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Tertiary palynomorph assemblage from eastern Chenor, Pahang

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Abstract: A palynological study has been carried out on samples from a well exposed outcrop near Kg. Pejing along the road connecting Chenor and Paloh Hinai in the central part of Pahang. This well exposed outcrop is described as flat interbedded carbonaceous mudstone and sandstone. A palynological investigation of the outcrop section has revealed that the palynomorph assemblages were dominated by typical Tertiary palynomorphs such as *Lanagiopollis emarginatus*, *Discoidites borneensis*, *Taxodiaceae*, *Stenochlaena palustris*, *Asplenium* type, freshwater, peat swamp pollen and abundant tricolpate and tricolporate pollen. These palynomorph assemblages suggest the occurrence of ephemeral peat swamp and riparian fringe type environment. The age of the rock succession is probably Late Miocene and/or younger based on the presence of certain stratigraphically significant and age restricted taxa such as *Lanagiopollis emarginatus* and *Stenochlaenidites papuanus*.

Keywords: palynology, palynomorph, Tertiary, Pahang

INTRODUCTION AND BACKGROUND

Samples for palynological analysis were collected from one of the well exposed outcrop located near Kg Pejing approximately 30 km to the east of Chenor (Figure 1). This area was previously mapped as the Tembeling Group by Khoo (1977). The Tembeling Group, formerly known as the Tembeling Formation, introduced by Koopmans (1968) which consists of four formations namely the Kerum Formation, Lanis Conglomerate, Mangkin Sandstone and Termus Shale. The rock succession from the study area had been described by Zainey Konjing *et al*. (2007) and Marahizal Malihan (2006) where it is dominated by siltstone, fine to coarse grained sandstone and conglomerate with channelized features indicating fluvial deposits. There is only a limited number of publications related to the Tertiary palynology particularly in the onshore part of Peninsular Malaysia, even though palynomorphs has been widely used as a correlation tool to define and establish biostratigraphic zonation scheme and also to interpret the depositional environment of the sedimentary deposits for oil and gas exploration in the Tertiary Malay Basin. This is because most of the sedimentary successions from the central to eastern belt of Peninsular Malaysia tend to be older than Tertiary. Moreover, compare to the Tertiary Malay Basin, the Tertiary beds found in the onshore part of Peninsular Malaysia are relatively small in scale for example, at Batu Arang, Selangor and Bukit Arang, Perlis. Tertiary palynomorphs within Peninsular Malaysia had previously been reported from Batu Arang Formation and Layang-Layang Formation by Ahmad Munif Koraini (1993), Ahmad Munif Koraini *et al*. (1994) and Mahendran *et al*. (1991). Most of the sedimentary successions especially in the eastern part of Peninsular Malaysia are characterized by common Mesozoic terrestrial megaspores and striate type palynomorphs of Late Jurassic to Early Cretaceous age. Based on the recent palynological study within the same and adjacent areas by Uyop Said *et al*. (2007), including the rock succession from the Tekai River area by Sharifah Shahira Wafa Syed Khairulminir Wafa *et al*. (2005) and Ainul Rubizah Ariffin *et al*. (2005), the interpreted age of the rock succession is Late Jurassic to Early Cretaceous. Other Upper Mesozoic palynomorph assemblages were reported by Uyop Said (2002) from the southern part of Pahang. The author also highlighted the emergence of angiopermous palynomorphs which could be related to the first appearance of Tertiary palynomorphs. The presence of Tertiary palynomorphs establishes the occurrence of a Tertiary sedimentary succession within central Pahang along Chenor to Paloh Hinai road. The aim of this paper is to document and to study the palynomorph variation and their significance in term of dating the rock and assisting in the interpretation of paleoenvironment.

