1/2	239.0 - 248.0Ma

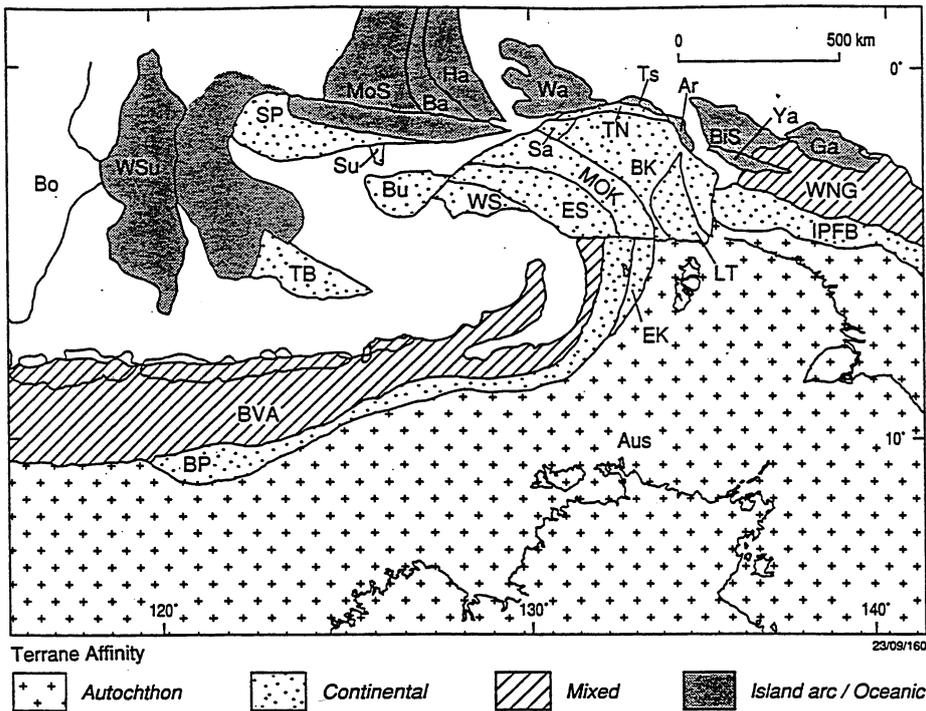
The time slices used for the BMR-APIRA Phanerozoic History of Australia Project were selected from those used in the initial Palaeogeographic Maps Project. In some cases the original time slice was used (e.g. K4), in others an amalgamation of two time slices were mapped (e.g. T1/2) and in others a finer division of the time slice suited the purposes of the second project (e.g. Cz4a & Cz4b). The linear time scale used was Harland & others (1982), except for the Cainozoic where Breggern was used, with the K/T boundary at 66.4 Ma.

TABLE 1.

ENVIRONMENT CLASSIFICATION TABLE

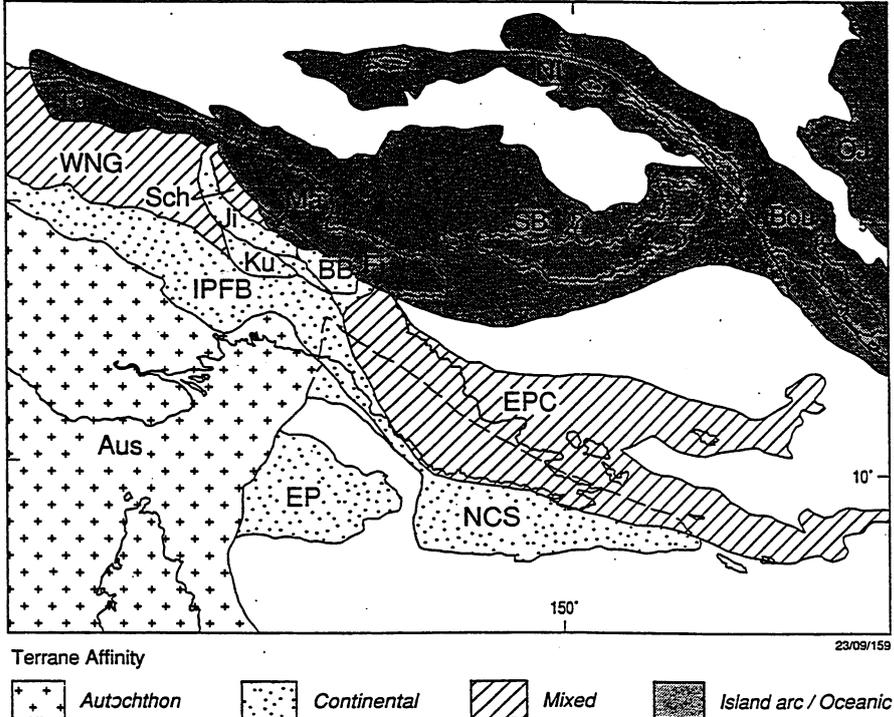
Code	Environment	Working definition
Land environments		
LEU	unclassified	Areas with no preserved sediments of time-slice age, interpreted as land. <i>BROWN</i>
LEE	erosional	Highland areas of sediment erosion, indicated by palaeocurrents, provenance studies, tectonic setting and the presence of igneous intrusions. <i>DARK BROWN</i>
LDU	depositional, unclassified	No indication of specific environment, often includes subaerial volcanics. <i>LIGHT BROWN</i>
LDL	depositional, fluvial	River deposits such as alluvial fans, braided and meandering channel deposits and coarser overbank sediments, and sand-dominated continental sequences with no evidence of aeolian or lacustrine deposition. <i>ORANGE</i>
LDL	depositional, fluvio-lacustrine	Sediments deposited in low-energy river environments such as channels, overbanks, backswamps and shallow lakes on low-gradient floodplains; typically sequences dominated by fine-grained sediments and coal, with sheet geometry. <i>GOLD</i>
LDL	depositional, lacustrine	Deposits of deep, persistent lakes, usually in tectonically controlled basins. Distinguished from LDL by thicker shales and more restricted distribution. <i>YELLOW</i>
LDA	depositional, aeolian	Generally sand deposited by wind action as dunes; characterised by large-scale cross-bedding, a high degree of sorting, and frosting of grains. Fossils rare. Local clay deposits between dunes. <i>ORANGE-PINK</i>
LDG	depositional, glacial	typically coarse, poorly sorted sediments, commonly with striated pebbles, cobbles and boulders. Complex facies ranging from aeolian sands flanking glaciers, river gravel, mud with or without dropstones, at times finely laminated (varved). <i>GREY</i>
Coastal environments		
CDP	paralic	Deposits of coastal or marginal marine environments. Includes the range of environments situated at the land/sea boundary such as lagoonal, beach, intertidal, deltaic, etc., and is recognised by a variety of depositional facies ranging from coarse cross-bedded beach sand, to sand deposited in tidal deltas, to finely laminated organic sediment deposited in lagoons and estuaries (includes deltaic and intertidal-supratidal environments). <i>GRASS GREEN</i>
CDIS	intertidal-supratidal	Sediments deposited in the tidal zone, indicated by the presence of finely interlaminated fine and coarse detritus, herringbone cross-bedding, flaser bedding, evidence of periodic exposure, etc. <i>EMERALD GREEN</i>
CDD	deltaic	Deltaic deposits indicated by isopach patterns, upward-coarsening sequences and the map pattern of adjacent environments. Cuspate or lobate form of deltas on maps in some cases follows isopach pattern. <i>PALE GREEN</i>
Marine environments		
MU	unclassified	No indication of specific depth of marine environment, often submarine volcanics. <i>POWDER BLUE</i>
MVS	very shallow (0-20 m water depth)	Marine sediments with evidence of deposition above wave base and/or occasional emergence, e.g. oolites, cross-bedding. <i>VERY LIGHT BLUE</i>
MS	shallow (0-200 m water depth)	Marine sediments deposited on the continental shelf or on flanks of volcanic islands, e.g. sand, mud and limestone containing fossils that typically lived in shallow water; also includes areas along young, active spreading ridges (includes MVS). <i>LIGHT BLUE</i>
MBA	bathyal to abyssal (> 200 m water depth)	Marine sediments with indicators of deep-water deposition, e.g. condensed sequences, turbidites, monotonous shale, and the presence of deeper-water organisms (includes abyssal environments). <i>BLUE</i>
MA	abyssal (>1000 m water depth)	Distal turbidites, red clays, siliceous and calcareous ooze, ocean floor basalt, includes sediments deposited below the CCD. <i>DARK BLUE</i>

TABLE 2.



