PALYNOLOGY OF THE LOWER KALIPUCANG FORMATION TLOGOSARI, CENTRAL JAVA

by
Eko Budi Lelono

ABSTRACT

The palynological investigation focuses on the transition sediment of the Lower Kalipucang Formation which overlies the non-marine lava of the Gabon Formation. Both formations are firmly separated by the unconformity which is indicated by the occurrence of basal conglomerate. The Lower Kalipucang Formation outcrops in a small village called Tlogosari, Central Java. Lithologically, it is characterised by the occurrence of basal conglomerate with the intercalation of thin lignites. This lithology is overlain by 2 meter thick of claystone containing lignite strings and some igneous fragments. The intercalation of thin sandstones, conglomerate and lignites are found within claystone lithology. Four samples from the Lower Kalipucang Formation were selected for laboratory processing. Only two samples collected from the upper part of this formation yield rich palynomorphs. The palynomorph assemblage shows the occurrence of brackish and fresh water floras. Based on the appearance of pollen Florschuetzia meridionalis *and* F. trilobata, *it is predicted that the age of the Lower Kalipucang Formation is Middle Miocene. The high abundance of mangrove taxa (especially in sample number LKP-4) such as* Avicenia type, Zonocostites ramonae *and* Camptostemon *indicates a well development of mangrove environment. This assumption is supported by well preservation of large mollusc with excellent ornamentation. This ornamentation must have developed in the environment with low energy such as mangrove.*

I. INTRODUCTION

The Lower Kalipucang Formation outcrops in the village of Tlogosari which is situated 25 kilometers west of Kebumen, Central Java (Figure 1). Although this formation has been well known to contain non-marine to transition sediments (Bemmelen, 1949 and Mulhadiyono, 1973), no attempt was made to investigate its palynological content. This is the first effort to explore palynology of the Middle Miocene sediments within this area. For Lemigas, this study will provide a good opportunity to learn more about the Middle Miocene palynology as previously conducted in the Gumai and Air Benakat Formations of South Sumatra and the Balikpapan Formation of East Kalimantan.

The aims of the study are to record all palynomorphs occurring within the Lower Kalipucang Formation, to establish the pollen zone, to predict the age of the formation and to interpret the palaeoenvironment during deposition. The palynomorph record is useful to complete the previous collection taken from other Middle Miocene formations. The pollen zone is constructed to prove its consistency and to estimate the age. In addition, palaeoenvironmental interpretation will help to predict depositional environment. On the other hand, further evaluation of this formation such as palaeoclimate and sea level changes will be carried out in the next study when sufficient data are obtained.

II. GENERAL STRATIGRAPHY

The stratigraphy of the study area refers to that introduced by Mulhadiyono (1973) and Suyanto and Roskamil (1975) for the Karangbolong area. As shown in Figure 2, it is initialised by the occurrence of the volcanic Gabon Formation. This formation consists of volcanic breccias, breccious sandstones and marl. In its type locality in Mountain Gabon Pangandaran, this formation forms turbiditic sequence which was deposited in the deep marine environment. The age of this formation is

interpreted to be Oligocene-mid Early Miocene (N1-N6) based on the marine microfossil contents. However, in the Karangbolong area there is a facies change in which the marine Gabon sediment turns to non-marine sediment. The non-marine Gabon Formation is then unconformably overlain by the Kalipucang Formation. The type locality of this formation is in the village of Kalipucang, east of Pangandaran. This formation generally consists of clastic limestone and reef. Based on marine microfossils, this formation is designated to be Middle Miocene (N10).

