

Significance of palynology in Late Quaternary sediments in Peninsular Malaysia

KAMALUDIN B. HASSAN

Geological Survey of Malaysia

P.O. Box 1015

30820 Ipoh

Abstract: Palynology is indispensable to Quaternary geological investigations. This paper discusses the palynological interpretation applied to the environments of deposition of some of the Holocene sediments in Peninsular Malaysia. The significance of palynology in delineating the Quaternary stratigraphy is stressed. A new unit for the Holocene, the Parit Buntar Member of the Gula Formation is introduced.

INTRODUCTION

Since the report by Haseldonckx (1977a), palynology has contributed much to the interpretation and reconstruction of the Quaternary sedimentary depositional environments in Peninsular Malaysia. In South-East Asia, the study has been widely used to reconstruct the vegetational history and as a tool in stratigraphic interpretation delineating the terrestrial from the marine sequence of the Tertiary. This is attributed, largely to its extensive use in biostratigraphy for petroleum exploration in the region.

Interpretation of the Depositional Environment

Various sedimentary depositional environments are recognised from the palynological study conducted at Seberang Prai (Kamaludin, 1989). Mangrove and back mangrove conditions are well depicted with instances of open swamp and fluvial influence as shown by borehole A13. Figure 1 shows the location of the study area while figures 2 and 3 represent the pollen diagrams of boreholes A13 and L7.

Similar work in other parts of the Peninsular by Chow (1971) and Hillen (1986) further elucidate the palynological characteristics associated with littoral and sublittoral environments. Anderson and Muller (1975), Haseldonckx (1977b) and Morley (1981) investigated the peat swamp environments in Sarawak, Johore and Kalimantan respectively.