MATERIAL AND METHOD

The well exposed, flat bedded outcrop (Figure 2) located near Kg. Pejing was described and logged. Palynological analysis was carried out on a total of 20 samples to determine the possible age of the rock and its depositional environment. The samples were mostly collected from the carbonaceous mudstone and coaly section and a few from the sandstone intervals. Most of the analyzed samples contain highly carbonaceous and coaly material. The selected samples were processed according to the standard palynological preparation adapted from Wood *et al*. (1996). 10% hydrochloric and 47% hydrofluoric acids were used to eliminate and dissolve carbonates and silicates. The residues were neutralized and centrifuged in a heavy liquid solution of zinc bromide (specific gravity about 2.2) for heavy mineral separation. Due to the condition of the samples which contain highly carbonaceous and coaly material, they were treated with nitric acid for about 4 to 6 hours. The remaining residues were then mounted on glass slides with Canada balsam. The palynology slides were examined by using a

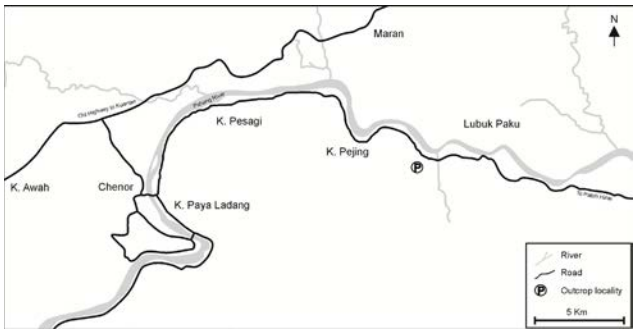

Figure 1: Location map of study area.

Figure 2: Well exposed flat bedded outcrop section near Kg. Pejing. Geologist for scale (1.8m).

Figure 3: Poorly bedded outcrop at the east side of the outcrop due to the extreme weathering.

Figure 4: Close up photograph shows, sharp to irregular basal contact of poorly sorted, loose and semi-consolidated sandstone unit overlying carbonaceous/coaly mudstone.

Leica DM 750 biological transmitted light microscope at magnification 100x and equipped with a Leica EC3 digital camera at the Biostratex Sdn Bhd palynological laboratory. The palynomorphs were identified by comparing to the present day plant community and other published data by previous workers such as Wyatt-Smith (1963), Anderson (1963), Morley (1976) and Anderson & Muller (1975). A semi quantitative method was applied in this study with at least 50-100 palynomorphs counted in each sample. Some of the samples contain a large number of unknown species from tricolporate and tricolpate pollen. However this type of pollen were not included in the absolute palynomorphs count in order to prevent miss-counting of the other more important species.

RESULT AND DISCUSSION

Outcrop and brief lithological description

The well exposed and almost flat bedded outcrop, which in some sections are poorly bedded due to the extreme weathering is described as interbedded sandstone and carbonaceous mudstone and coal, (Figure 3). There are thin-bedded of sandstone-siltstone in between the carbonaceous mudstone layers. A coaly lithology in the lower part of the succession is more dominant before it gradually changes to highly carbonaceous mudstone which is also characterized by the presence resin of nodules. In general, the sandstone unit is relatively coarse-grained, poorly sorted, partially loose or semi-consolidated. Possible sharp to irregular basal contacts between the sandstone and carbonaceous mudstone can be observed at the upper part of the succession (Figure 4), which forms a wedge-shaped sandbodies overlying the carbonaceous/coaly mudstone. The overall thickness of the outcrop is approximately 5 m. The logged section and sample positions from the outcrop are shown in Figure 5.

Palynology

Most of the samples yielded abundant and relatively well preserved palynomorphs, except for the sandstone samples which were found to be barren or contained badly preserved palynomorphs.

The palynomorph assemblages are characterized and dominated by the abundance of angiospermous, tricolpate and tricolporate pollen, monolete spores with some mangrove pollen. Some of the selected palynomorphs are shown in Plate 1-4. The palynomorph assemblages from this outcrop show some similarity to the palynomorph assemblages from the Batu Arang Formation of Ahmad Munif Koraini, (1993) and from the Layang-Layang Formation, Bandar Tenggara Johor of Ahmad Munif Koraini *et al*. (1994). However, certain species of theirs were not encountered from this area. For example, the freshwater algae species such as *Pediastrum* sp. and *Botryococcus* sp. which characterized the lacustrine environment for both of the formations are absent from all of the samples. The present assemblages also recorded no occurrence of large spores such as *Cicatricosisporites dorogensis, Crassoretitriletes vanraadshoveni* and *Osmundacidites* where these species

are common in Batu Arang Formation. The freshwater and peat swamp elements are more dominant here along with the abundance of angiospemous, tricolpate and tricolporate pollen. This outcrop section also has regular occurrence of typical climbing ferns taxa represented by *Stenochlaena palustris* and large monolete bean-shaped spores, of the *Asplenium* type.