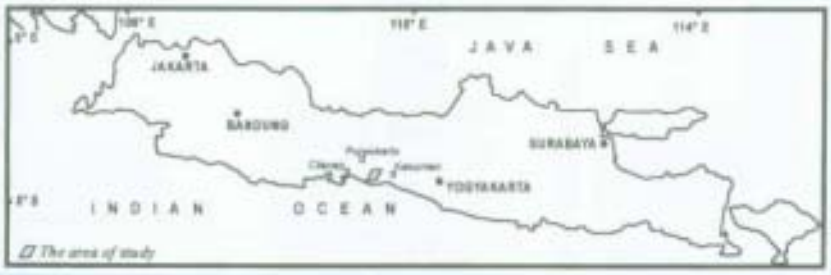

Figure 1
Location of the study area

Unlike in Karangbolong area, in Pangandaran area the marine Gabon Formation has the foram zones of N1-N9 and it is overlain by turbiditic Penanjung Formation (Figure 2). The Penanjung Formation is conformably overlain by the Kalipucang Formation which ranges from N13-N14 of foram zone. It is subsequently overlain by the turbiditic Halang Formation. The succession is ended up by the occurrence of the Bantardawa Formation.

Slightly different stratigraphy occurs in the Besuki area where Gabon Formation is not exposed and the Penanjung and Kalipucang Formations turn to clay lithology of the Pemali Formation. The Halang Formation is separated into two members, the turbidic Marl Claystone 1 (MS1) and the shallow marine Marl Claystone 2 (MS2). The Kumbang Formation appears to interfinger with the Halang Formation. The youngest formation is Talanggudang Formation. Suyanto and Roskamil (1975) unified the Bantardawa and Talanggudang Formations into a formation called Talanggudang-Bantardawa Formation.

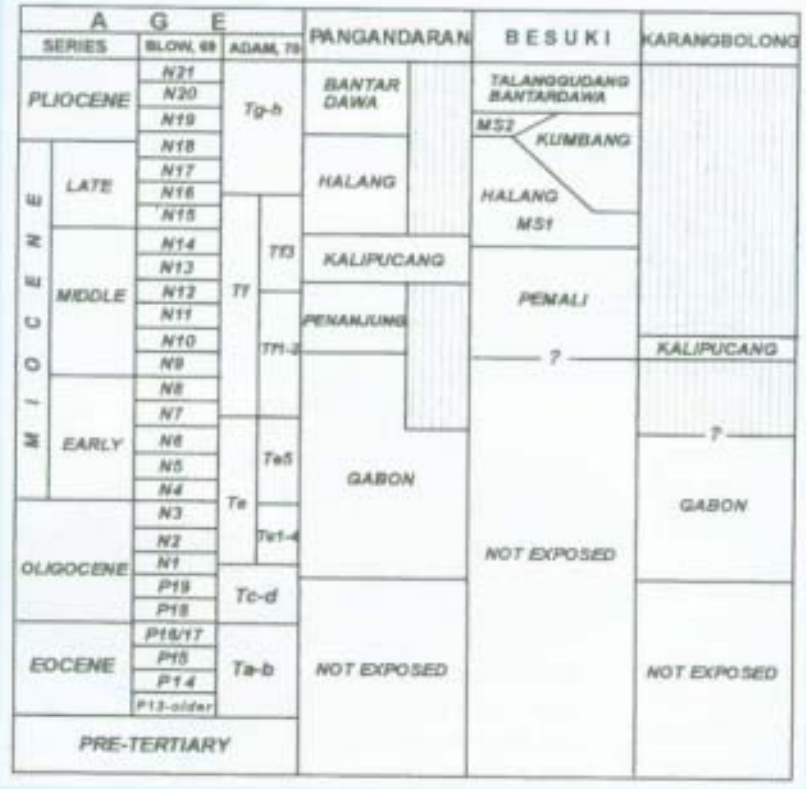

Figure 2
Regional stratigraphy of the Banyumas area
(from Sujanto, F. X. and Roskamil, 1975 with small modification)

Detailed sections on the Kalipucang Formation show the occurrence of non-marine to transition succession situating below the clastic limestone and reef. The non-marine to transition succession is the subject of this study and directly lies above the non-marine Gabon Formation

(Figure 3). Due to its position in the basal Kalipucang Formation, this succession is called the Lower Kalipucang Formation, which consists of basal conglomerate with the intercalation of thin carbonaceous layers. The basal conglomerate is polemic and overlain by 2 meter thick of claystone containing lignite strings and some igneous fragments. Within the claystone lithology there are some intercalations of thin sandstones, conglomerate and lignites (Figure 3).