- Aus Australia
 - Ar Arfak
 - Ba Bacan
 - BiS Biak Supiori
 - BK Birdsheed / Kemum Terrane
 - Bo Borneo
 - BP Banda Para-autochthon
 - Bu Buru
 - BVA Banda Volcanic Arc C.
 - EK East Kai
 - ES East Seram
 - ESu East Sulawesi
 - Ga Gauttier Terrane
 - Ha Halmahera
 - LT Lengguru Terrane
 - MOK Misool/Onin Kumawa T.
 - MoS Molluca Sea Collision C.
 - IPFB Irian Jaya-Papuan Fold Belt
 - Sa Salawati
 - SP Sula Platform
 - Su Sulabesi
 - TB Tukangbesi / Buton
 - TN Tamrau / Netoni Terrane
 - Ts Tosem
 - Wa Waigeo Terrane
 - WNG West New Guinea Composite Block
 - WS West Seram
 - WSu West Sulawesi
 - Ya Yapen
- (T. = Terrane C. = Complex)

Figure 1. Tectonic components of eastern Indonesia.



- Aus Australia
- BB Bena Bena Terrane
- Bou Bougainville Block
- EP Eastern Plateau
- EPC East Papua Composite Terrane
- Fi Finisterre Terrane
- Ji Jimi Terrane
- Ku Kubor Block
- Ma Marum Terrane
- NCS North Coral Sea
- NI New Ireland Block
- OJ Ontong Java Plateau
- IPFB Irian Jaya-Papuan Fold Belt
- SB South Bismarck Block
- Sch Schrader Terrane
- To Torricelli Terrane
- WNG West New Guinea Composite Block

Figure 2. Tectonic components of Papua New Guinea.

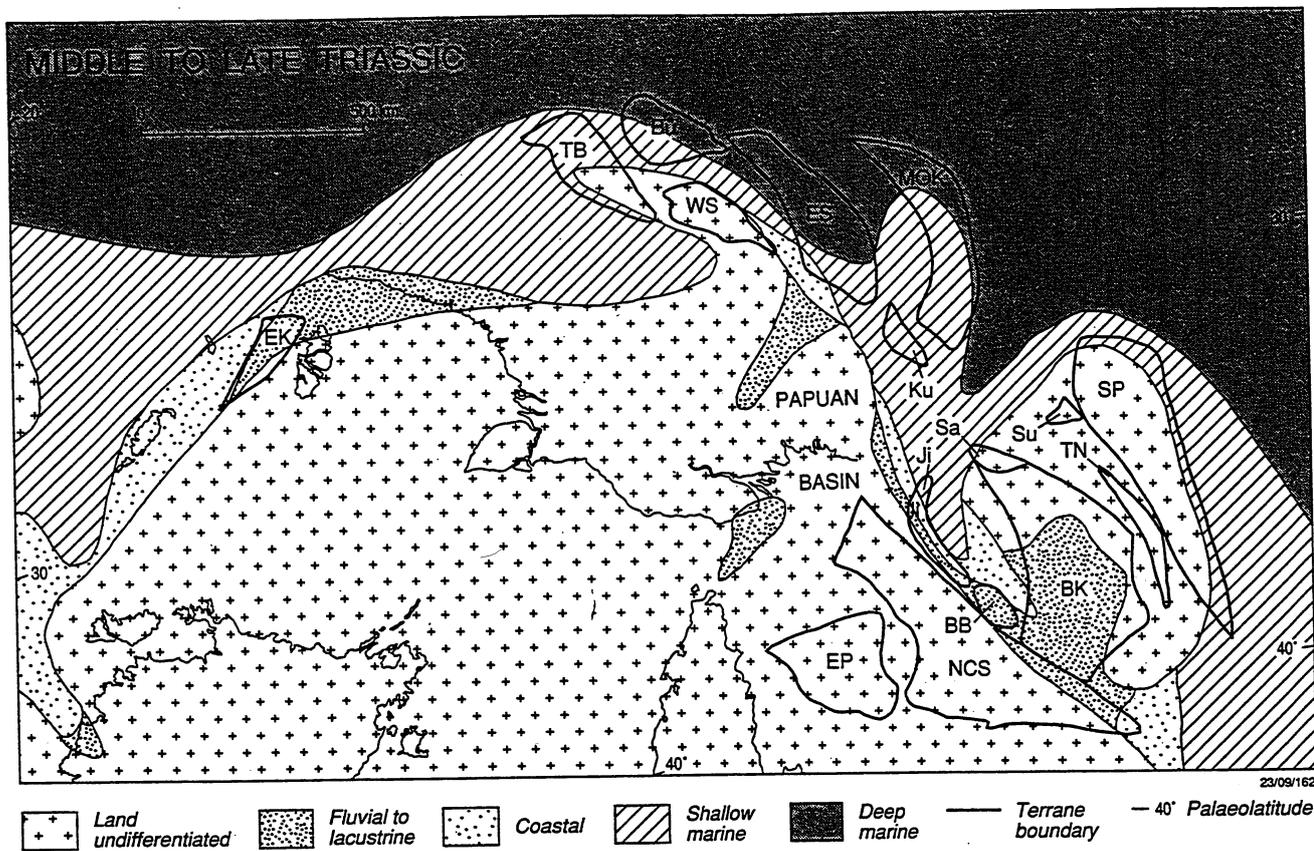


FIGURE 3.