Overall, a good biostratigraphic signature was obtained from the studied outcrop section. Most of the samples contained abundant and well preserved palynomorphs. In general, the comparison of the playnomorphs species is mainly focused on taxa known to be occurring in peat swamp forests compared to the other plant communities such as, mangrove and riverine vegetation. However there are some species especially the unidentified tricolpate and tricolporate type pollen that seem to be over represented in most of the samples, but these pollen types will be excluded in the discussion. There are also some species which commonly occur in peat swamp setting but also exist in other communities like, riparian and fresh water vegetation. The presence of common typical peat swamp pollen such as *Lanagiopollis* spp., affiliated to *Alangium*, *Blumeodendron*, *Cephalomappa*, *Calophyllum* and other fresh water and riparian plant communities such as *Pandanus, Eugenia* and *Sapotaceae* (*Palaquium*) may demonstrate the occurrence of an ephemeral peat swamp and/or a former riparian fringe type environment. The species of *Lanagiopollis emarginatus,* affiliated to *Alangium havilandi,* also occurs commonly in most of the samples. This species was previously reported from Sarawak and East Kalimantan by Anderson and Muller (1975) where it tends to be associated with a restricted assemblage of pollen taxa (e.g. pollen of *Calophyllum, Blumeodendron* and *Palaquium* type) indicative of peat swamp vegetation. The common *Asplenium* type may also supported this assumption, as this species has similar spore morphology to the genera of *Crypsinus, Lecanopteris, Platycerium* and *Schizae* (Anderson & Muller, 1975) which all occur in peat swamp forests. The abundance of *Stenochlaena palustris*, characteristic of climbing ferns, may reflect the initial stage of peat swamp development which was later substituted and dominated by a truly peat swamp community.

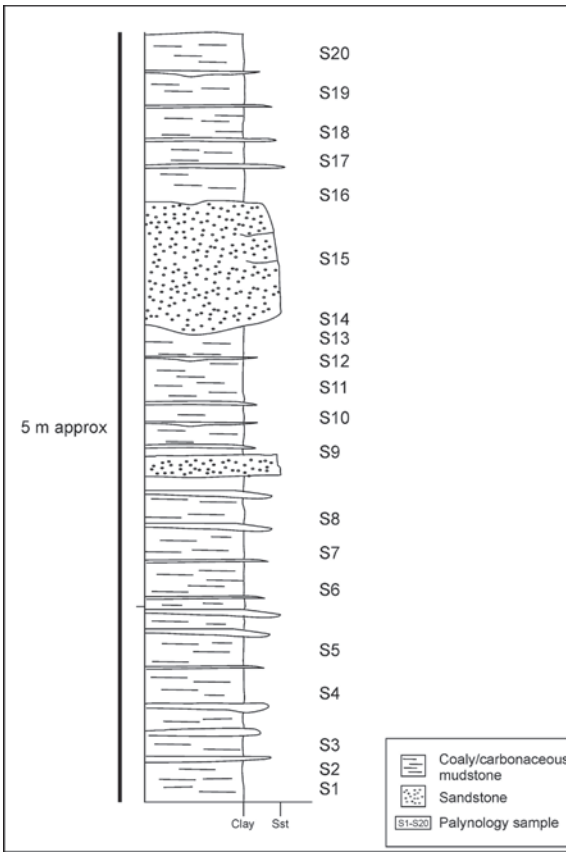

Figure 5: Sedimentary log of the studied outcrop and sample positions.