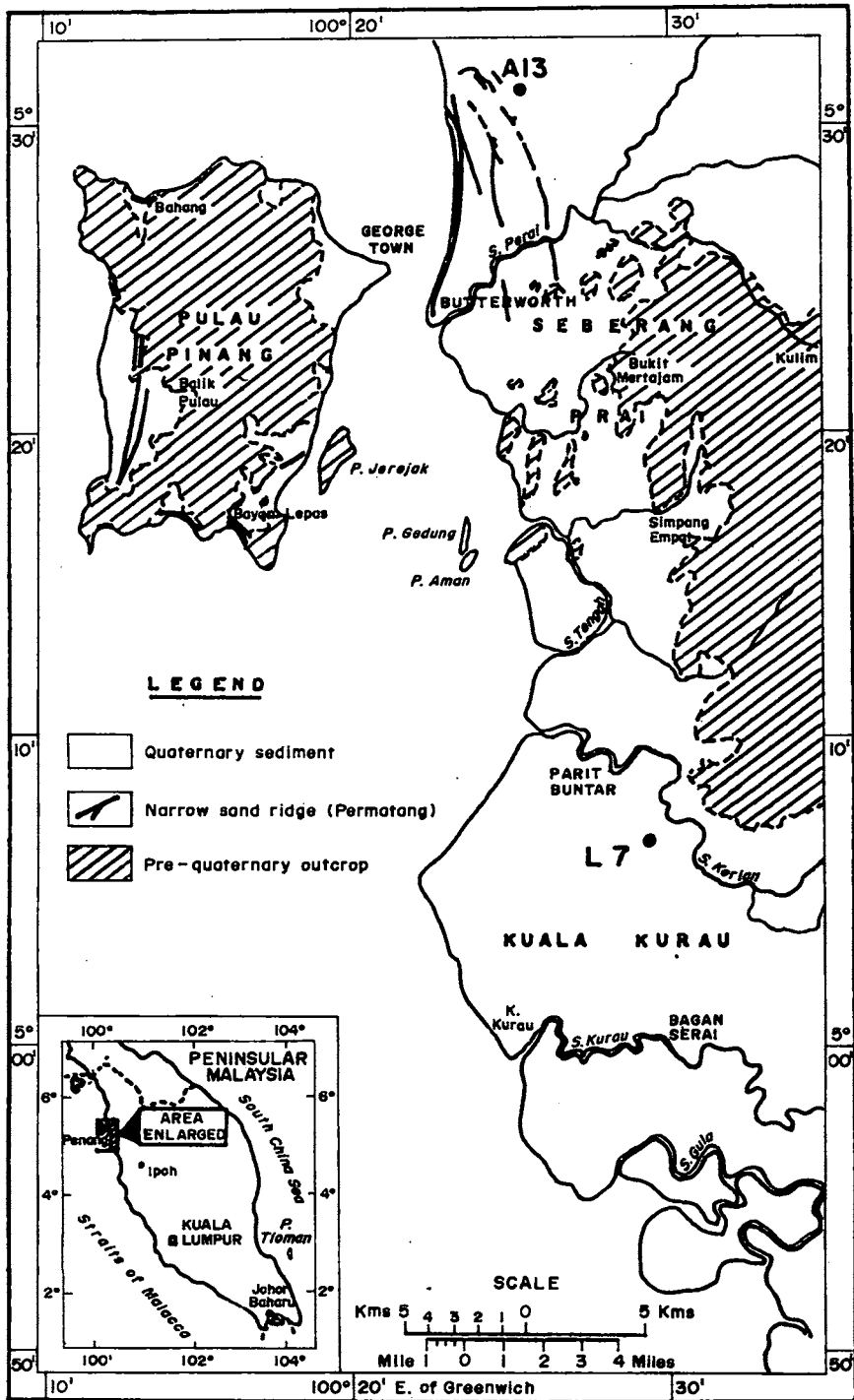
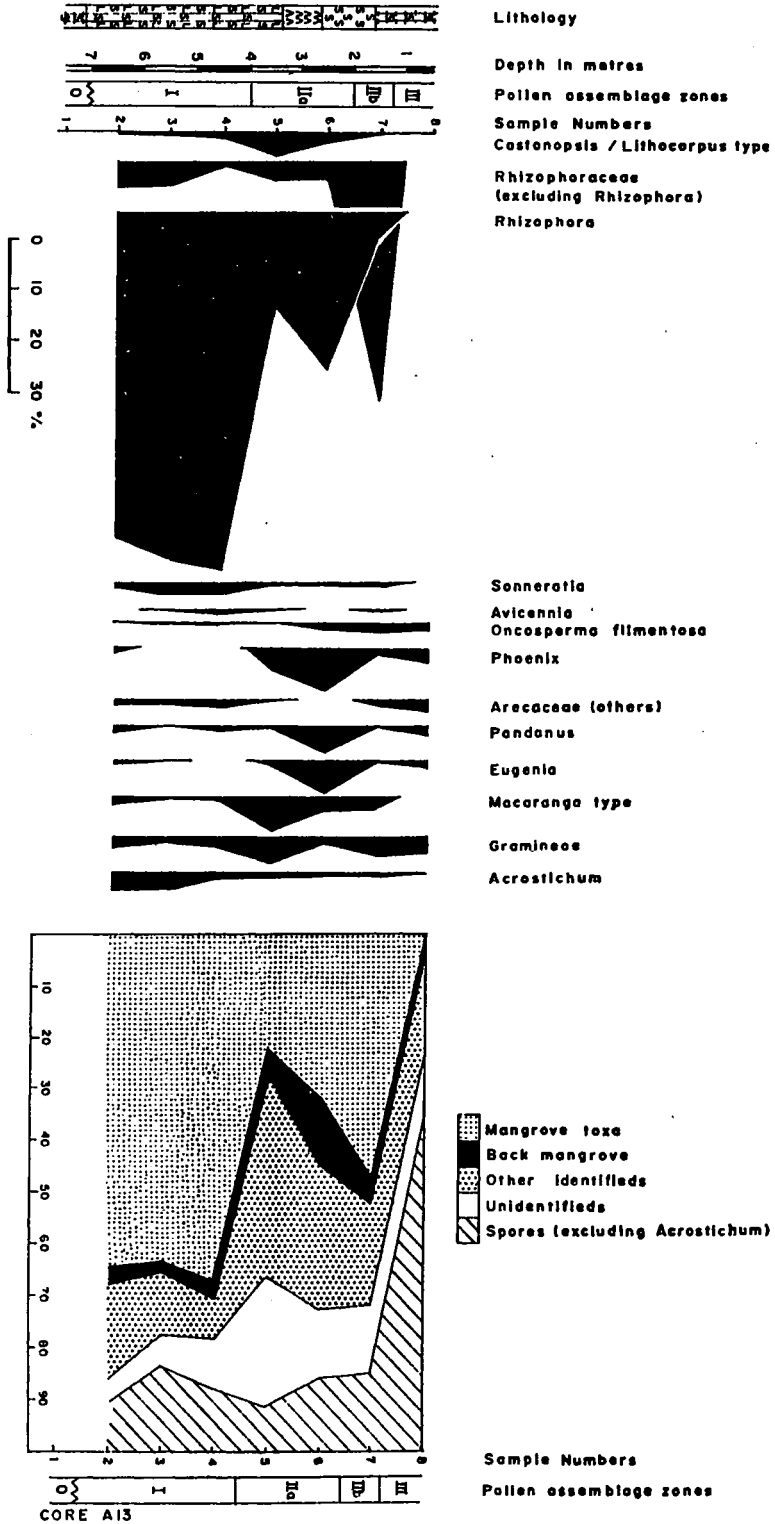
