A PALYNOLOGICAL STUDY OF THE SAWAHLUNTO FORMATION OMBILIN BASIN, WEST SUMATRA

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ABSTRACT

Low to moderate yields of well preserved palynomorphs were recovered from the Sawahlunto Formation, Ombilin Basin, West Sumatra. More than 50 spore-pollen species have been recognised of which many have been corroborated with previously described taxa. The palynological assemblages recovered indicate an Oligocene to lower Miocene rather than Eocene age for the deposition of the Sawahlunto Formation.

Botanical affinities of the dispersed palynomorphs are mainly with the ferns and palms. A variety of other angiosperm groups are also represented, but gymnospermous elements are minimal. The assemblages appear to represent the products of vegetation of seemingly low diversity.

I. INTRODUCTION

Palynology is mainly used in Southeast Asia for bio-stratigraphical studies of marginal marine and continental sediments where marine microfossils such as foraminifera and nannoplankton are either absent or non-diagnostic. Despite palynological studies undertaken by foreign oil and service companies there is very little published data available on the Tertiary palynology of Indonesia (Morley, 1978, 1985; Caratini and Tissot, 1987, 1988). Morley (1978) discussed the factors that control and influence the abundance and distribution of pollen grains and spores in the sediments of Southeast Asia and concluded that in an archipelagic area such as Indonesia these factors may result in the necessity for the creation of separate palynological zonal schemes for each individual basin.

In 1988 LEMIGAS (Indonesia Oil and Gas Research and Development Centre) undertook field work in West Sumatra to determine the geological evolution of a small intermontane basin, the Ombilin Basin. In the absense of age diagnostic macrofossils and marine microfossils, samples were collected for palynological analyses in order to evaluate the bio-stratigraphy of the Tertiary sediments within the basin. This paper presents some preliminary results from the palynological study of sediments from the Sawahlunto Formation.

II. GEOLOGICAL BACKGROUND

The Ombilin Basin is a Tertiary intermontane basin situated in the Barisan mountain range of West Sumatra (Fig. 1). It covers an area of approximately 1500 square kilometres and is filled by up to 4600 m of Tertiary sediments. The basin is well known for its coal reserves which have been mined since 1891. Oil seeps are present in the area and hydrocarbon exploration has indicated potential reserves of oil and gas (Koning, 1985).

A detailed investigation of the stratigraphy and sedimentation of the Ombilin Basin was undertaken by Koesoemadinata & Matasak (1981). The results of

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their field mapping enabled them to subdivide the Tertiary sediments within the basin into a series of formations (Table 1). Koning (1985) confirmed the subsurface stratigraphy from seismic data although recognised depositional hiatuses not recognised by previous workers.

Structurally the basin is considered to be a graben-like pull apart structure resulting from early Tertiary tensional tectonics related to dextral strike-slip movements along the Great Sumatran Fault System (Harding et al., 1985; Koning, 1985). The depositional history of the sediments is considered to reflect this development (Koesoemadinata & Matasak, 1981; Koning, 1985; Whateley & Jordan, 1989). High basement relief adjacent to the basin acted as a source for debris flows and fan delta formation around the margin of a central lake, with fine grained lake sediments accumulating in the centre of the basin. Shallowing of the lake and reduction in sedimentation rates allowed peats to accumulate (Fig. 2) prior to the reactivation of clastic lacustrine sedimentation.

The lower formations in the Ombilin basin are considered to be non marine. Freshwater fish have been recovered from the Sangkarewang Formation (Musper, 1929), and there is an absence of marine microfossils. Koesoemadinata & Matasak (1981) gave tentative ages to formations based on palynological analyses undertaken in Japan (JICA 1981). The Sawahlunto Formation was asigned a Palaeocene/Eocene age based on the identification of proxapertites operculatus and the absence of florscheutzia pollen, which indicate a post Eocene age. Florscheutzia pollen are considered to be derived from sonneratia, a mangrove taxa (Muller, 1978) and the bsense of sonneratia pollen should have been expected in a freshwater lacustrine environment. The underlying Sangkarewang Formation was also dated as Palaeocene-Eocene and the overlying Sawahtambang Formation was barren. Koning (1985) published bio-stratigraphical data from the Sinamar No.1 well which gave the age of the Sangkarewang Formation as Eocene based on the presence of florscheutzia trilobata. Samples from the Sawahlunto Formation were described as barren. In order to resolve uncertainty as to the age of the sediments and to assist in exploration work a small study was undertaken of the palynology of the Sawahlunto Formation.

III. MATERIAL AND METHODS

The Sawahlunto Formation was designated a separate formation as it forms an economically important coal bearing unit of the area (Koesoemadinata & Matasak, 1981). It consists of a sequence of brownish grey shales, muddy siltstones and interbedded brown dense, quartz sandstones, and characterised by the presence of coals. Three main coal seams in the formation achieve thicknesses normally considered suitable for mining. Whateley & Jordan (1989) interpreted the overall environment of deposition of the Sawahlunto Formation as lacustrine.

Acknowledgements a series of samples were collected from the Sawahlunto Formation. Short sections of the exposure were logged and sampled between the top of Seam C and the base of the Sawahtambang Formation (Fig. 3). The section consists of a sequence of fining upwards units of sands, silts and mudstones.

Approximately 60g of sediment per sample were collected. The preparations of the samples followed standard processing techniques. After cleaning and crushing approximately 15g of sediment were treated with dilute hydrochloric acid for the removal of carbonates, followed by treatment in hydrofluoric acid for the removal of mineral matter; this was followed by heavy liquid separation and washing on a [illegible] um mesh screen. After each step the residues were washed thoroughly to neutrality. For coal samples 0.5g subsamples of crushed coal were treated with nitric acid for two hours followed by treatment with very dilute potassium hydroxide for one minute before washing on a 5 um mesh screen. Strew slides were prepared from each productive residue for light microscopic study using entellan as mounting medium.