Age

Most of the palynomorphs encountered in the analyzed samples are stratigraphically long ranging taxa. However, it is still possible to establish the age for the rock succession based on the presence of certain significant diagnostic taxa by comparing to the published zonation and palynomorph assemblages particularly within South East Asia region. The analyzed samples commonly include the important marker species of *Stenochlaenidites papuanus* and *Lanagiopollis emarginatus*. The species of *Lanagiopollis emarginatus* was very common in the Late Miocene and Pliocene of Brunei/Sarawak, Java Sea and also in the South China Sea (Morley, 1982). This species also occurs in the Lower Pliocene Liang Formation, as reported by Leichti *et al*. (1960) and Fui, (1978). The spore of *Stenochlaenidites papuanus* previously known as *Stenochlaena laurifolia* that has a great affinity to the fern species, *Stenochlaena milnei* is well used as an important marker for the Late Miocene and Pliocene especially within the Sunda region (Morley 1991). This species is also widely used as an indicator for the Upper Miocene and Pliocene sedimentary sequences for oil and gas exploration in the Malay Basin as well as in offshore Sarawak. In the Malay Basin the presence of *Stenochlaenidites papuanus* characterize the PR 14 Zone which corresponds to the Late Miocene-Early Pliocene as reported by Azmi *et al*. (1996). The association of *Stenochlaenidites papuanus* and *Lanagiopollis emarginatus* species suggests a Late Miocene and/or younger age for this outcrop section.

CONCLUSION

The palynological study of the selected outcrop samples from Eastern Chenor has revealed that the palynomorph assemblage resembles that of Tertiary palynomorphs. This palynomorph assemblage is the first Tertiary palynological data reported from this area. The assemblage is dominated by peat swamp and riparian freshwater plant communities which reflect the occurrence of a peat swamp succession and possibly a former riparian fringe type environment. The presence of age restricted species such as *Lanagiopollis emarginatus* and *Stenochlaenidites papuanus* suggests the age of the outcrop section is Late Miocene and/or younger.