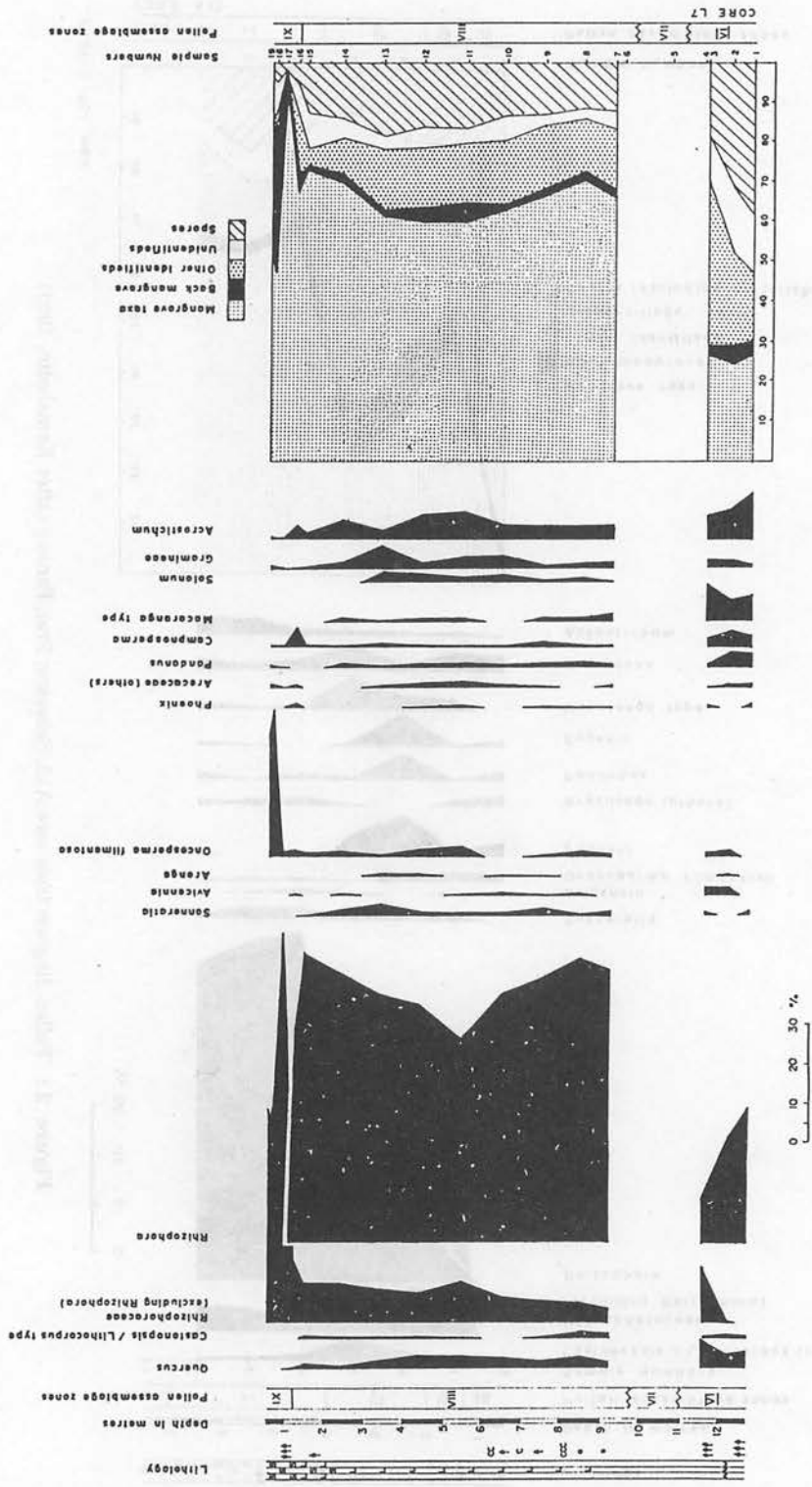