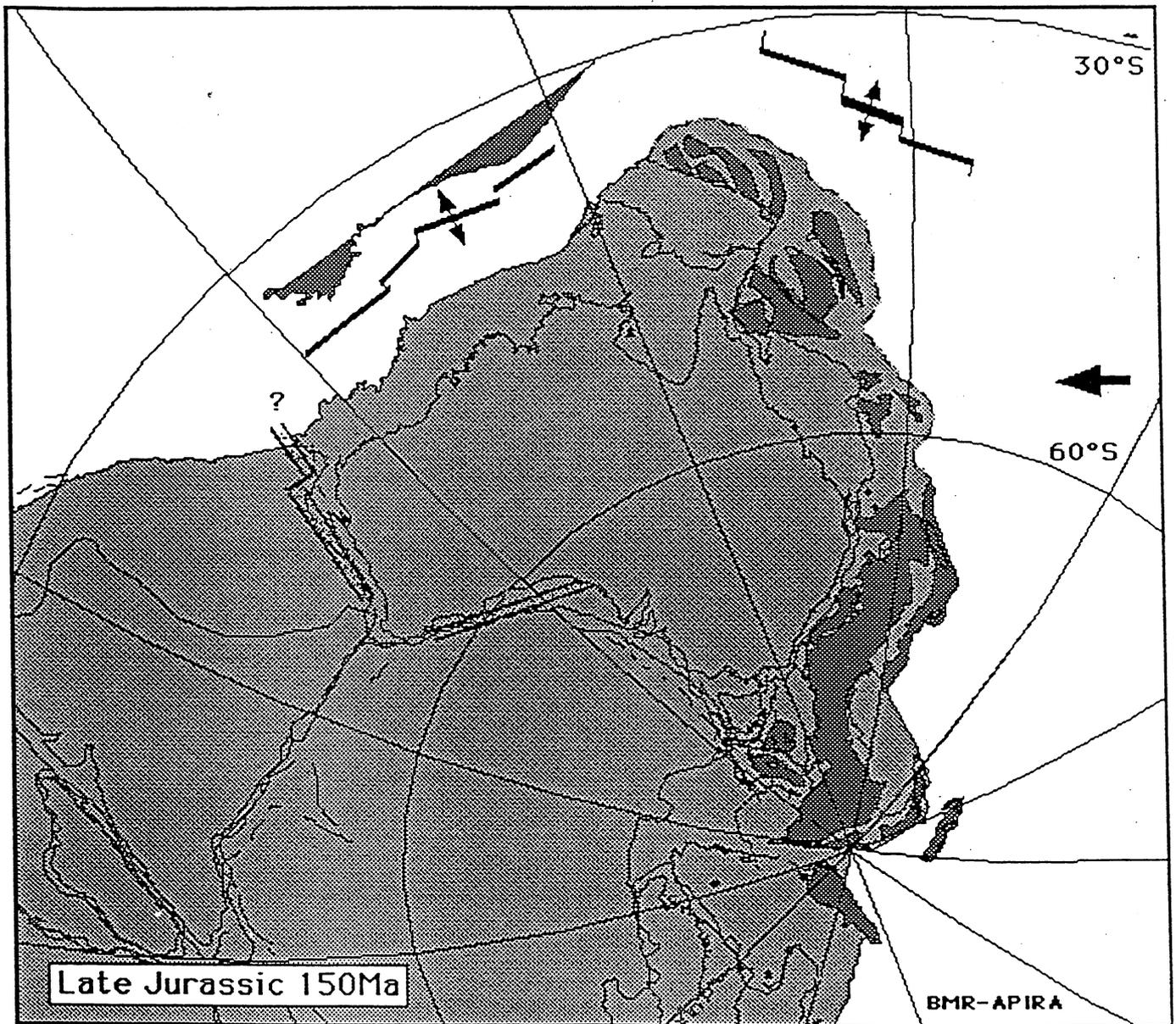


FIGURE 4.

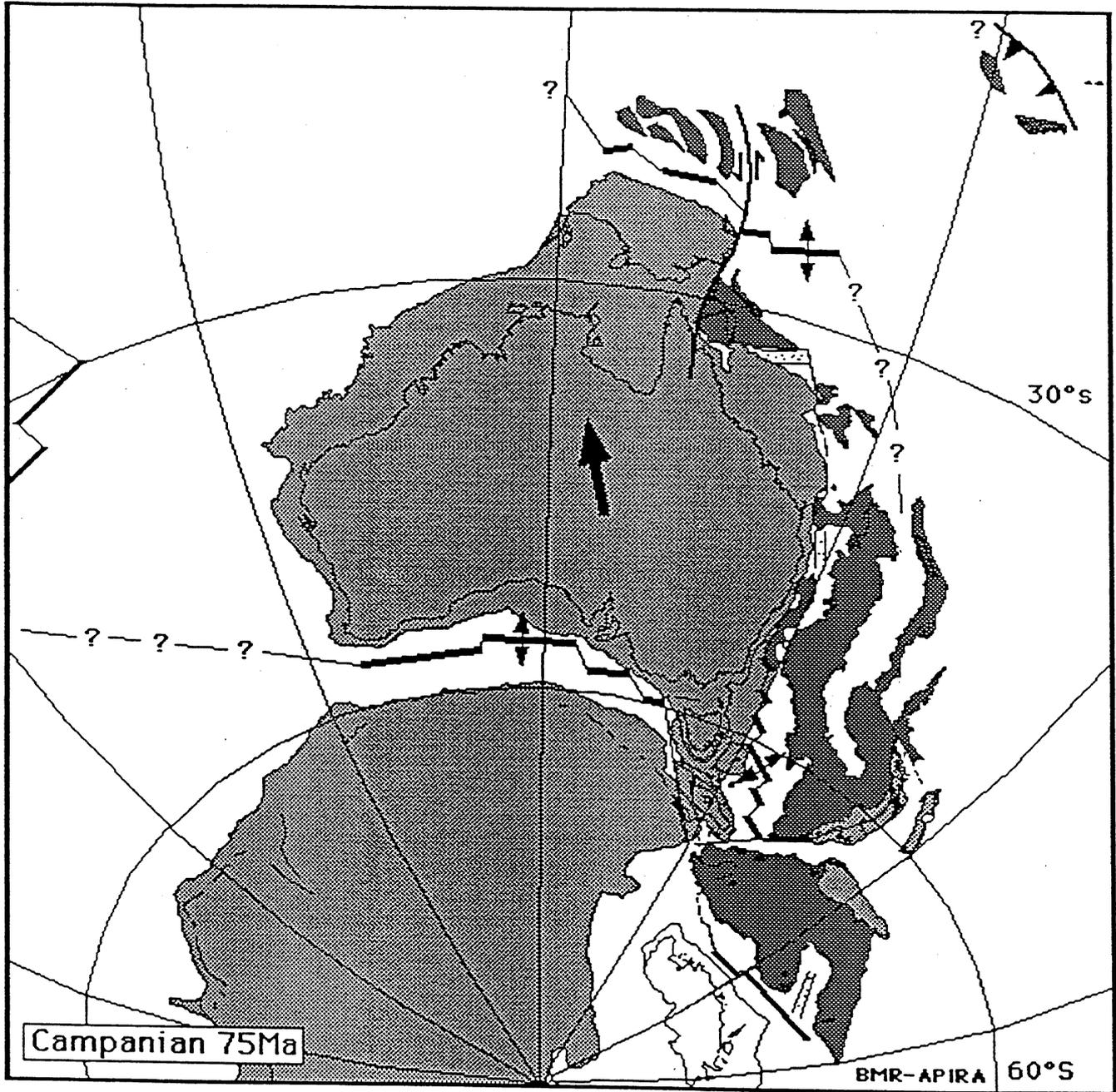


FIGURE 5.