III. MATERIAL AND METHOD

The material used in this study includes four surface samples which consist of two carbonaceous clays (LKP-1 and LKP-4) and two lignites (LKP-3 and LKP-5). The carbonaceous clay colours brown, soft, poor laminated and contains calcareous materials. Macrofosslis such as molluscs (gastropods, pelecypods and bivalves) are frequently found within this sediment. Interestingly, these molluses are mostly big in size and show good ornamentation. Lignite is black, thin layer (1-2 centimeters), soft and non-calcareous.

The standard methods of maceration using HCl, HF and HNO_3 were employed to get recovery of plant microfossils. These acid treatments were followed by the alkali treatment using 10% KOH to clear up the residue. Sieving using 5 microns sieve was conducted to collect more palynomorphs by separating them from debris materials. Finally, residue was mounted on the slides using polyvinyl alcohol and canada balsam.

The fossil examination was taken under the transmitted light microscope with an oil immersion objective and X 12. 5 eye piece. The result of examination is recorded in the determination sheets and used for the analyses.

IV. BIOSTRATIGRAPHY

Sixty distinct palynomorphs were recorded within this study as shown in

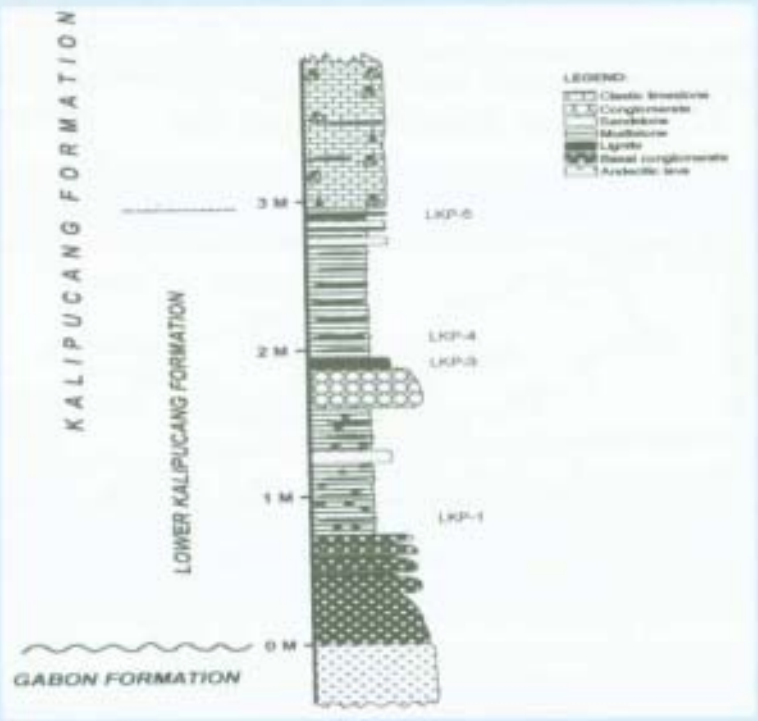

Figure 3
Lithologic column of the Lower Kalipucang Formations shows the sample position in which they were collected for this study