Figure 1: Location of boreholes A13 and L7 in Seberang Prai, Penang.

Figure 2 : Pollen diagram from core A13, Seberang Prai, Penang (after Kamaludin, 1989)

KBM : (09) D-28-87





KBM : (09) D-29-87

Figure 3: Pollen diagram from core L7, Seberang Prai, Penang (after Kamaludin, 1989)

Six types of Quaternary depositional environments based on the palynological and lithological characteristics are interpreted and classified as presented in Table 1.

Shallow marine offshore

Generally the lithology of the sediment deposited under this condition is homogeneous and made up of clay, silt and sand. Shell and plant remains may be abundant or in moderate amounts.

Palynological characteristics are shown by the moderate* amount of pollen grains dominated by mangrove species which constitute at least more than 40%, back mangrove type forming less than 15%, other tree pollen generally less than 30%, and spores show poor values.

Deltaic, lagoonal and estuarine

The sediment normally consists of clay, silt and sand. Gravel is sometimes present. Thin layers of fine to coarse sand are frequently encountered. Small to moderate amount of shell and plant remains may be present.

The pollen content is moderate to moderately rich. According to Hillen (1986), the sediment shows 40-60% mangrove species, 15-35% *Palmae*, high *Sonneratia* and spore values, and is moderately rich in mangrove species.

Mangrove

Clay and silt make up the sediment and occasionally peat (generally less than 2 metres) is encountered. Small to moderate amount of plant remains and sometimes shell remains are present. Quite often wrinkled plant structure could be found.

* The terminology used is subjective. A count of at least 200 grains per sample is required for a good interpretation. A suggested guide for the number of pollen grains counted per slide is listed here. (It has to be noted that pollen content or amount and diversity of pollen in a sample are two separate entities).

- | | | |
|--------------------|---|----------------------|
| 1. absent | - | no pollen |
| 2. very poor | - | less than 10 grains |
| 3. poor | - | 11 to 30 grains |
| 4. moderate | - | 31 to 100 grains |
| 5. moderately rich | - | 101 to 200 grains |
| 6. rich | - | more than 201 grains |

Table 1 : Classification of Late Quaternary depositional environments and the corresponding lithological and palynological characteristics.

Depositional Environment	Lithology	Palynological Characteristics
Shallow marine offshore (including tidal flat)	clay, silt sand shell & plant remains	moderate pollen content mangrove species > 40% Palmae < 15% other pollen types < 30% pollen diversity low to moderate low spore value
Deltaic, lagoonal and estuarine	clay, silt sand rare gravel plant & some- time shell remains	moderate to rich pollen content mangrove species 40 to 60% high <i>Sonneratia</i> Palmae 15-35% moderately rich in species high spore value
Mangrove	clay, silt peat rare sand & gravel shell & plant remains	moderate to rich pollen content mangrove species > 40% <i>Rhizophora</i> > 50% Palmae < 10% pollen diversity low to moderate low spore value
Back mangrove	clay, silt sand, peat rare gravel plant remains	moderate to rich pollen content low mangrove species <i>Rhizophora</i> < 40% high Palmae., peak in the individual profile e.g. <i>Ooncosperma</i> <i>Phoenix</i> <i>Nypa fruticans</i> <i>Calamus</i> etc. high Pandanaceae pollen diversity moderate to high low to moderate spore value
Freshwater swamp	peat clay, silt sand rare gravel	moderately rich to rich pollen content absent or low mangrove species low Palmae common pollen types: <i>Eugenia</i> <i>Macranga</i> , <i>Pandanus</i> , Gramineae, Euphorbiaceae Rubiaceae, etc. pollen diversity high moderate to high spore value
Peat swamp	peat	rich pollen content absent or very low mangrove and Pal- mae constituents common pollen types: <i>Stemonurus</i> , <i>Ilex</i> , <i>Camposperma</i> , <i>Palaquium</i> , <i>Pandanus</i> , Rubiaceae <i>Euphorbiaceae</i> , etc. pollen diversity high low to moderate spore value