The slides were examined using Leitz Laborlux microscopes with standard magnifications of x250, x400 and x1000. Photographs were taken using an ordinary light system.

IV. RESULTS

IV.1. General

The palynological recovery from these samples varied from poor to moderate. Recovery was best from mudstones and shales whereas most of the coal samples were barren. Palyno morph identifications were based on published data and comparisons made with a modern pollen reference collection developed at LEMIGAS. 55 taxa were identified (Fig. 4). No standardisation of the nomenclature has been attempted i.e. both form-generic names based on morphological features and modern generic names have been employed. As this is a preliminary paper taxa descriptions are not given and no new form genera have been named. Key and common taxa are illustrated in Plates 1, 2, 3 and 4.

The distribution of the taxa through the section is shown in Figure 4. Many of the taxa are rare and only occur in single samples. This is probably a reflection of poor palynomorph recovery. The most common taxa are *Laevigatos porites, Verrucatosporites usmensis, Cyathidites and Cycas.* No formal zonation of the sequence is proposed although Jessenia/Iguanura and coarse reticulate pollen seem restricted in their occurence to the lower portion of the sequence.

IV.2. Biostratigraphic Interpretation

Several index taxa were recovered in this study. Their stratigraphic ranges in Borneo are plotted in figure 5. There is no published data on pollen and spore biostrati graphies for the island of Sumatra. Morley (1978) discussed the problems of correlating between regions in archipelagic areas therefore a comparison of the stratigraphic palynolo gy of Sumatra with that of Borneo may prove useful. In the absence of other palaeontological data within which to reconstruct a stratigraphic framework of the Ombilin Basin it is assumed that these index taxa have similar ranges in both Sumatra and Borneo.

Most of the index taxa have ranges which start in the Late Eocene thereby precluding a Palaeocene age of deposition for the Sawahlunto Formation. The presence of Alni pollenites also indicates an age of not younger than early Miocene. One specimen was recovered of a pollen which was similar in appearance to *Florschuetzia trilobata.* This taxa also has a range which would indicate an age as not younger than Lower Miocene. *Crassoretitriletes vanraadshooveni* (*Lyqodium scandens*) which indicates an age of not older than Miocene was also recovered in 5/4 and 5/25 (Fig. 4).

IV.3. Botanical Results

The lower vascular plants, namely the ferns and also the palms, are dominantly represented in all of the Ombilin samples. The only indications of gymnosperm are a few grains of Dacrydium and a single grain of *Podocarpus amarus.* These taxa could have been transported from the montane area. The small percentage of mangrove taxa occurs mostly at the top of the sequence. Thus, the evidence suggests that the sequence consists predominantly of freshwater taxa with a slight increase in mangrove taxa at the top which indicates the increasing encroachment of marine conditions.

V. ACKNOWLEDGEMENTS

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Table 1
Stratigraphic table for the Ombilin Basin, West Sumatra (after Koesoemadinata & Matasak, 1981)

		FORMATIONS	Lithology	Thickness	Environment
PLEISTOCENE		RANAU FORMATION	Tuffa		Terrestrial
TERTIARY	EARLY MIOCENE	OMBILIN FORMATION	Grey calcareous shales (marls) with limestone lenses, tuff interbeds in the upper part.	not less than 1442 m	Marine neritic
	OLIGOCENE	PORO MEMBER	Interbedded sandstones, siltstones and shales, and coal stringers.	0 - 320m	
		SAWAHTAMBANG FORMATION	Massive conglomeratic sandstones and conglomerates, often crossbedded.	625 m	Braided river system
		RASAU MEMBER	Interbedded conglomeratic sandstones and grey mudstones, non coal bearing	0-300m	Meandering streams
	EOCENE	SAWAHLUNTO FORMATION	Interbedded coal, sandstones and shales.	0-195 m	Meandering streams and swamps (flood plain)
	PALEOCENE ?	SANGKAREWANG FORMATION	Calcareous shales (marls) dark grey, papery, slump structure typical, thin sandstone intercalations present.	0-280m	Lacustrine
		BRANI FORMATION	Conglomerates breccias, typical purple to violet in colour, poorly sorted, poorly bedded, components vary locally.		Alluvial fans
PERMIAN AND TRIASSIC		TUHUR FM. SILUNGKANG FM.	Volcanics, andesite and basaltic lavas, and tuffs, argillites in the upper part and limestone.	Unknown	Marine with volcanic activity
		KUANTAN FM.	Slates and marbles.	100-450m	