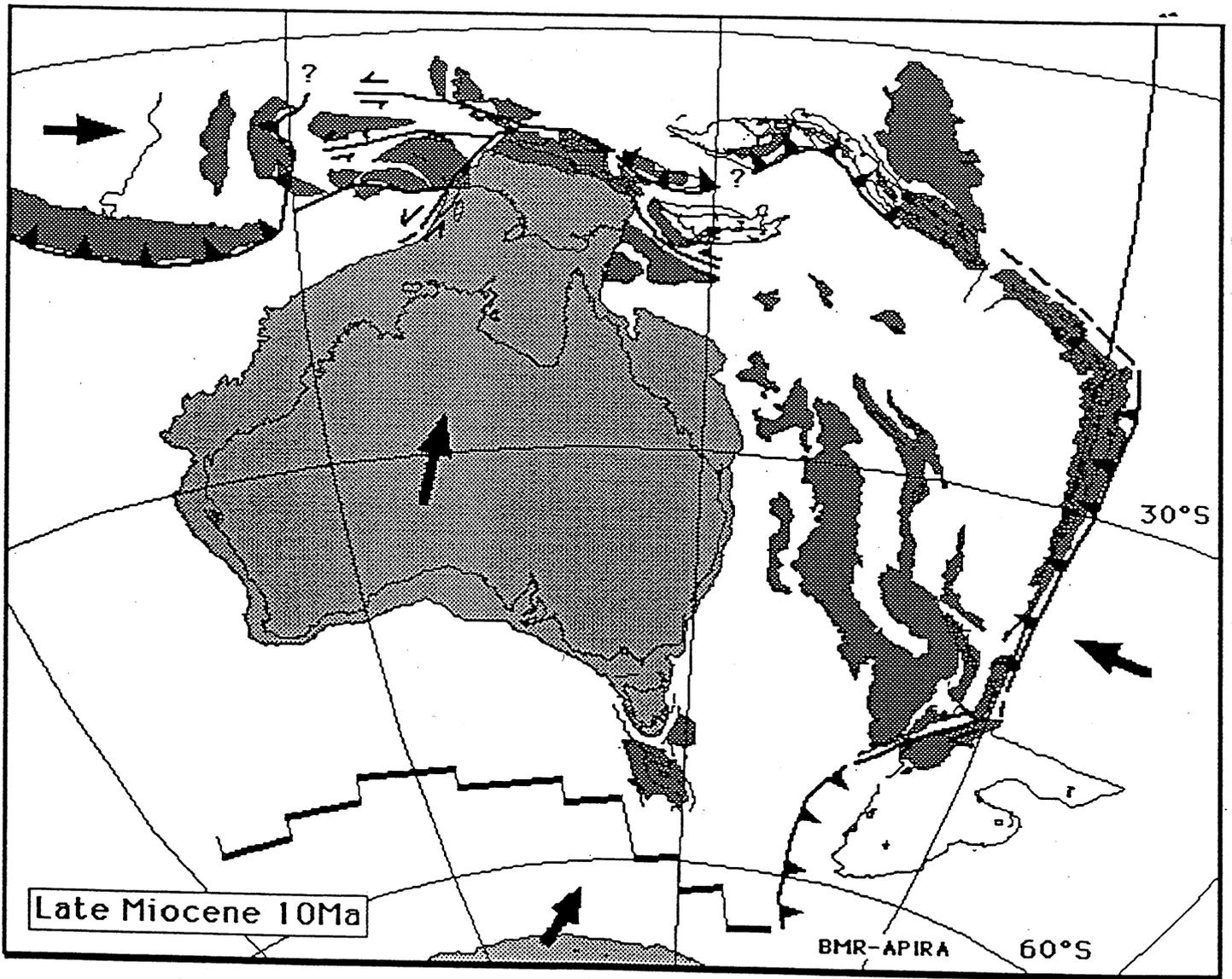
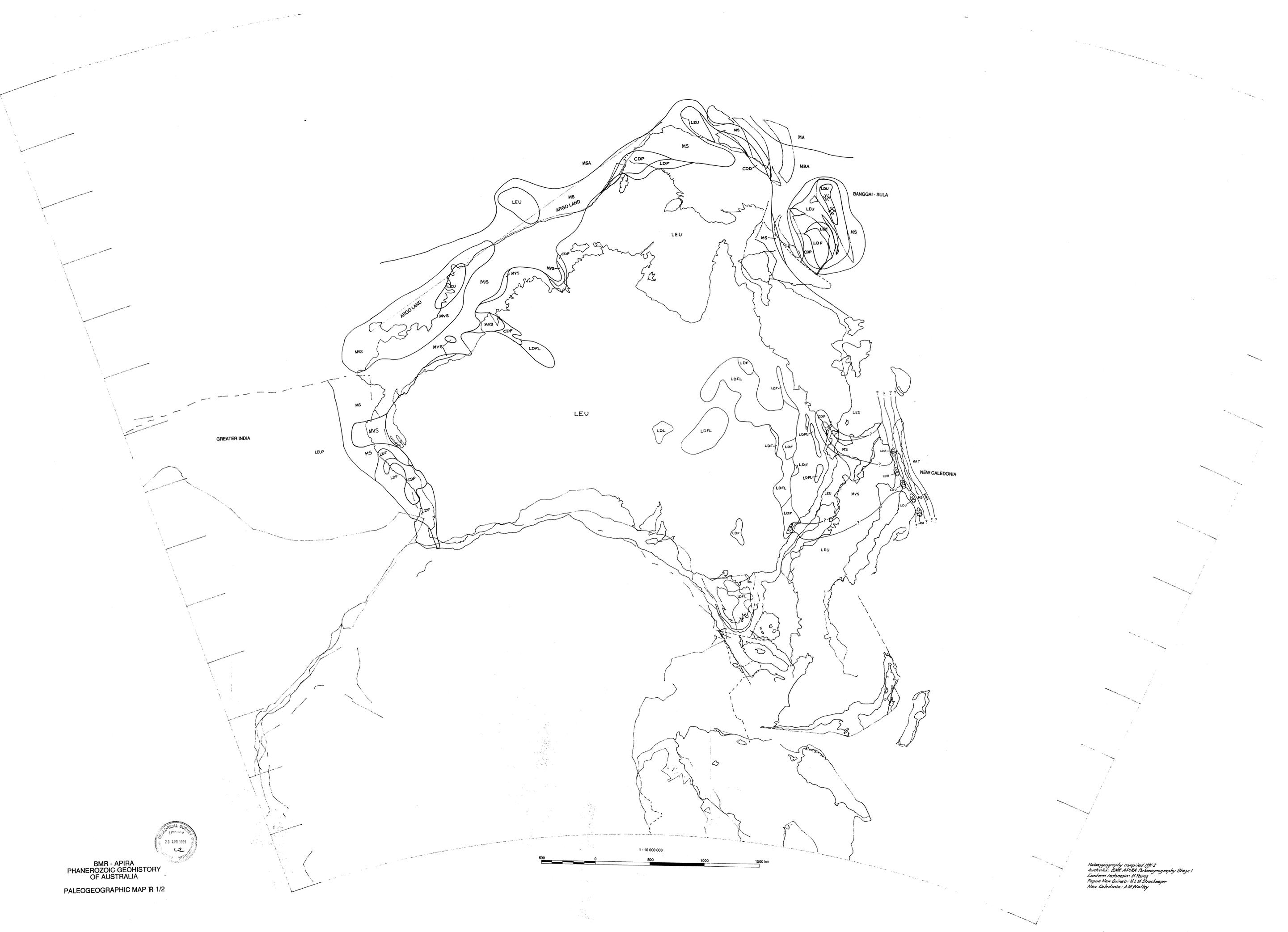
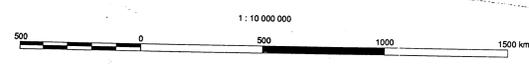


FIGURE 6.



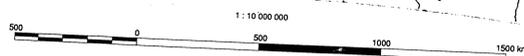
BMR - APIRA
PHANEROZOIC GEOHISTORY
OF AUSTRALIA
PALEOGEOGRAPHIC MAP R 1/2



*Paleogeography compiled 1992
Australia: BMR-APIRA Paleogeography Stage 1
Eastern Indonesia: M. Hart
Papua New Guinea: H. M. Streckmeyer
New Caledonia: A. M. Wallis*

