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LAURA BASIN EXPLANATORY NOTES AND STRATIGRAPHIC CORRELATIONS

by

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Introduction

The Jurassic-Cretaceous Laura Basin is a shallow, elongate, intracratonic basin in northern Queensland, containing largely undisturbed sediments that form part of the Trans-Australian Platform cover (GSA, 1971). The basin sediments dip gently towards the depocenter, located onshore near the coast, where they are one kilometre thick. The basin underlies 37 500 km^2, approximately 21 000 km^2 of which is onshore, along the eastern side of Cape York Peninsula.

The Laura Basin overlies, and is bounded on the southeast and south by, the Palaeozoic Hodgkinson Basin. The western limits are the Coen and Yambo inliers, which separate most of the Laura Basin from the Carpentaria Basin; across the Kimba Arch the basins are contiguous. The offshore margins are less clearly marked. The northern boundary, which separates the Laura and Papuan Basins, is taken as the Grenville High (Fig. 1) a northeast-trending basement high (J. Smart & J.S. Rasidi, BMR, personal communication, 1978). The eastern limit is the sharp topographic break that marks the edge of the continental shelf.

The main structural feature within the basin is the Palmerville Fault. Subsidence was greatest adjacent to the fault, which suggests that activity along the fault influenced deposition of basin sediments, but there is no evidence of syndepositional movement. Post-depositional deformation of basin sediments consists of faulting along several northerly trends, including the Palmerville Fault, and gentle folding over areas of elevated basement, owing to differential compaction of draped sediments (Day, 1976).

The geological history and rock sequence in the Laura Basin are similar to those of the adjacent Carpentaria Basin (Smart & others, in press), and the two basins have probably been connected across the Kimba Arch since end of the Jurassic. Seismic data imply that a connection with the Papuan Basin could have existed since the Cretaceous. Laura Basin sediments unconformably overlie a basement of varied age and rock type. Small remnants of Permian sedimentary rocks, some of which are bound by faults, occur near the Palmerville Fault. East of the fault, the basement consists mainly of strongly folded Hodgkinson Basin rocks and isolated intrusives of Late Palaeozoic age,

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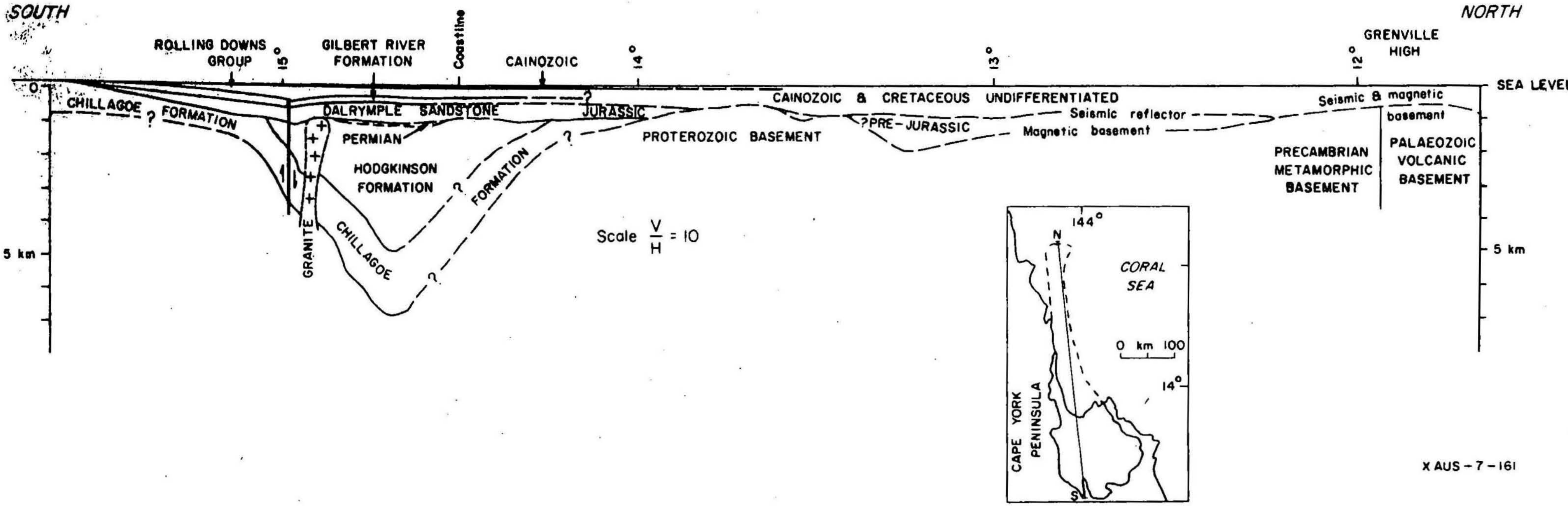
Figure Au 3a and these explanatory notes were prepared as a contribution for the United Nations ESCAP Atlas of Stratigraphy.