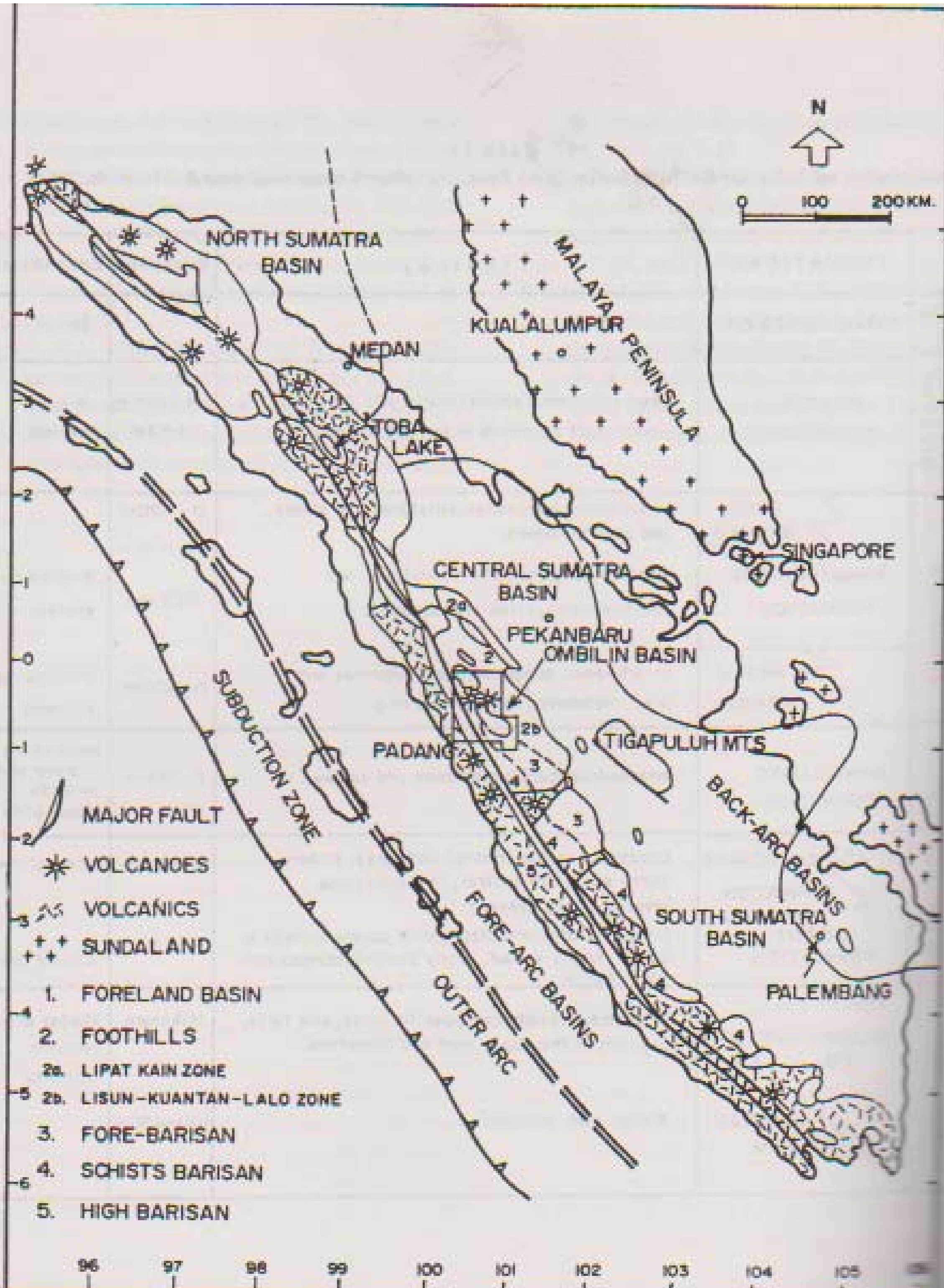


Figure 1
Ombilin Basin, West Sumatra, Indonesia (after Koesoemadinata & Matasak , 1981)

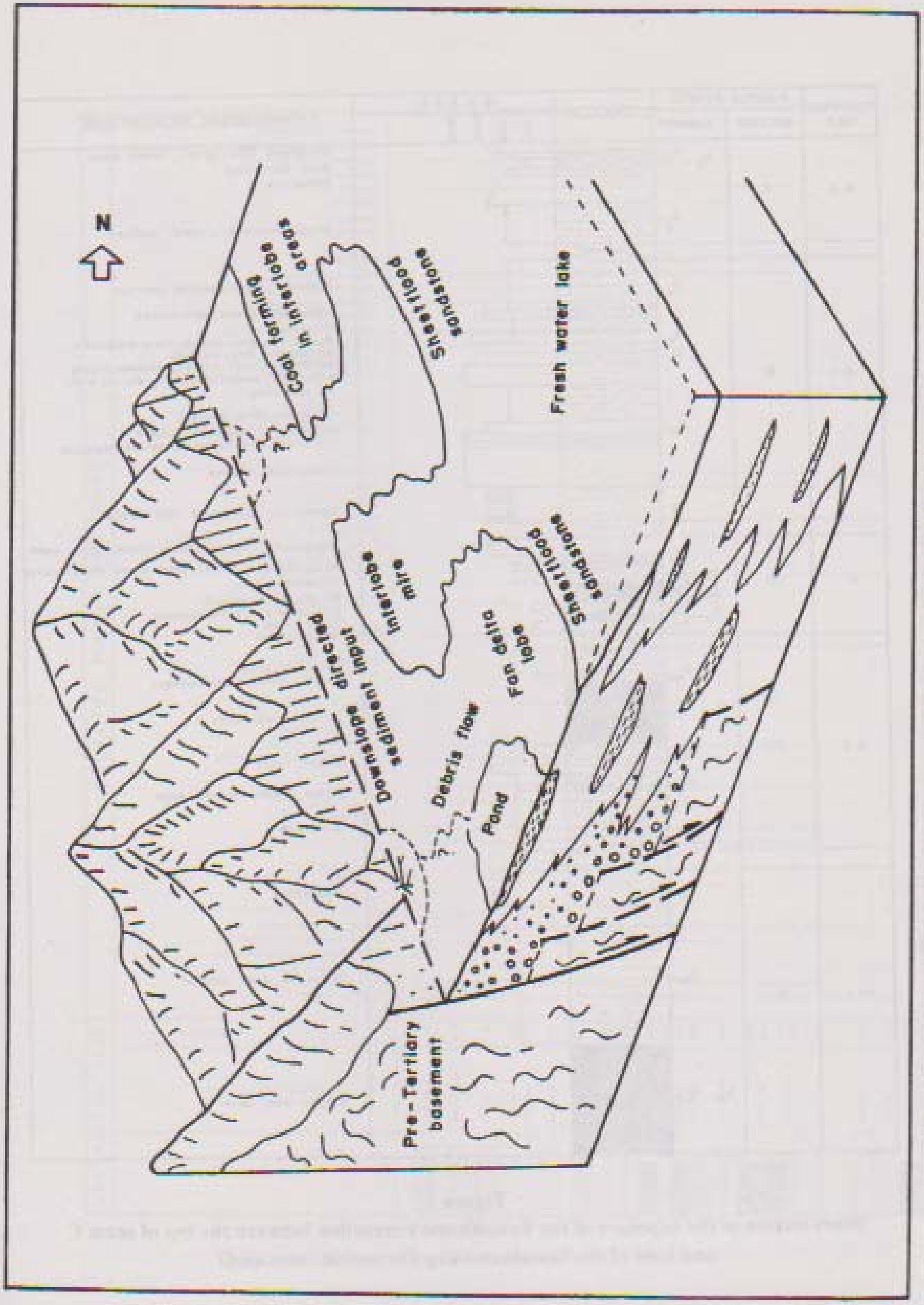


Figure 2. Depositional model of the sediments in the Ombilin Basin, West Sumatra (Whately & Jordan, 1989)