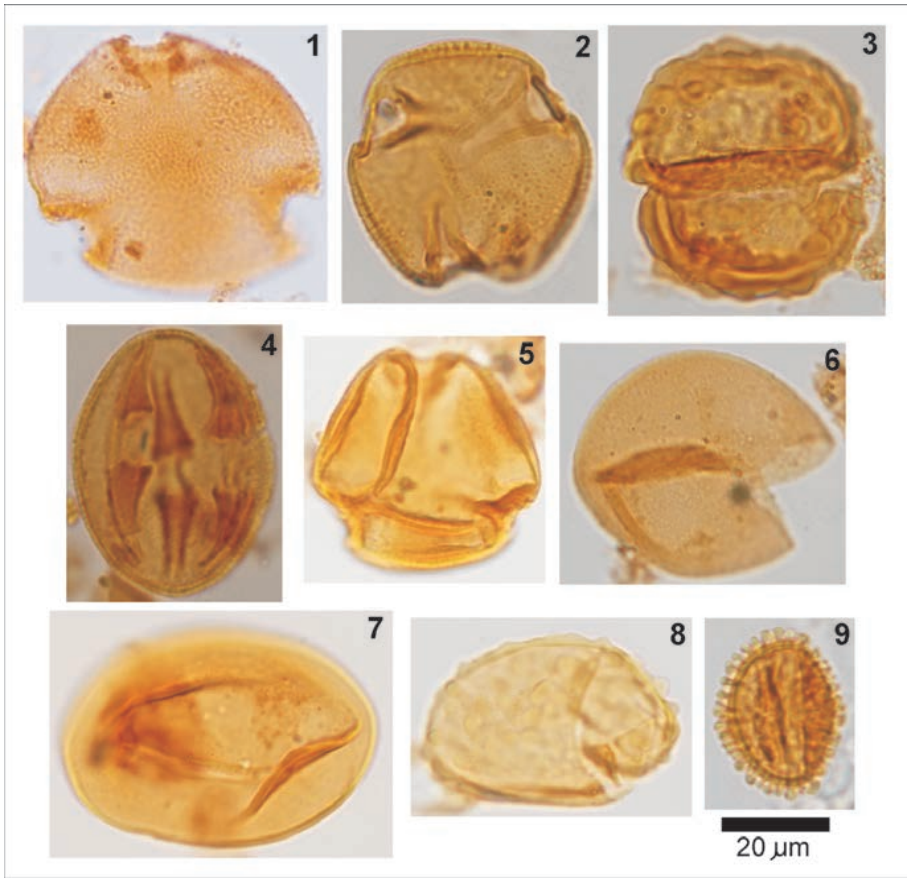

Plate 1: 1. *Lanagiopollis emarginatus,* 2. *Lanagipollis* sp., 3. *Stenochlaeniditis papuanus,* 4. *Lanagipollis* sp., (Equatorial view) 5. *Lanagipollis* sp. 6. *Taxodiaceae* 7. *Asplenium* type, 8. *Stenochlaena palustris,* 9. *Ilex* .