Fig. 1



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Cross-section Laura Basin (after Smart and Rasidi, BMR, in prep.)

and west of the fault, of Precambrian metamorphic and Palaeozoic igneous rocks.

Data Compilation

The stratigraphy of the onshore basin is best known from three exploration wells east of the Palmerville Fault: Cabot-Blueberry Marina 1, drilled in 1962 by Mines Administration Pty Ltd (MINAD, 1962), and Breeza Plains 1 and Lakefield 1, drilled in 1970 by Crusader Oil N.L. (Hardy, 1970). Additional data are provided by outcrops, shallow stratigraphic bores, and water wells. Correlation of basin units is based on field mapping (Table 1), wireline logs, and on lithological descriptions from company reports and de Keyser & Lucas (1968), but nomenclature follows that used by Powell & others (1976). Formation ages for the well columns are chiefly from palynology described in company reports, using palynological subdivisions recognized by Evans (1966a).

TABLE 1 MAPPING COVERAGE - 1:250 000 SCALE

SHEET NAME *	SHEET NUMBER	YEAR
Cape Melville	SD/55-9	1965
Cooktown	SD/55-13	1965
Cape Weymouth	SD/54-4	1977
Coen	SD/54-8	1977
Ebagoola	SD/54-12	1977
Jardine River - Orford Bay	SC/54-15 SC/54-16	1977
Hann River	SD/54-16	in press

* Bureau of Mineral Resources, Australia, 1:250 000 Geological Series Maps and Explanatory Notes

Information about the offshore part of the basin is restricted to geophysical survey results (Table 2) and thus the lithology and environment of deposition are unknown. Much of the offshore data, and the offshore and onshore geophysical interpretations were taken from a study of the geology and petroleum potential of the Laura Basin and Torres Shelf by J. Smart and J.S. Rasidi, BMR, Australia; the results of this work are still in preparation and unpublished, and, therefore, are not included in the selected bibliography. Seismic data suggest that Laura Basin sediments may be present offshore, but the lack of good reflectors makes it difficult to separate the Mesozoic sediments of the basin from the overlying Cainozoic deposits.

TABLE 2 GEOPHYSICAL INVESTIGATIONS

NAME OF SURVEY	YEAR	COMPANY	OFFSHORE/ OFFSHORE	REFERENCE
SEISMIC SURVEYS				
Marina Plains	1963	Marathon Petroleum Australia Ltd	Onshore	BMR File 63/1517
Torres Strait-Princess Charlotte Marine	1965	Gulf Interstate Overseas Ltd	Offshore	BMR File 65/4599
Northern Great Barrier Reef Area	1966	Tenneco Australia Inc.	Offshore	BMR File 66/11086
Offshore Laura Basin	1969	Endeavour Oil Company N.L.	Offshore	BMR File 69/3041
Princess Charlotte Bay	1969	Exoil N.L.	Offshore	BMR File 69/3047
Breeza Plains	1969	Crusader Oil N.L.	Onshore	BMR File 69/3095
AEROMAGNETIC SURVEYS				
Cape York Peninsula	1962	Gulf Interstate Overseas Ltd	Offshore	BMR File 62/1725
Cooktown	1968	Corbett Reef Ltd	Offshore	BMR File 68/3010
GRAVITY SURVEYS				
Gravity Surveys of the Great Barrier Reef and Adjacent Coast, North Queensland	1954-1960	Bureau of Mineral Resources	Onshore and Offshore	BMR Report 73
Reconnaissance Helicopter Gravity Survey, Northern Queensland, 1966.	1966	Bureau of Mineral Resources	Onshore	BMR Record 1974/140