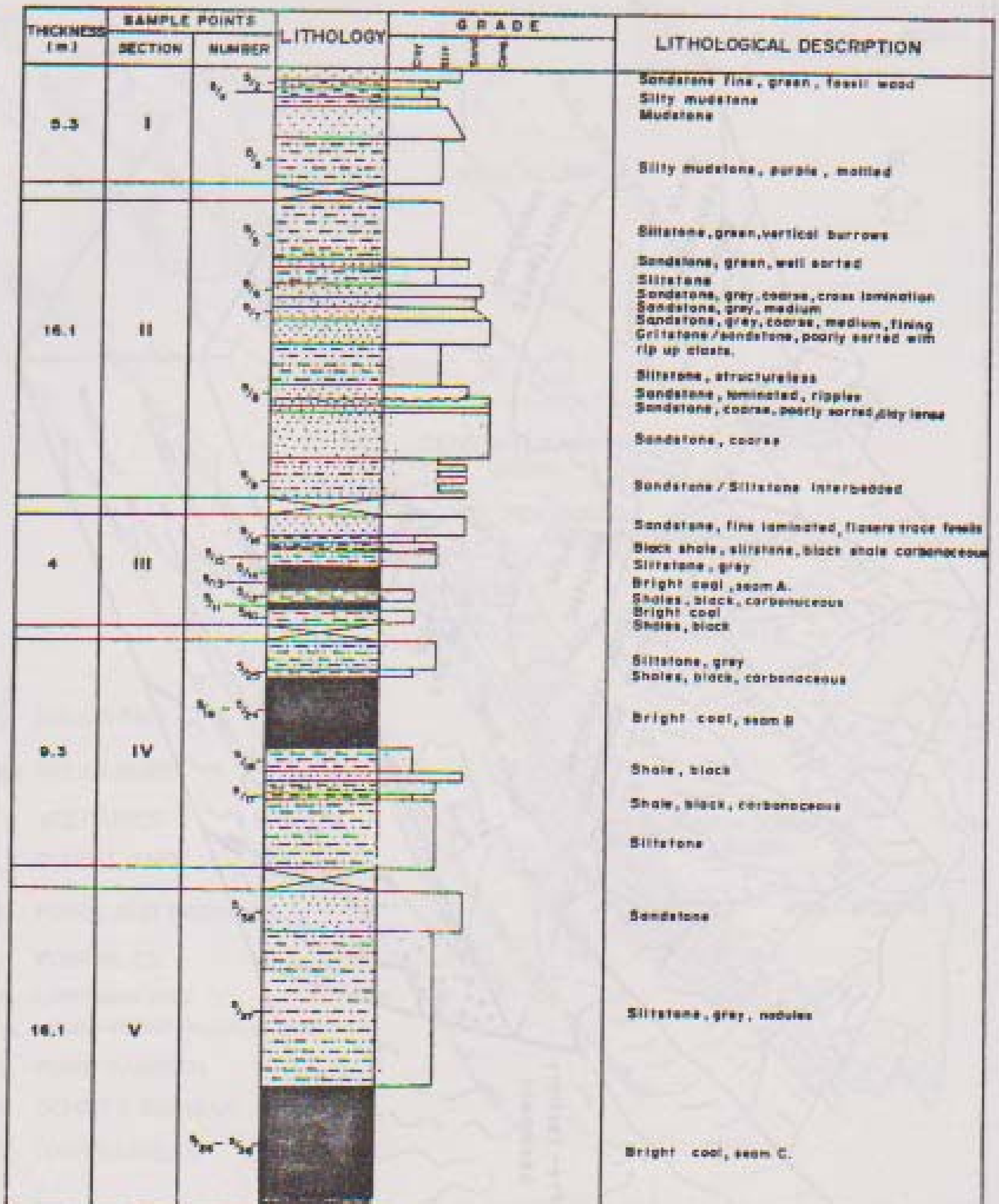


Figure 3
Short section of the exposure of the Sawahlunto Formation between the top of seam C and base of the Sawahtambang Formation (unscaled)