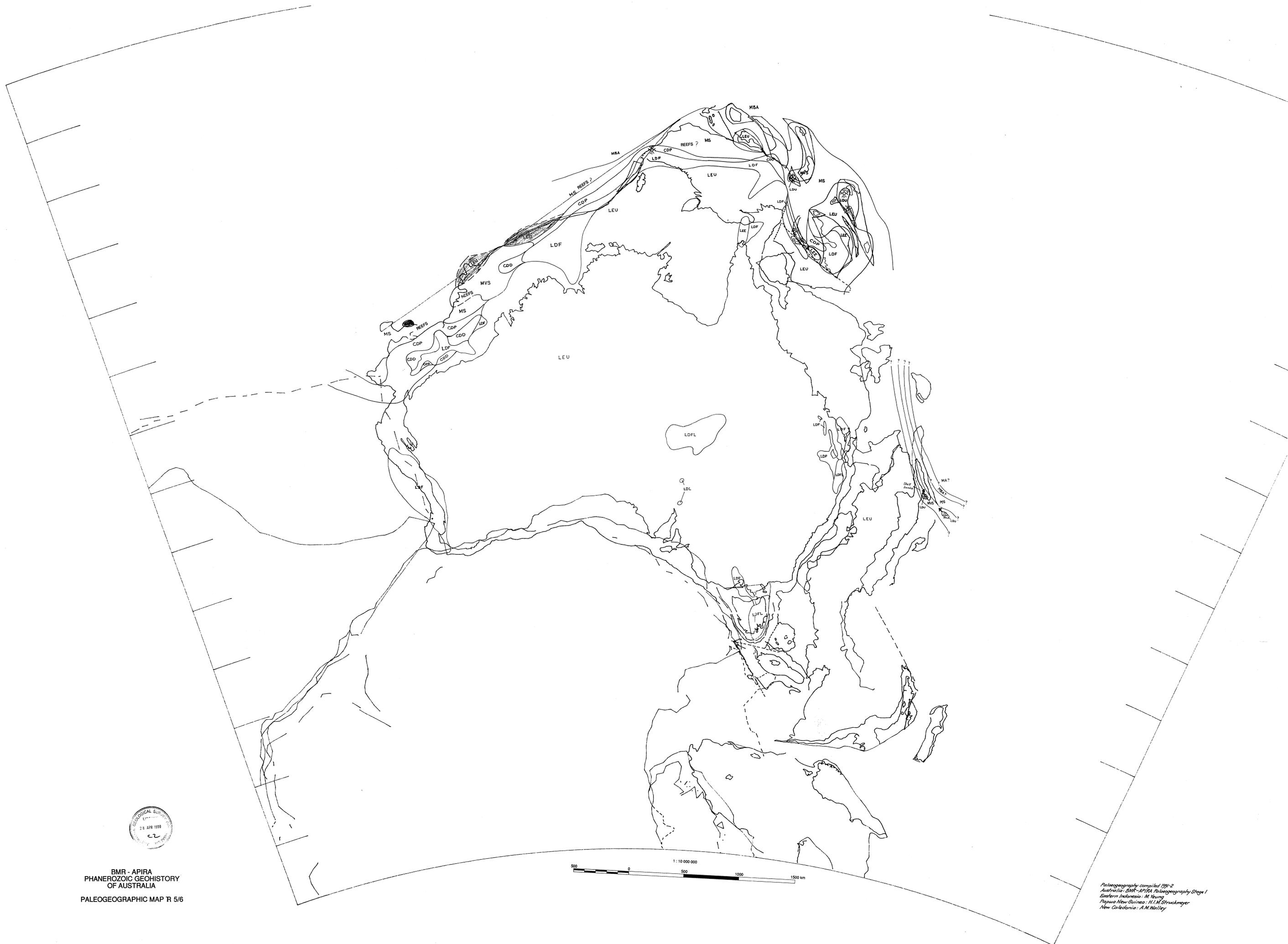


BMR - APIRA
PHANEROZOIC GEOHISTORY
OF AUSTRALIA
PALEOGEOGRAPHIC MAP R 3/4



*Paleogeography compiled 1951-2
Australia: B.M. 4/1954 Paleogeography Stage 1
Eastern Indonesia: H. Neumeier
Papua New Guinea: H. M. Struckmeyer
New Caledonia: A. M. Walley*

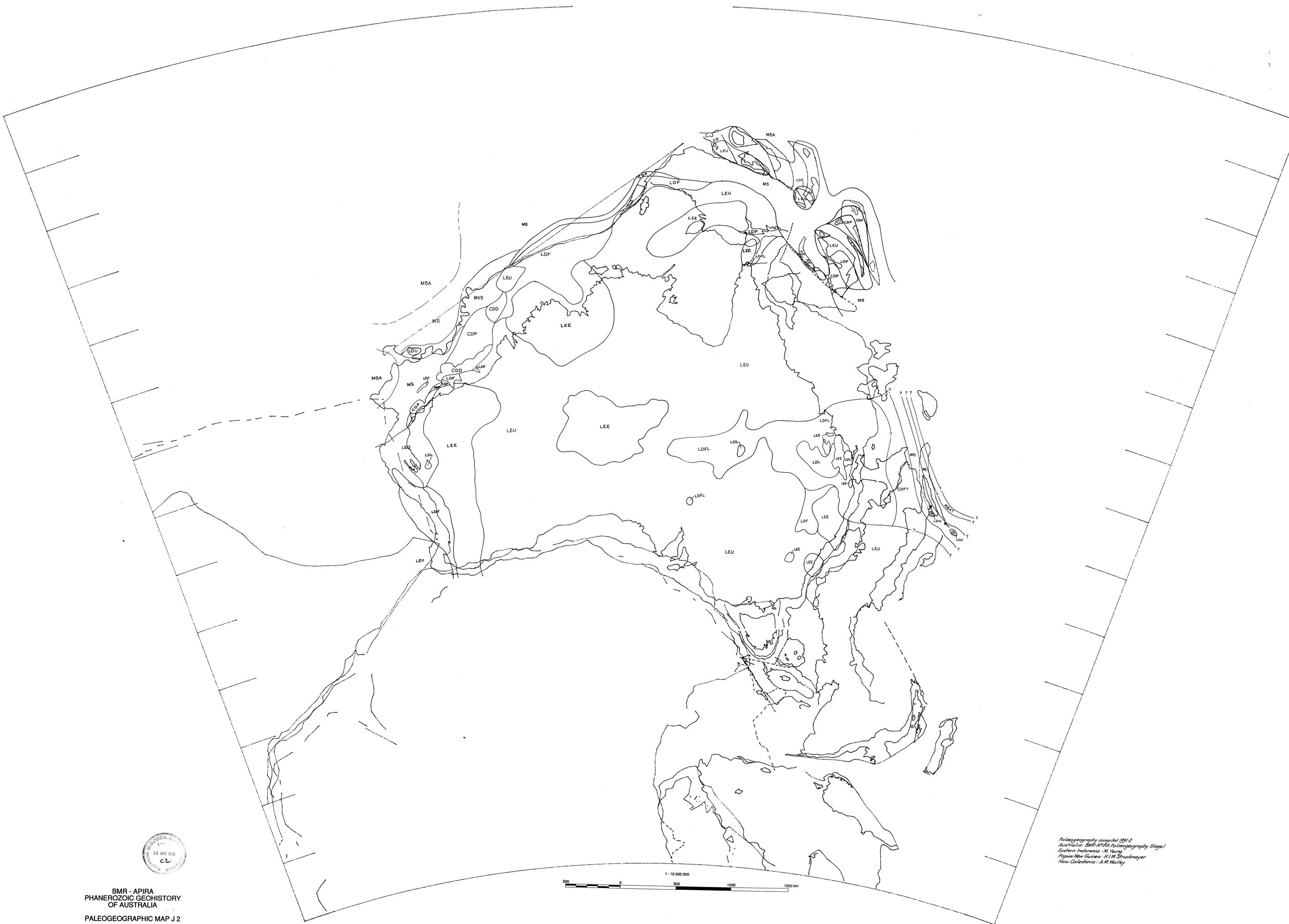




BMR - APIRA
 PHANEROZOIC GEOHISTORY
 OF AUSTRALIA
 PALEOGEOGRAPHIC MAP R 5/6



*Paleogeography compiled 1991-2
 Australia: SIM-APRICA Paleogeography Stage 1
 Eastern Indonesia: M. Young
 Papua New Guinea: H.J.M. Struckmeyer
 New Caledonia: A.M. Walley*