Moderate to rich pollen content is usually the case. Mangrove species constitute at least more than 60% consisting of *Rhizophora* (the major component), *Bruguiera*, *Sonneratia*, *Avicennia*, and *Acrostichum*. *Palmae* is generally less than 10%, and low value of spores and the indeterminate species. Pollen diversity is often low to moderately represented.

Back mangrove

Clay, silt and quite often peat constitute the sediment. Sand is often present and gravel can be expected. Small amount to abundant plant remains may be present. Frequently the sediment is organic. In thick peat sequence, generally the basal layer characterize the sediment. Shell remains are absent.

The pollen content is moderate to rich and generally pollen diversity is fairly well represented. *Oncosperma*, other *Palmas* and often *Pandanus* are the indicator for the environment and they normally show a high value within their profile. Mangrove species especially *Rhizophora* is generally less than 40% and normally its pollen curve exhibits decreasing trend. The spore value is low to moderate.

Freshwater swamp

Peat is basically the major component. Clay, silt, some sand and in places minor amounts of gravel are present. Shell remains are absent.

The sediment is moderately rich to rich in pollen and shows a high representation of pollen types. Mangrove and back mangrove pollen may be present but often in poor amounts. Some of the common pollen types include *Eugenia*, *Macaranga*, *Pandanus*, *Gramineae*, *Euphorbiaceae*, *Rubiaceae* and others. When present riparian fringe species often show and increase in value. Spore value may vary from moderate to high.

Peat swamps

As the name implies peat forms the only component present. The thickness varies from less than a metre to more than 5 metres in different places and the top sequence is less compacted than the horizon below.

The palynological characteristic is typically rich in pollen exhibiting high diversity of pollen types. When present mangrove and back mangrove species occur in small amounts. The common pollen types include *Stemonurus*, *Ilex*, *Camptosperma*, *Calophyllum*, *Eugenia*, *palaquium*, *Pandanus*, *Rubiaceae*, *Euphorbiaceae* and others. Spore value is often low to moderate. During peat development individual species may predominate within the taxa.

STRATIGRAPHIC APPLICATION

The Quaternary stratigraphy of Malaysia has been defined according to the lithologic criteria and is divided into various lithostratigraphic units (Suntharalingam 1983; Bosch 1986; Loh 1986). The Simpang and Kempadang Formations are interpreted to be of Pleistocene in age. The Holocene units are made up of Gula and Beruas Formations in which four members are assigned to the former and one member to the latter respectively.

Until recently palynological investigation and interpretation that had been carried out were from the lowland coastal areas ascribed to the Holocene units. The information gathered from the study, further updates an interpretation previously derived solely from the lithological characteristics. The environments of deposition interpreted explain the various members in the two Holocene Formations.

In the Gula Formation the four defined members are:-

1. Bagan Datoh Member
2. Teluk Intan Member
3. Port Weld Member
4. Matang Gelugor Member

The Bagan Datoh Member is interpreted from the pollen assemblages that define shallow marine offshore environment. The Teluk Intan Member is represented in the deltaic lagoonal or estuarine environment. The Port Weld Member shows a typical mangrove deposit.

The Matang Gelugor Member is defined as shallow marine coastal deposit. It is distinguished by the lithology. Sand (often coarse grained), gravel and shell remains which constitute the deposit are unsuitable for pollen analyses since pollen is generally absent or if present the interpretation is often unreliable.