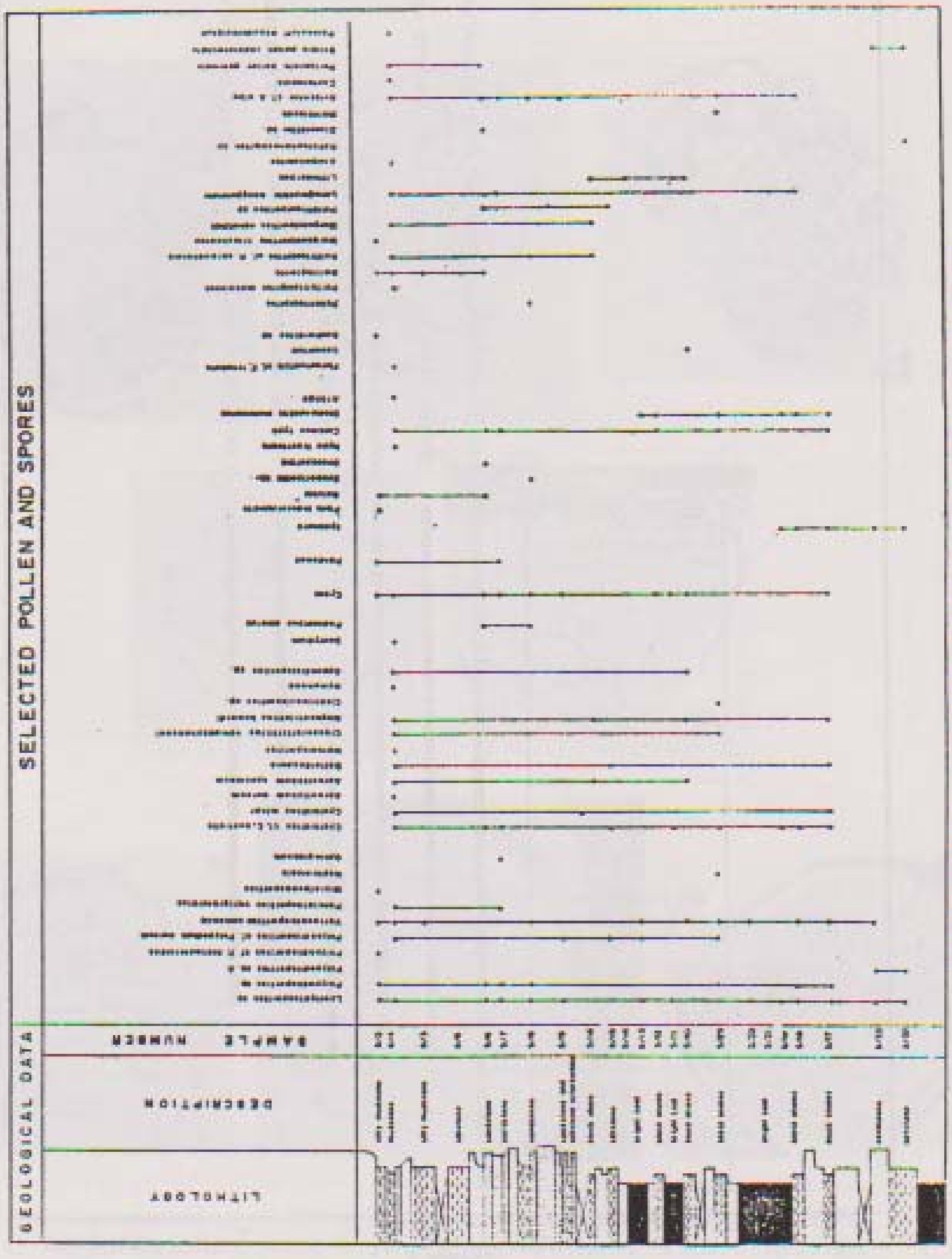


Figure 4. Distribution of taxa in the Sawahlunto Formation (unscaled)