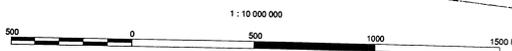


BMR - APIRA
 PHANEROZOIC GEOHISTORY
 OF AUSTRALIA
 PALEOGEOGRAPHIC MAP J 2

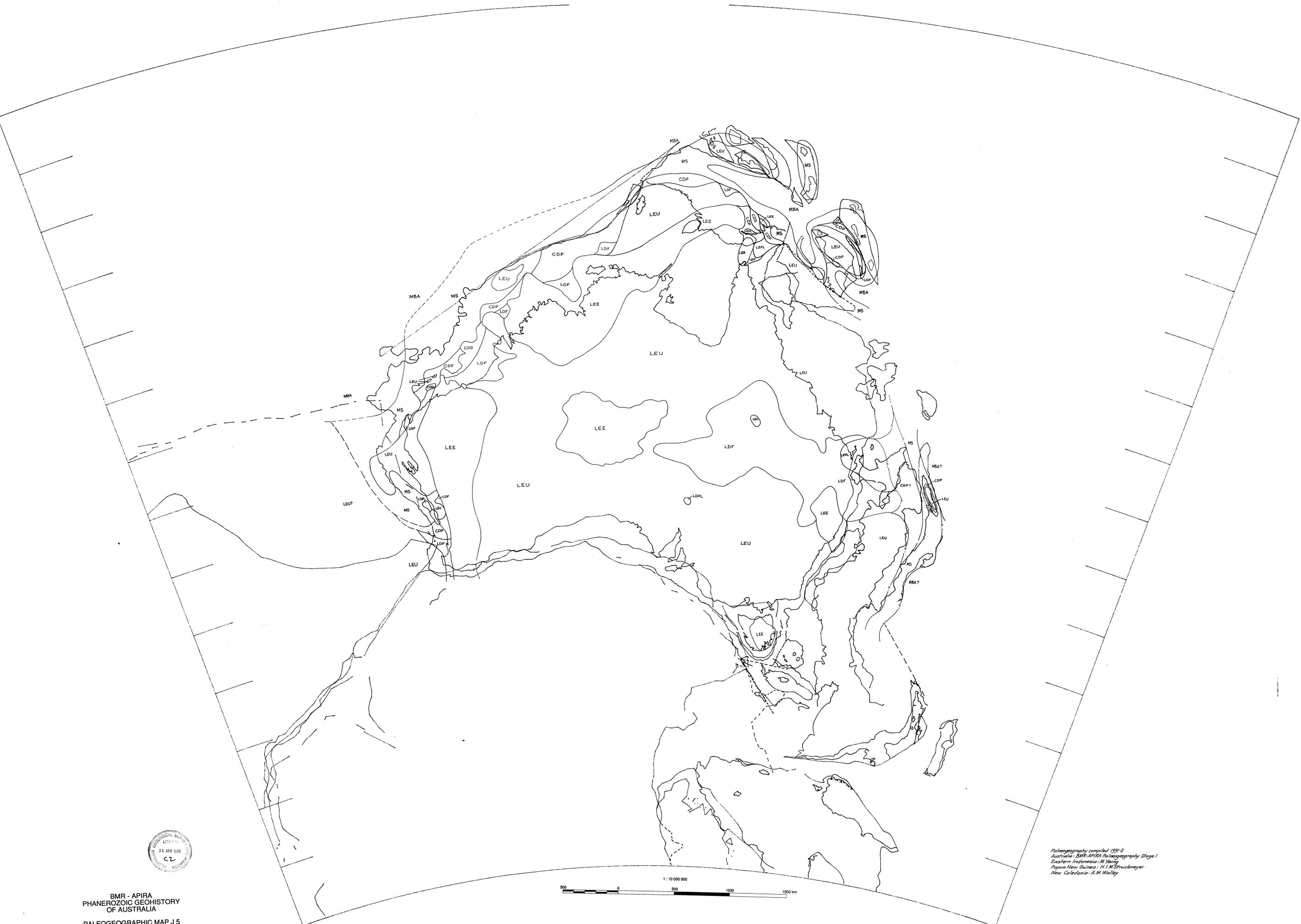
*Paleogeography compiled 1991-2
 Australia: BMR 1974 Paleogeography Stage 1
 Eastern Indonesia: M. Young
 Papua New Guinea: H. M. Struckmeyer
 New Caledonia: A. M. Walley*



BMR - APIRA
PHANEROZOIC GEOHISTORY
OF AUSTRALIA
PALEOGEOGRAPHIC MAP J 5

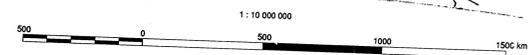


*Paleogeography compiled 1991-2
Australia: BMR-APIRA Paleogeography Stage 1
Eastern Indonesia: M. Young
Papua New Guinea: H. I. M. Struckmeyer
New Caledonia: A. M. Wallig*



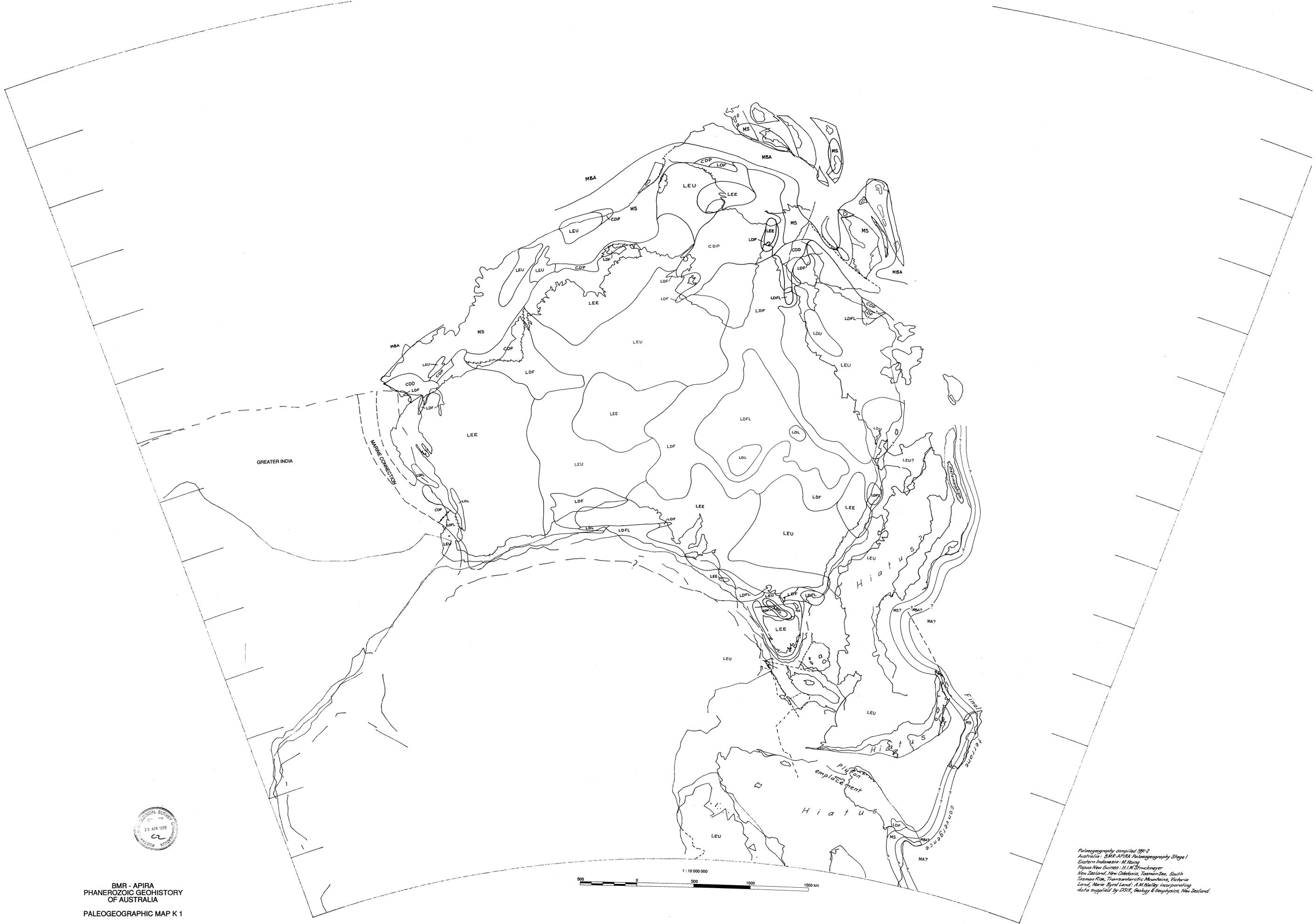


BMR - APIRA
PHANEROZOIC GEOHISTORY
OF AUSTRALIA
PALEOGEOGRAPHIC MAP J 8



*Paleogeography compiled 1991-2
Australia - BMR-APIRA Paleogeography Stage 1
Eastern Indonesia - M. Venz
Papua New Guinea - N.I. M. Struckmeyer
New Caledonia - A.M. Wallby*