Basin Evolution

The Laura Basin was initiated in the Early Jurassic, when the basement began to subside along the eastern side of the Palmerville Fault. De Keyser and Lucas (1968) suggest that this sagging may have been caused by movement on the fault, but there is no evidence of syndepositional growth at this time (J. Smart & J.S. Rasidi, BMR, personal communication, 1978). Nevertheless, the development of the axis of the basin and greatest subsidence parallel to the northern onshore end of the fault implies some depositional control.

Clastic sediment was derived from the surrounding hinterland and laid down as fluvial deposits over the uneven basement. By Late Jurassic most of the topographic relief had been buried. Granite stocks up to 300 m in height, which protruded above the basement floor, were covered by Dalrymple Sandstone, except in the northeast, where some were only partly buried (de Keyser & Lucas, 1968). That the eastern onshore margin of the basin must have had considerable relief in the Jurassic is suggested by the granite inselbergs in the northeast and the thick conglomerate on one of the Flinders Group islands. Thin coal seams in wells in the deep part of the basin near the Palmerville Fault indicate that in this area conditions were probably swampy. Microplankton in Marina 1 (Minad, 1962) record only one marine transgression from the north in the Middle Jurassic, however, the area further north may have been subject to several marine incursions.

A basement high off Cape Sidmouth appears to have formed a northern limit to the Dalrymple Sandstone or its equivalent, which onlapped it from the south (Fig. 1). The overlying Gilbert River Formation equivalent, however, apparently spread across the basement high, and Cretaceous sediments were deposited not only in the southern Laura Basin, but also onto the ?pre-Jurassic basement in the northern part of the basin and across the Grenville High, connecting the Laura and Papuan Basins. In the southwest, the Gilbert River Formation onlapped basement rocks to the west, and a connection with the Carpentaria Basin was established by the Early Cretaceous over the Kimba Arch. The onlap of the Gilbert River Formation over the present western margin suggests that much of the Coen and Yambo Inliers had been reduced to low relief by the end of the Jurassic and had ceased to be a significant provenance for the Laura Basin. There is no evidence to suggest significant overlapping of the Dalrymple Sandstone by the Gilbert River Formation in the rest of the basin, except over the inselbergs in the northeastern onshore part of the basin, which were finally buried by the Gilbert River Formation.

The Cretaceous rocks are generally finer grained, and contain more evidence of marine conditions than the Jurassic rocks, although around the onshore margins of the basin it is often difficult to distinguish the Gilbert River Formation from the Dalrymple Sandstone (de Keyser & Lucas, 1968). The decrease in grain-size probably reflects a reduction in the relief of the surrounding source areas. Although parts of the Coen Inlier probably remained emergent during the Cretaceous, the main provenance for the Rolling Downs Group as for the Gilbert River Formation must have been mainly to the south and the east of the basin.

Fluvial deposition, which predominated in the Jurassic over large parts of the basin, continued into the earliest Cretaceous until a major change in environment, which began with the onset of a marine transgression, produced widespread shallow marine conditions during the Early Cretaceous. This marine transgression was part of a world-wide transgression that took place in the Cretaceous. Shelly marine fossils and glauconite indicate that an arm of the sea transgressed southward across the eastern part of the basin in the Neocomian (Woods, 1964), and the thick marine sequence in the Bathurst Range suggests that at this time the depocenter may have shifted eastwards. Just to the north of the Bathurst Range on an island in the Flinders Group, the Gilbert River Formation unconformably overlies Dalrymple Sandstone, implying that in this area there was still high relief at the end of the Jurassic. A lack of marine indicators in the Cretaceous rocks suggests that the area remained above sea level throughout the Cretaceous marine inundation. In the western part of the basin, fluvial to paralic conditions continued until the Early Aptian, when the sea apparently receded from the eastern part of the basin and inundated the western area, re-establishing its depocenter near the Palmerville Fault. Lucas & de Keyser (1965) suggest that the fault scarp which marks part of the eastern edge of the basin, may have formed an Albian shoreline to the Rolling Downs Group. The absence of the Rolling Downs Group and the upward transition in the Gilbert River Formation from a basal marine to a non-marine sequence in this area support the suggestion that uplift was post-Neocomian. The apparent absence of the Rolling Downs Group over the Kimba Arch is probably the result of subsequent erosion rather than non-deposition. The sea regressed northward in the Late Albian, but how far north of the present coastline is uncertain.