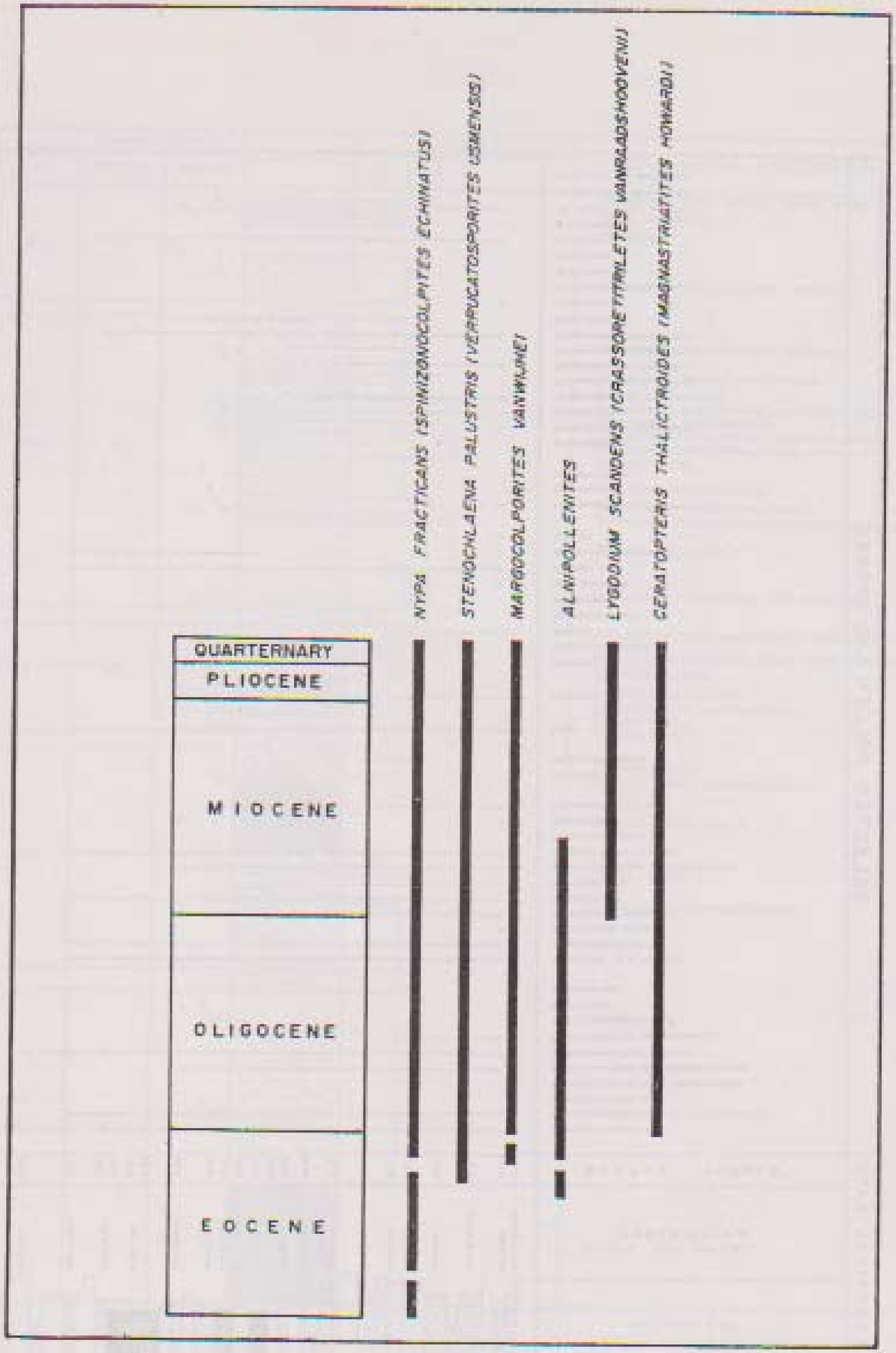
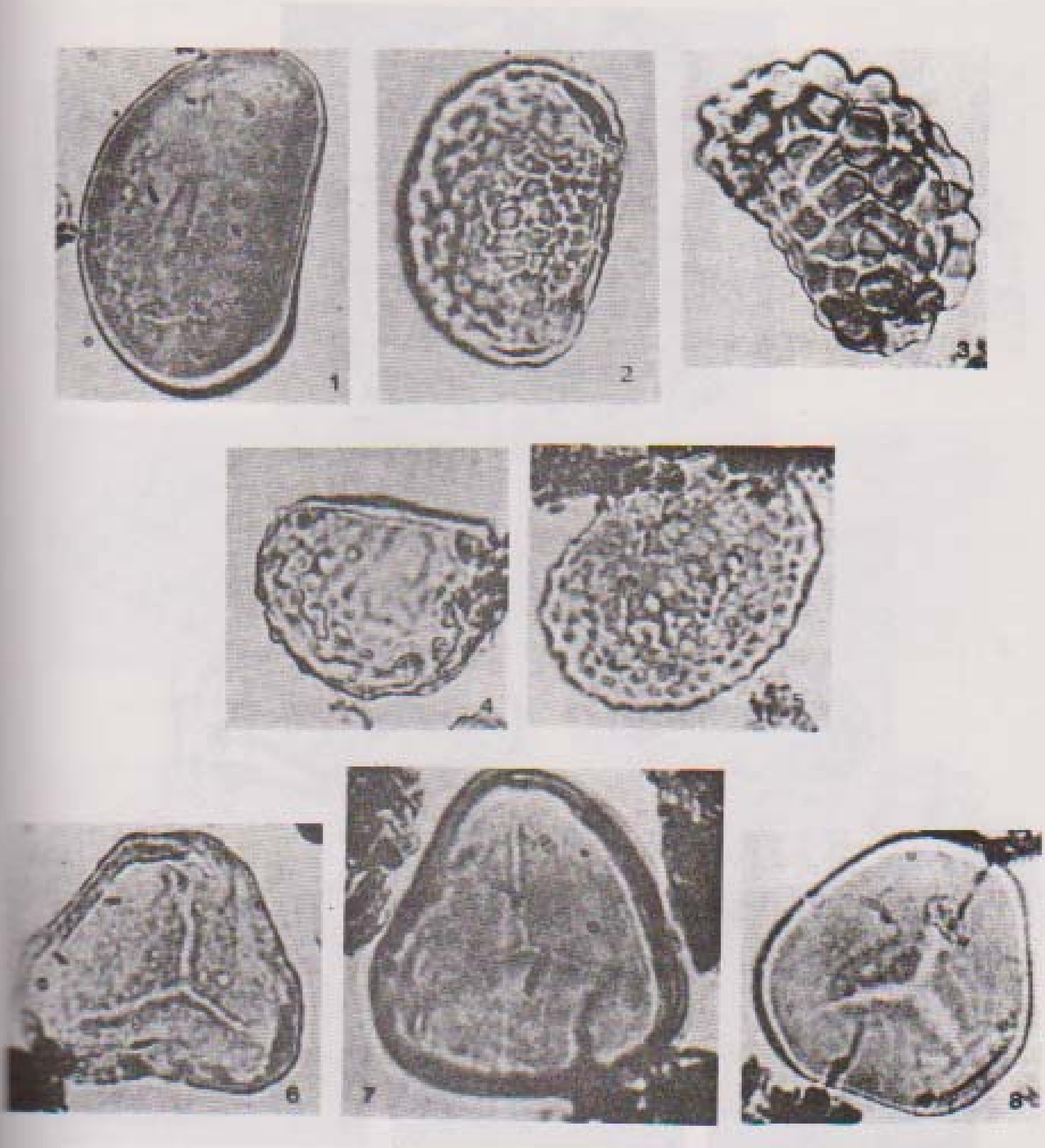