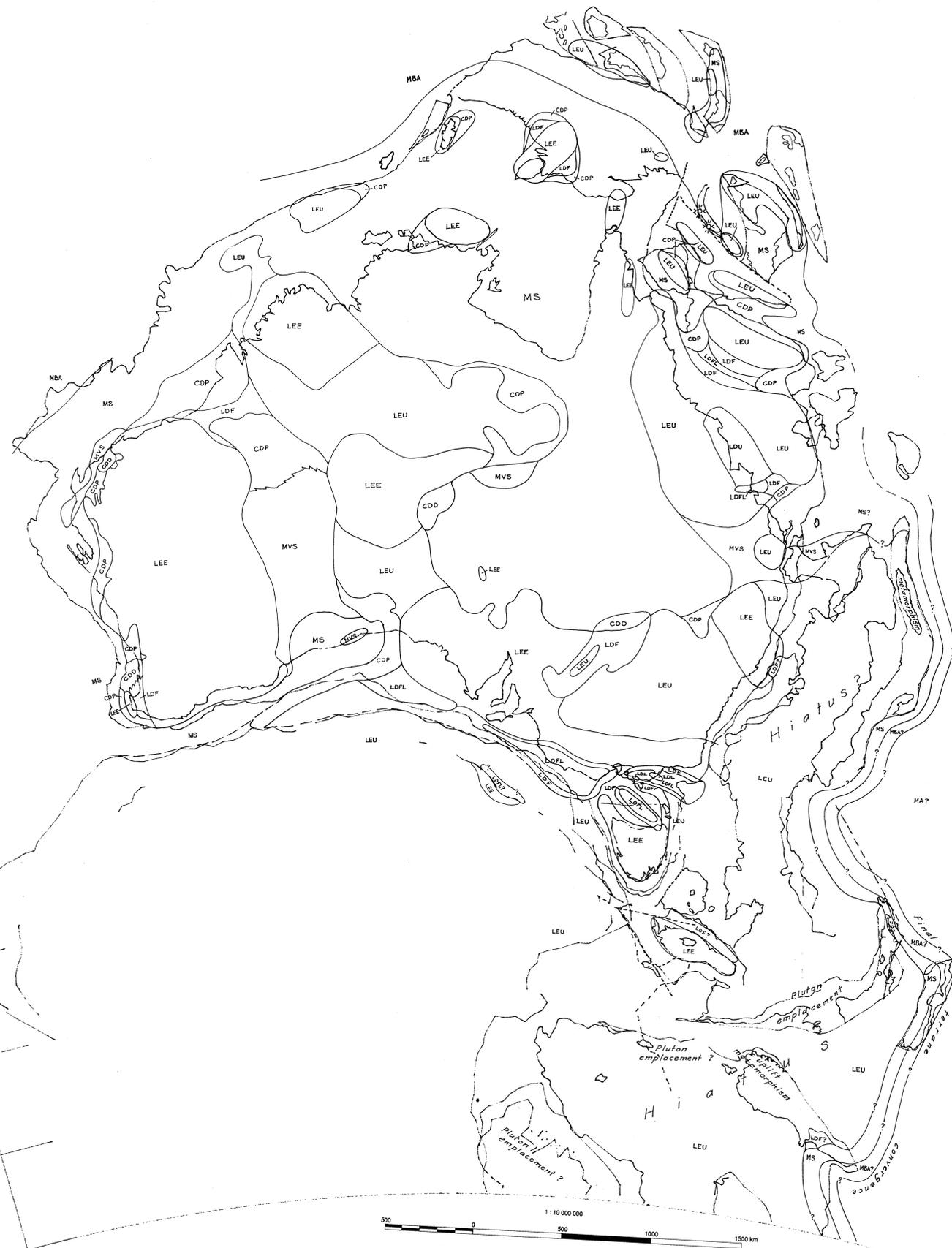




BMR - APIRA
 PHANEROZOIC GEOHISTORY
 OF AUSTRALIA
 PALEOGEOGRAPHIC MAP K 1

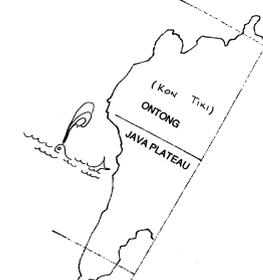
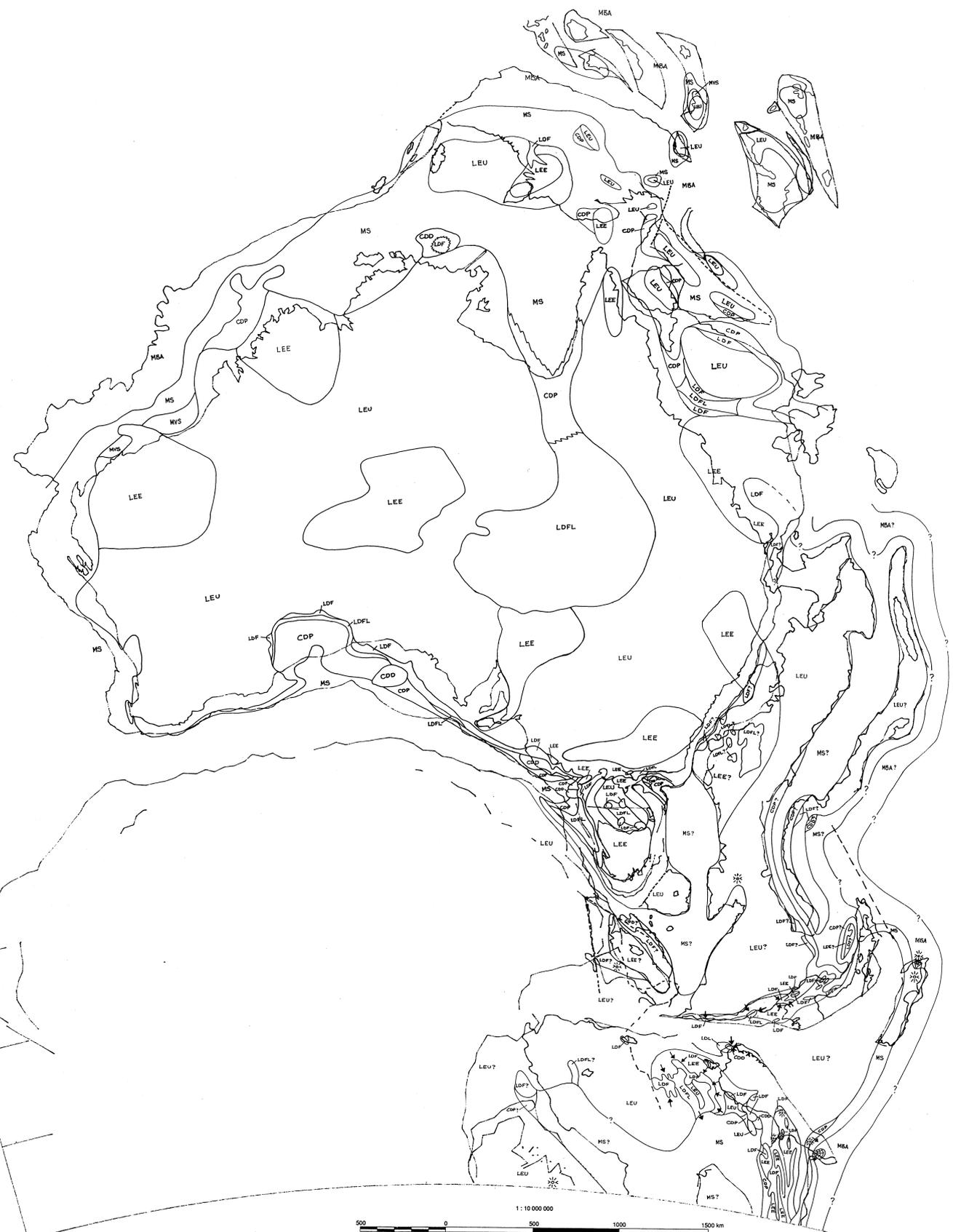
*Paleogeography compiled 1991-2
 Australia: BMR-APIRA Paleogeography Stage 1
 Eastern Indonesia: H. König
 Papua New Guinea: H.M. Struckmeyer
 New Zealand, New Caledonia, Tasman Sea, South
 Tasman Rise, Transantarctic Mountains, Victoria
 Land, Marie Byrd Land: A.M. Hallett incorporating
 data supplied by DSM, Rangitikei Geophysics, New Zealand.*