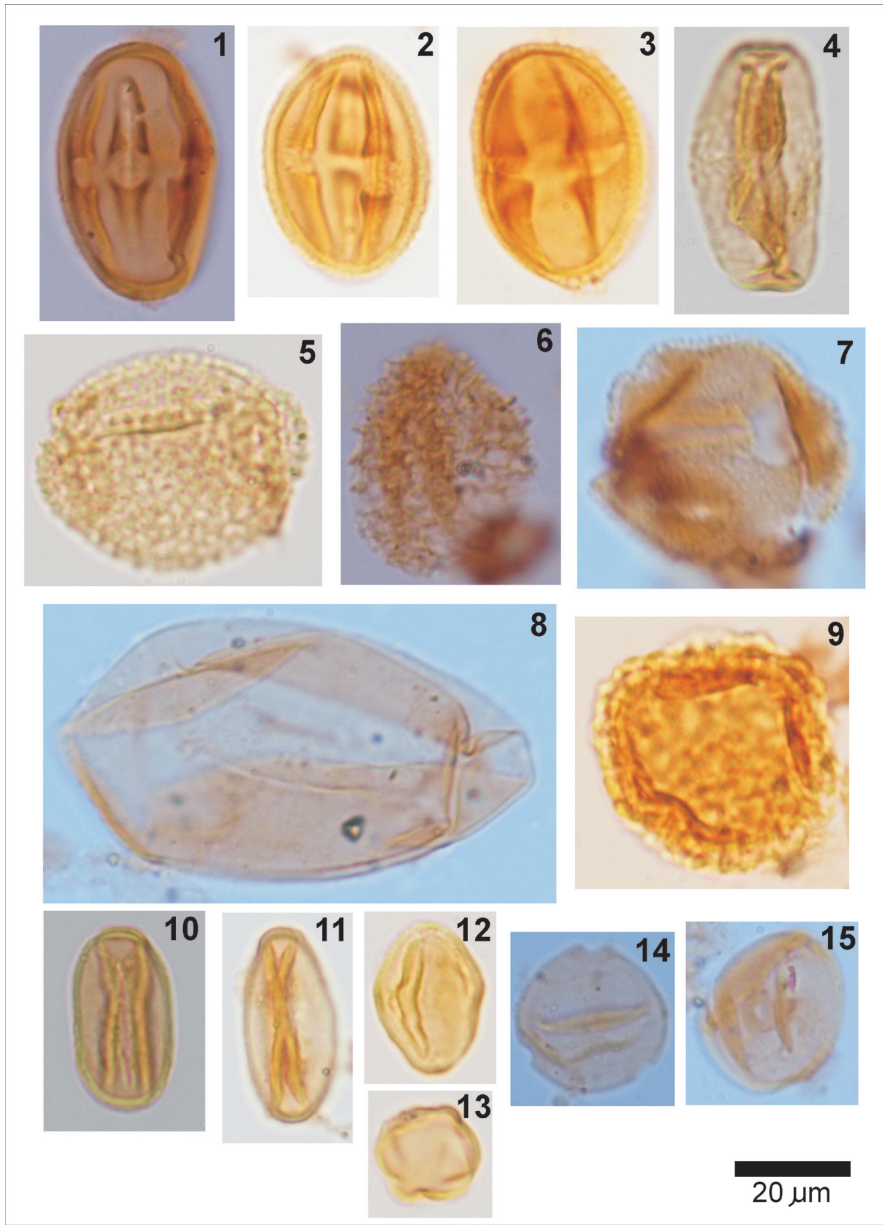

Plate 2: 1, 2, 3. *Tricolporites* sp., 4. *Quercus* 5,7. *Cephalomappa,* 6. *Nenga,* 8. *Magnoliaceae,* 9. *Gonystylus* type, 10, 11. *Tricolpites* sp., 12, 13. *Dactylocladus* type, 14. *Stemonurus,* 15. *Monoporites annulatus.*

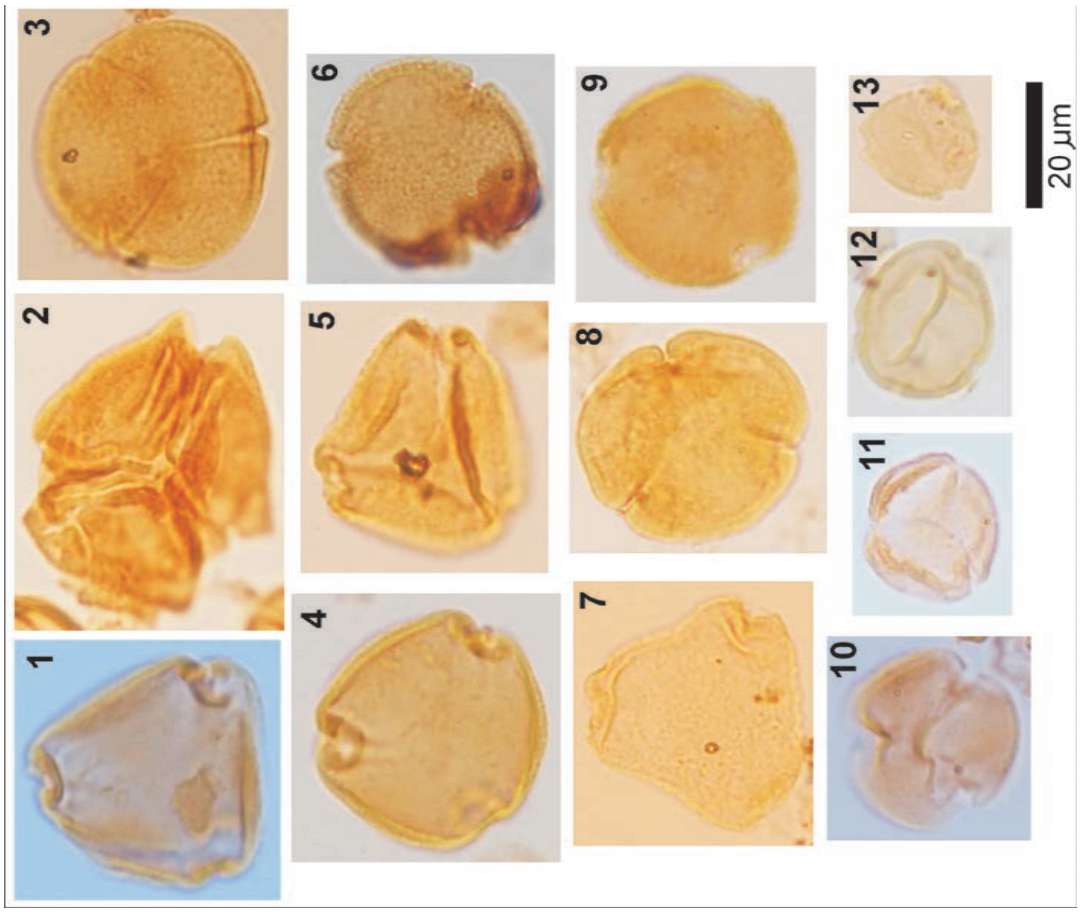

Plate 3: 1, 4. *Tricolporites* sp., 2. *Nyssapollenites* sp., 3,8. *Diccoidites* sp., 5,7. *Protaceae* type, 6. *Discoidites novaguineensis*, 9. *Engelhardia* type, 10,11. *Eugenia* type, 12. *Impantiensidites* sp., 13. *Randia* sp.