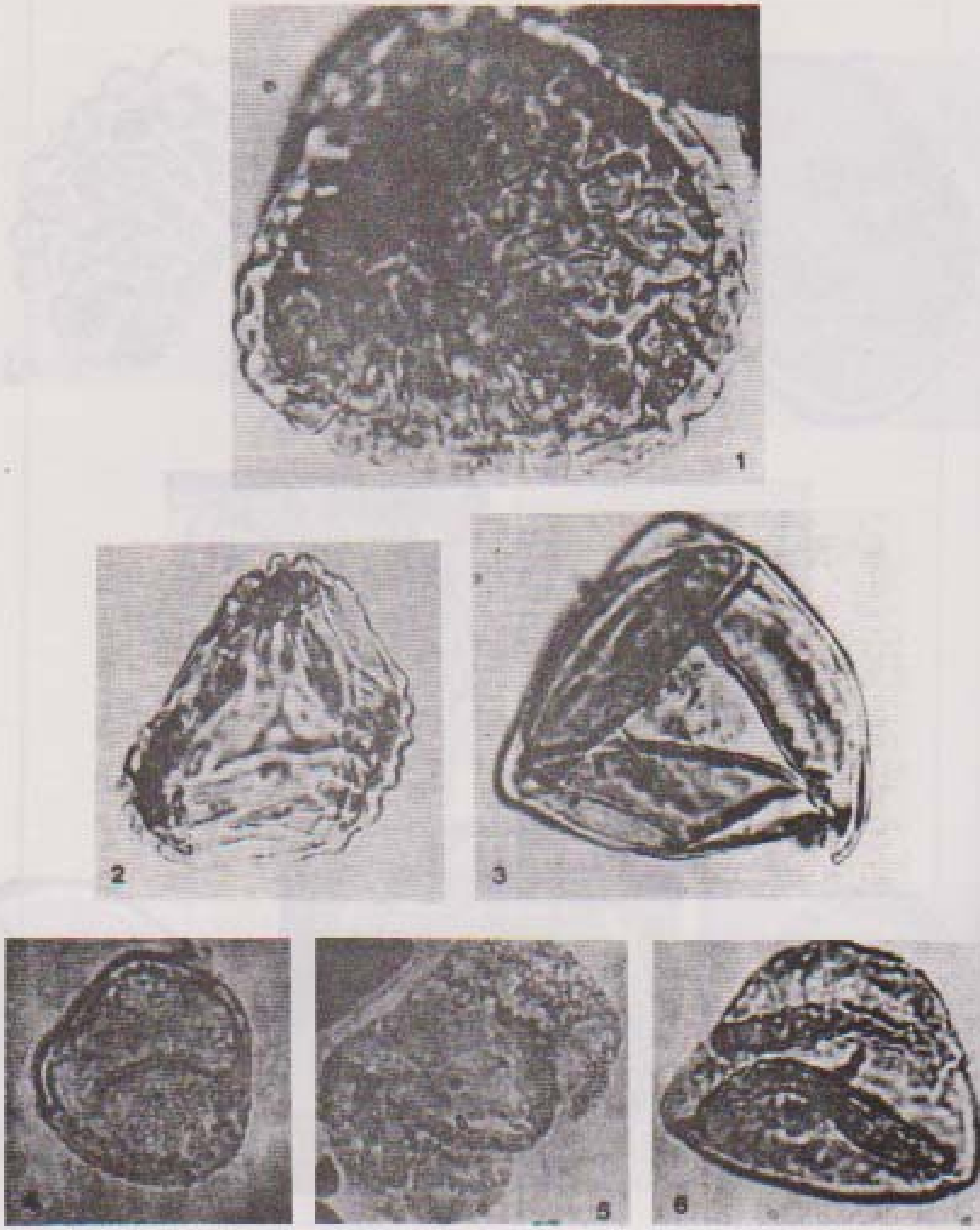
Figure 5
Stratigraphic range in Kalimantan of index taxa recovered in the Sawahlunto Formation

Plate I



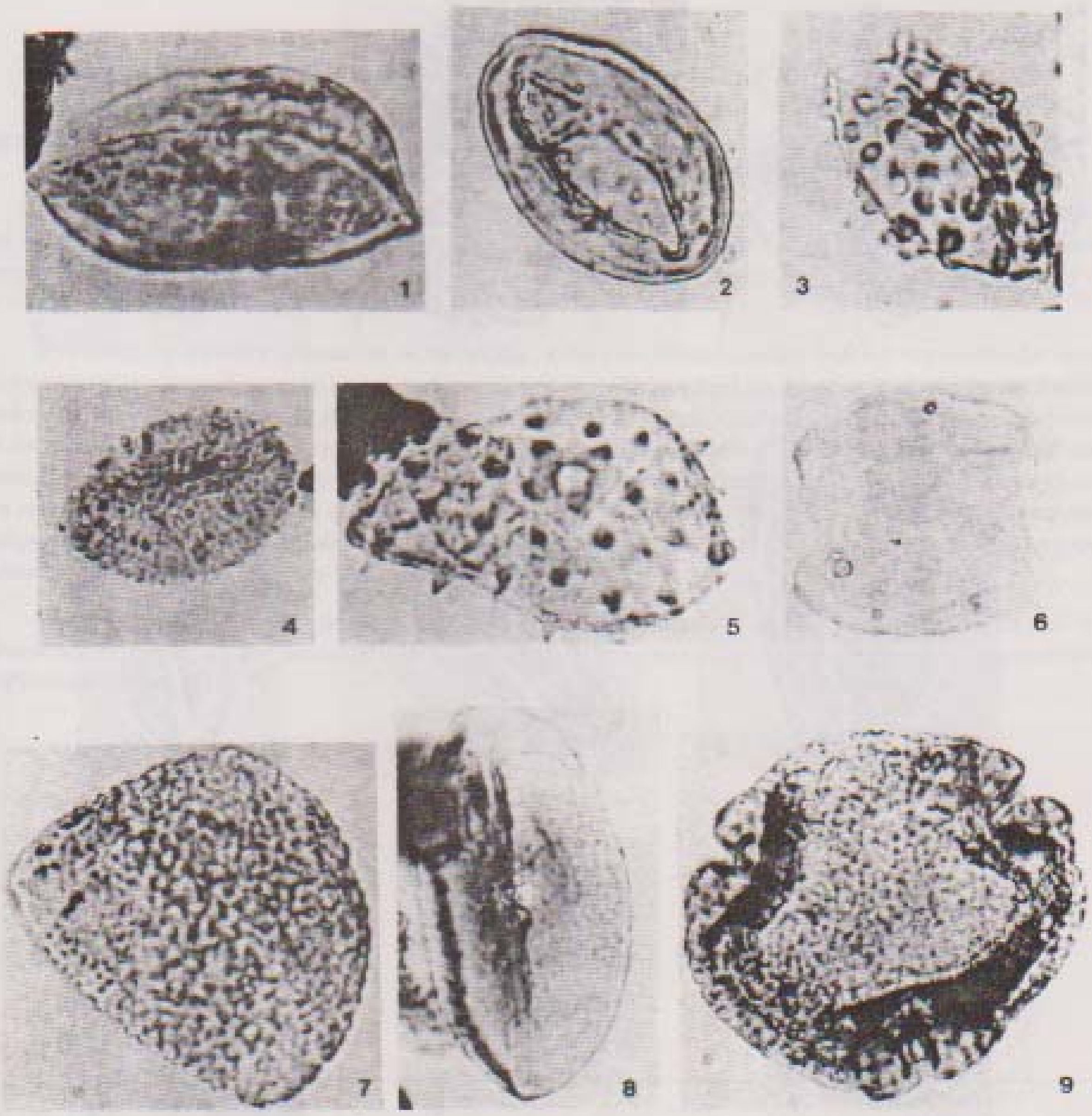
1. Laevigatosporites sp. ; x 800 2. Polypodiisporites sp. ; x 800 3. Polypodiisporites cf. Polypodium aureum ; x 800 4. Verrucatosporites usmensis ; x 800 5. Polypodiis porites sp A ; x 800 6. Acrostichum aureum ; x 800 7. Acrostichum speciosum ; x 800 8. Cyathidites australis ; x 800