BMR - APIRA
PHANEROZOIC GEOHISTORY
OF AUSTRALIA
PALEOGEOGRAPHIC MAP K4



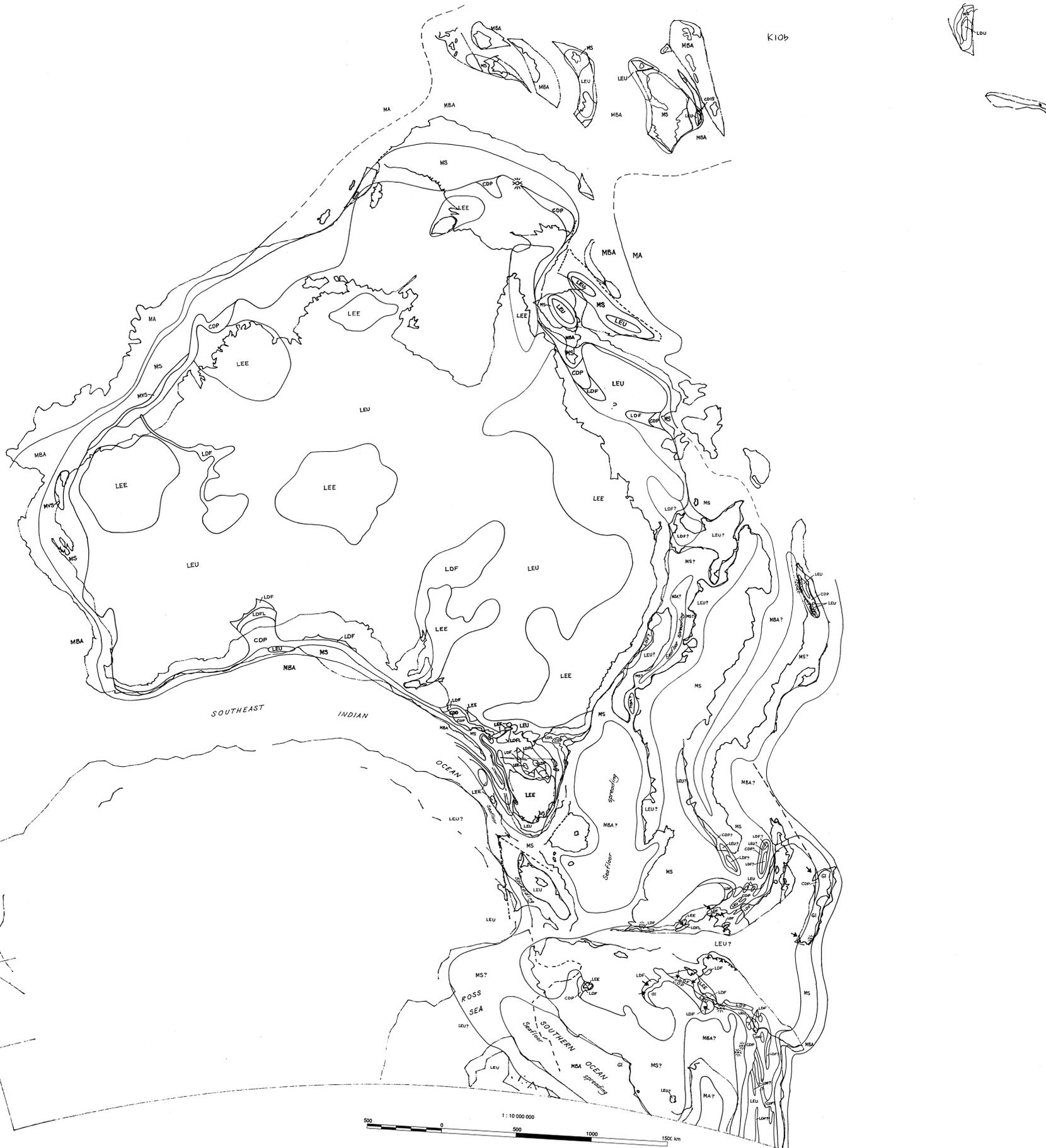
*Paleogeography compiled 1971-2
Australia: BMR-APIRA Paleogeography Stage 1
Eastern Indonesia: M. Young
Papua New Guinea: P.I. M. Struckmeyer
New Zealand, New Caledonia, Tasman Sea, South
Tasman Rise, Transantarctic Mountains, Victoria
Land, Marie Byrd Land: A.M. Walley incorporating
data supplied by DSIR, Geology & Geophysics, New Zealand.*

BMR - APIRA
PHANEROZOIC GEOHISTORY
OF AUSTRALIA
PALEOGEOGRAPHIC MAP K8



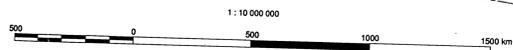
*Paleogeography compiled 1991-2
Australia: BMR, 1974 Paleogeography Stage 1
Eastern Indonesia: M. Neung
Papua New Guinea: H.M. Struckmeyer
New Zealand, New Caledonia, Tasman Sea, South
Tasman Rise, Transantarctic Mountains, Victoria
Land, Marie Byrd Land: A.M. Holley incorporating
data supplied by DSIR, Geology & Geophysics, New Zealand.*

BMR - APIRA
 PHANEROZOIC GEOHISTORY
 OF AUSTRALIA
 PALEOGEOGRAPHIC MAP K 10b



*Paleogeography compiled 1991-2
 Australia: BMR - APIRA Paleogeography Stage 1
 Eastern Indonesia: M. Vening
 Papua New Guinea: S.L. M. Strickberger
 New Zealand, New Caledonia, Tasman Sea, South
 Tasmann Rise, Transantarctic Mountains, Victoria
 Land, Marie Byrd Land: A.M. Walley incorporating
 data supplied by D.3101, Geology & Geophysics, New Zealand.*

BMR - APIRA
 PHANEROZOIC GEOHISTORY
 OF AUSTRALIA
 PALEOGEOGRAPHIC MAP Cz 1



*Paleogeography compiled 1981-2
 Australia: BMR-APIRA Paleogeography Stage 1
 Eastern Indonesia: M Young
 Papua New Guinea: H. H. Struckmeyer
 New Zealand, New Caledonia, Tokelau, South
 Tasmann Rise, Transantarctic Mountains, Victoria
 Land: A. M. Walby incorporating data supplied
 by CSIR, Geology & Geophysics, New Zealand.*



4.0



BMR - API: A
 PHANEROZOIC GEOHISTORY
 OF AUSTRALIA
 PALEOGEOGRAPHIC MAP Cz 6a

Paleogeography compiled 1991-2
 Australia: BMR-API: A Paleogeography Stage 1
 Eastern Indonesia: M. Young
 Papua New Guinea: H. M. Strickberger
 Solomon Islands, Vanuatu, Fiji, Tonga: M. Bradshaw
 New Zealand, New Caledonia, Tasman Sea,
 South Tasmann Rise: A. M. Wallby incorporating data
 supplied by DSIR, Geology & Geophysics, New Zealand



C27



**BMR - APIRA
PHANEROZOIC GEOHISTORY
OF AUSTRALIA**

PALEOGEOGRAPHIC MAP C27 (PLEISTOCENE)

→ paleocurrent
* volcanic centre

*Bathymetry compiled 1951
Eastern Indonesia: M. Peary
Rapas New Guinea: K. M. S. Brachinger
Solomon Islands, Vanuatu, Fiji, Tonga: M. T. Bradshaw
New Zealand, New Caledonia, Tasman Sea: A. H. Milley*