The Pengkalan Member of the Beruas Formation is explained either from the freshwater of peat swamp environment.

From the palynological study in the Seberang Prai area (Kamaludin, in manuscript) and comparison made with other studies, it is found that back mangrove sediments are present from the drilling cores investigated. The sequence is described by Anderson and Muller (1975) and Haseldonckx (1977b) just below the peat layer, and in Hillen's (1986) diagram A it forms the transition zone, while in the Seberang Prai area it is shown in the pollen assemblage zones II and IX (figure 2 and 3). In these studies *Oncosperma* shows a distinctly high value within its profile.

This finding necessitates an explanation for a separate sequence and an introduction of a new unit in the Gula Formation. Thus it is here introduced the Parit Buntar Member.

The Parit Buntar Member

The Parit Buntar Member constitutes a sequence of grey (7.5Y 5/1) to brownish black (10YR 2/2) clay, silt, in places thin layers of sand and gravel, and peat, deposited in the back mangrove environment. Its occurrence is widespread in the west coast of Peninsular Malaysia often less than 3 metres thick, generally stratigraphically above the Port Weld Member.

The type area is at Parit Buntar and its vicinity.

Table 2 shows the various depositional environments derived from the pollen assemblages for the Holocene and the corresponding stratigraphic units designated.

CONCLUSION

In the geological investigation of Late Quaternary sediments, it is emphasised that apart from lithology, palynological characteristics is important in delineating the sedimentary environments of deposition. Whenever possible, radiocarbon dating on representative samples should be supplemented.

The introduction of the Parit Buntar Member in the Holocene units further updates the stratigraphy of the Quaternary.

Table 2 : Late Quaternary stratigraphy and the characteristic depositional environment

Quaternary Epoch	Formation	Member	Depositional environment
Holocene	Beruas	Pengkalan	freshwater/peat swamp
		Matang Gelugor	shallow marine coastal
		Parit Buntar	back mangrove
	Gula	Port Weld	mangrove
		Teluk Intan	deltaic/lagoonal/estuarine
		Bagan Datoh	shallow marine offshore

REFERENCES

- ANDERSON, J.A.R., & J. MULLER, 1975. Palynological study of a Holocene peat and a Miocene coal deposit from NW Borneo. *Review of Palaeobotany and Palynology* 19: 291-351.
- BOSCH, J.H.A., 1986. Young Quaternary sediments in the coastal plain of southern Perak, Peninsular Malaysia: *Geological Survey Malaysia Quaternary Geology Report No. 1/86*.
- CHOW, Y.C., 1977. *The palynology of a west Malaysian mangrove and shallow marine environment*. Unpub. MSc Thesis, Univ. College, London.
- HASELDONCKX, P., 1977a. Palynology and its application to Quaternary geology in the Sunda Shelf region. *CCOP/TP* 5: 37-49
- HASELDONCKX, P., 1977b. The palynology of a Holocene marginal peat swamp environment in Johore, Malaysia. *Review of Paleobotony and Palynology* 24: 227-238.
- HILLEN, R., 1986. Palynology as a tool in delineating tropical lowland depositional environments of Late Quaternary age. *GEOSEA V Proceedings Vol. I, Geological Society Malaysia, Bulletin* 19: 495-504.
- KAMALUDIN BIN HASSAN, 1989. Palynology of the lowland Sebarang Prai and Kuala Kurau Areas NW Peninsular Malaysia. *Bull. Geol. Soc. Malaysia*, Vol. 23.
- LOH, C.H., 1986. Quaternary stratigraphy of Peninsular Malaysia. *Proceedings of the First International Colloquium on Quaternary Stratigraphy of Asia and the Pacific*, Osaka.
- MORLEY, R.J., 1981. Development and vegetation dynamics of a lowland ombrogenous peat swamp in Kalimantan Tengah, Indonesia. *Journal of Biogeography* 404.
- SUNTHARALINGAM, T., 1983. Cenozoic stratigraphy of Peninsular Malaysia. *Proc. Workshop on Stratigraphic Correlation of Thailand and Malaysia*, vol. 1: 149-158.

Manuscript received 24th June 1988.