Late Cretaceous-Early Tertiary tectonism signalled the end of deposition in the Laura Basin, as uplift and faulting resulted in widespread subaerial erosion. Many of the north to northwest-trending faults were activated, including the Palmerville Fault. The Palmerville Fault, a reactivated Palaeozoic fault, shows a reversal of its previous relative vertical movement, with the east side the upthrown block (de Keyser, 1963). The vertical displacement across the faults is commonly less than 100 m, although this represents more than one period of movement in the Late Cretaceous and Cainozoic. The Late Cretaceous-Early Tertiary activity in the Laura Basin was probably caused by the same tectonic event that produced uplift and block-faulting in the adjacent Carpentaria Basin. J. Smart (BMR, personal communication, 1978) believes this tectonism to be related to the tectonic activity which led to the separation of the Pacific and Australian plates in the Eocene (Taylor & Falvey, 1977) and formed the present offshore eastern margin of the basin.

A thin veneer of Late Tertiary and Quaternary sediments overlie the Laura Basin sequence. In terms of lithology and age, these sediments are more closely related to those of the Karumba Basin, which overlies the Carpentaria Basin.

Resources

No economic resources are known in the Laura Basin, although hydrocarbons and coal have been explored for, and wells have been drilled to provide water for local needs.

Hydrocarbons

The basin has few structures with significant vertical closure for the entrapment of hydrocarbons. The Crusader Oil wells were sited on drape structures, and tested two of the closures. Drilling showed that the sandstones which form suitable reservoir rocks are flushed by fresh water. Although vitrinite reflectance values suggest that the Mesozoic rocks are marginally mature for the generation of hydrocarbons (Gorter, 1978), the other factors must downgrade the basin's hydrocarbon potential. Only the onshore part of the basin has been tested, but lack of adequate structures and the absence of any evidence of improved reservoir conditions suggest the offshore potential of this area is also low.

Cainozoic sediments overlying the Laura Basin lack suitable source rocks, are thin, and overlie immature Mesozoic rocks. In the underlying Permian sequence the rocks are sheared and altered, and have low permeability. Vitrinite reflectance values for Permian material from Marina 1 and Breeza Plains 1 indicate that the source rocks are over-mature (Gorter, 1978). These factors rule out any hydrocarbon potential for the sedimentary sequence above and below the basin.

Coal

Very thin seams and laminae of coal are recorded from the lower parts of the Dalrymple Sandstone and in the Gilbert River Formation, but these are considered to be without economic potential (Traves & King, 1975). Coal seams in the Permian sediments to the south of and beneath the Laura Basin although up to 6 m thick, have recorded ash contents of up to 46% (Traves & King, 1975), and are also considered uneconomic. Exposed Permian seams are faulted, deformed, and steeply dipping beds contained within grabens.