Plate II



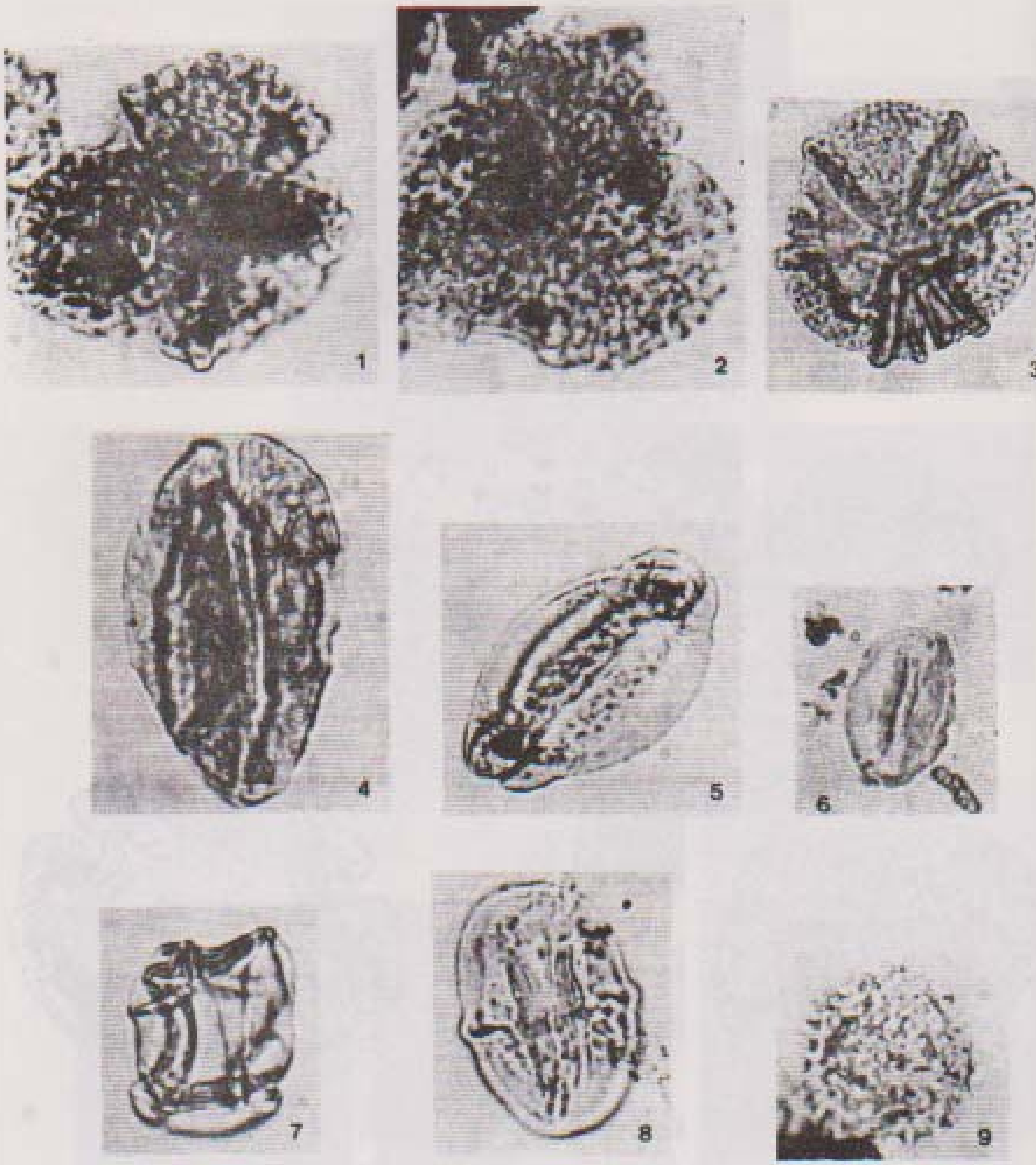
1. *Crassoretitriletes vanraadshooveni* ; x 800 2. *Magnastriatites howardi* ; x 400 3. *Nymphaea* ; x 800 4. *Dacrydium* ; x 800 5. *Podocarpus amarus* ; x 800 6. *Dacrydium* ; x 800

Plate III



1. Cycas ; x 800 2. Iguanura ; x 800 3. Palm indeterminate ; x 800 4. couperipollis sp ; x 800 5. Nypa fructicans ; x 800 6. Calamus type ; x 800 7. Dicolpollis malesianus ; x 800 8. Florschuetzia cf. F. trilobata ; x 800 9. Lanagiopollis nanggulensis ; x 800

Plate IV



1 & 2 Avicennia cf. A. alba 3. Margocolporites tricuneatus 4. Retitricolpites cf. R. sarawakensis 5. Barringtonia 6. Castanopsis 7. Alnipollenites 8. Palaquium pseudo-rostatum 9. Malvaceae.