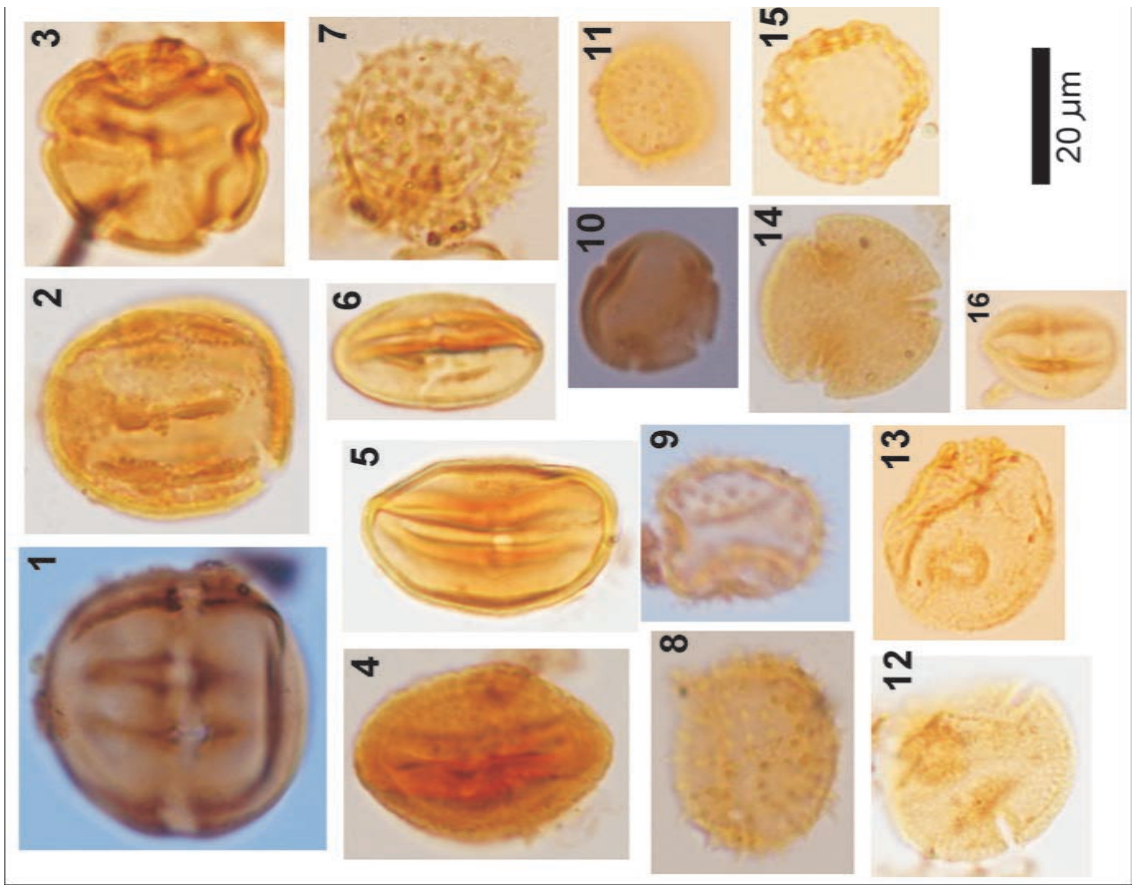

Plate 4: 1-2. *Sapotaceae*, 3. *Retistephanocolpites williamsi*, 4-5. *Florschuetzia* type, 6,16. *Lithocarpus* sp., 7. *Arenga*, 8,11. *Pandanus*, 9. *Echitriporites irregularis*, 10. *Impantiensidites* sp., 12. *Discoidites borneensis*, 13. *Cephalomappa*, 14. *Psilatricolporites operculatus*, 15. *Chenopodiaceae* .

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