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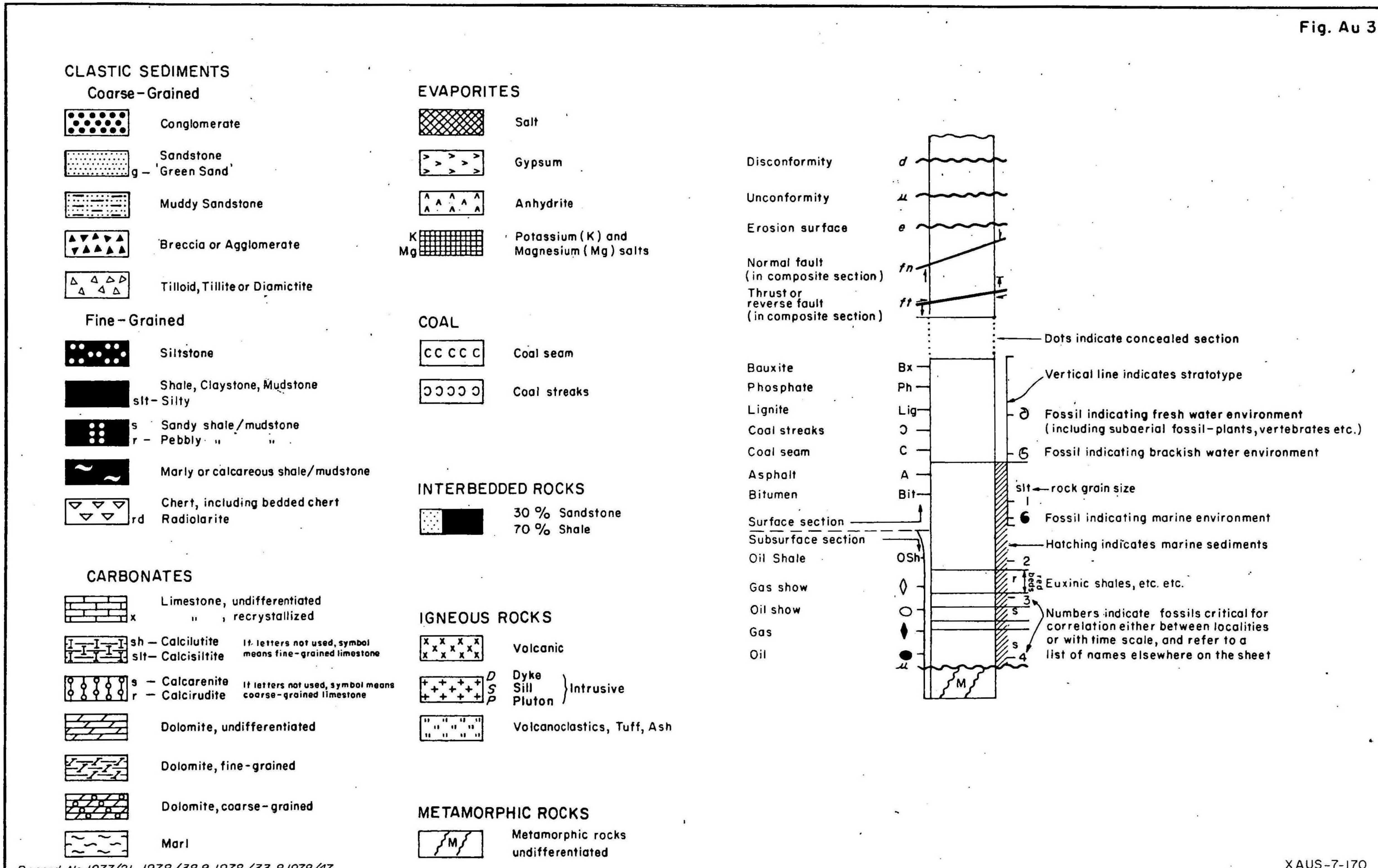
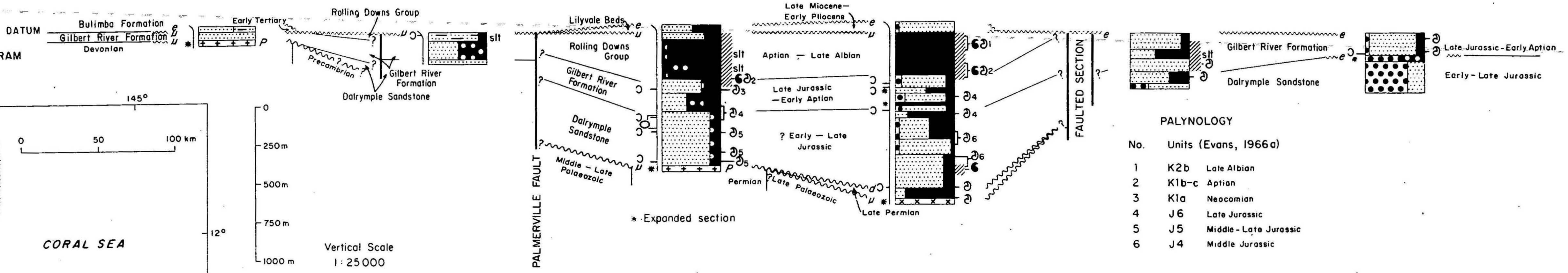


Standard legend for stratigraphic columns

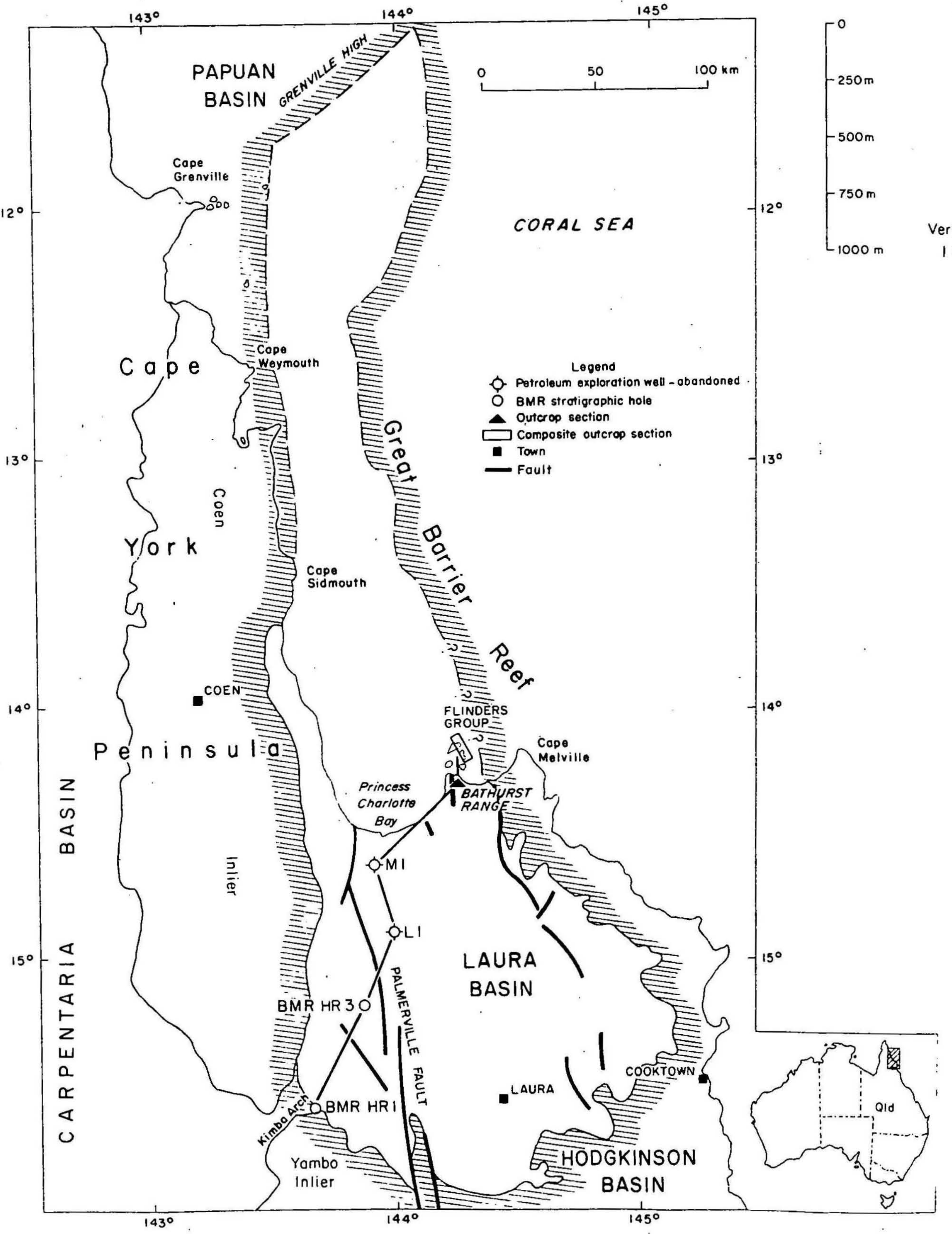
LAURA BASIN : NORTHEASTERN QUEENSLAND

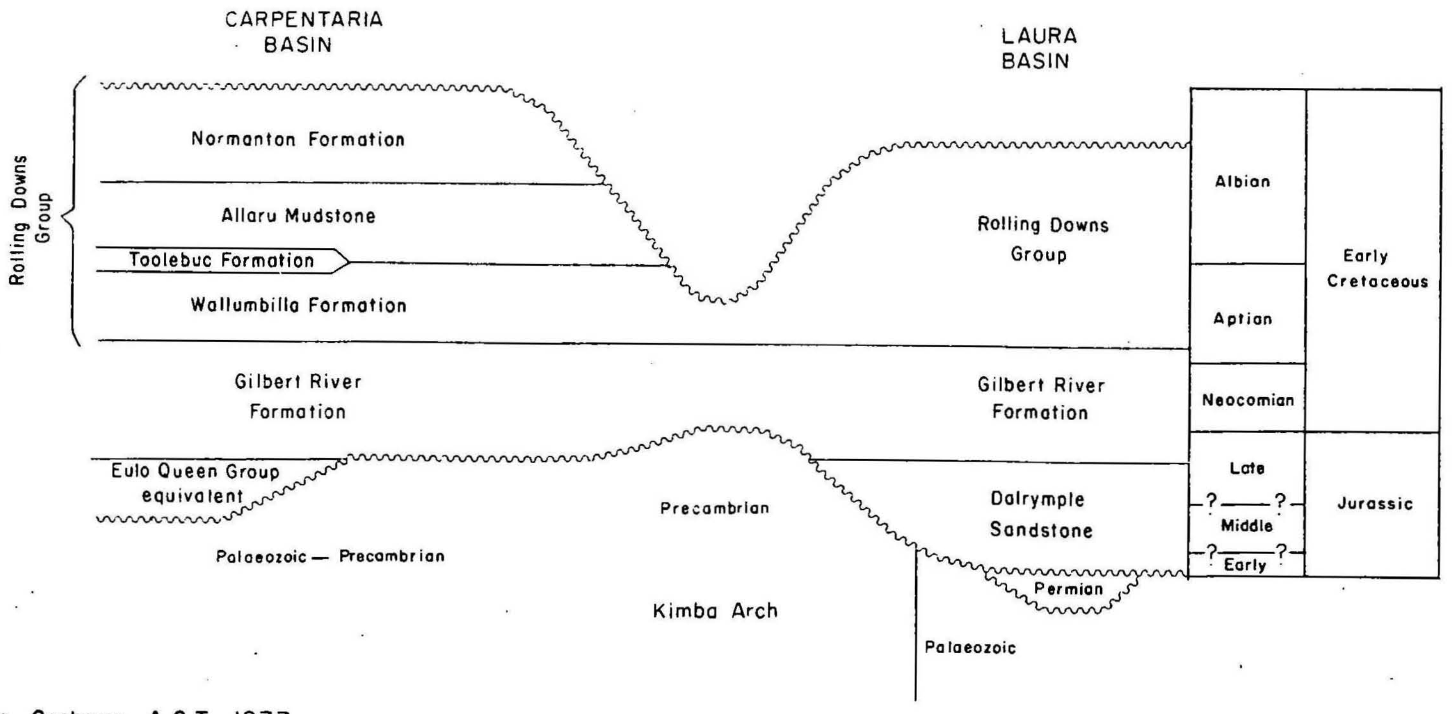
Fig. Au 3a

ESCAP ATLAS OF STRATIGRAPHY (IGCP PROJECT No. 32)



LOCATION DIAGRAM





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