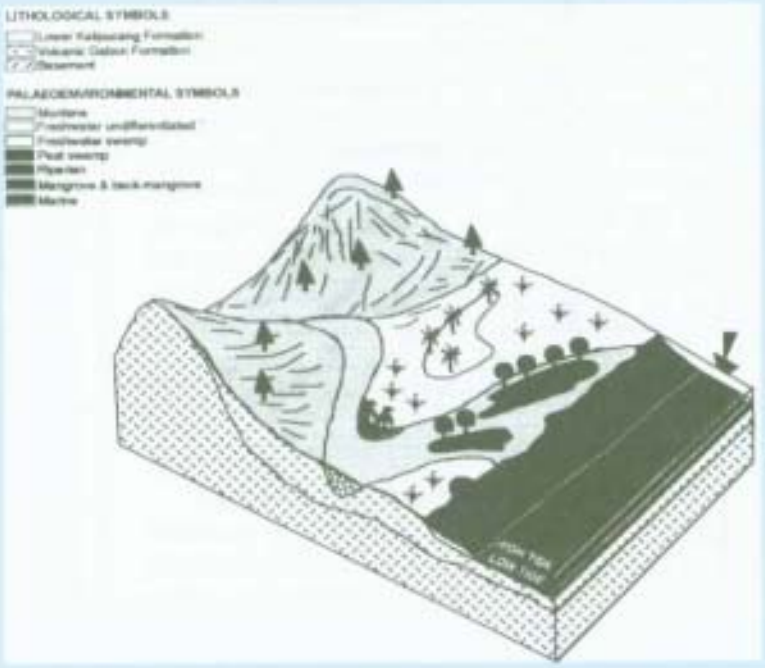

Figure 4
Palaeoenvironmental reconstruction during the deposition of the Lower Kalipucang Formation in the Middle Miocene

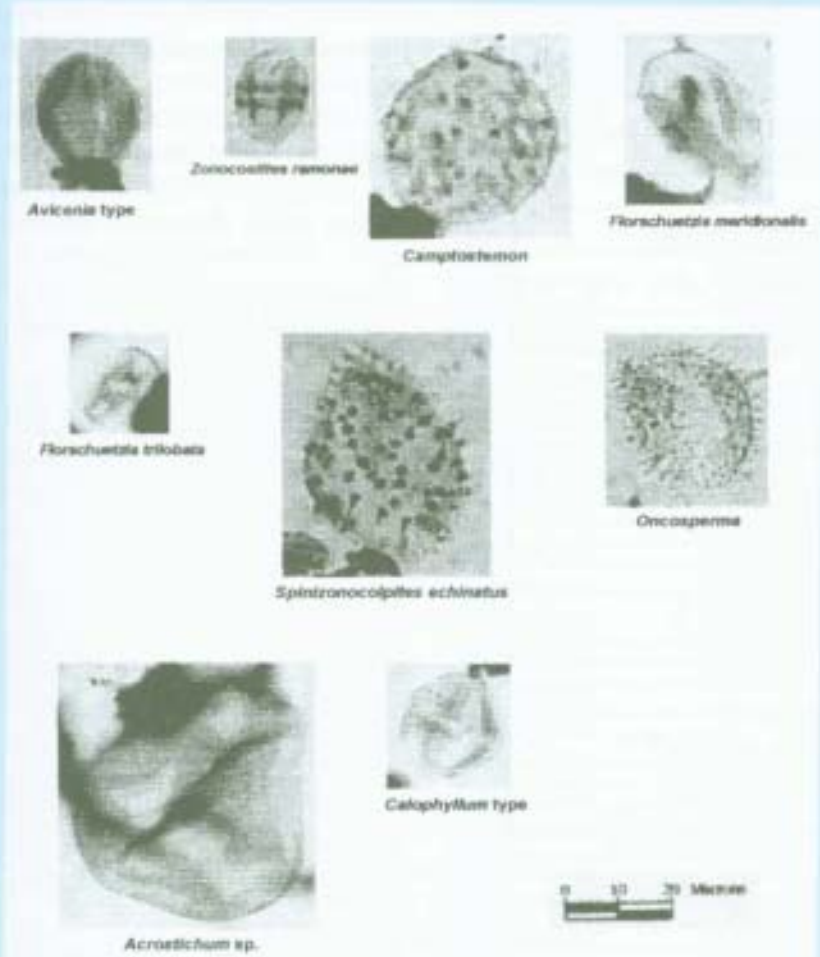

Figure 5
Some important palynomorphs from the Lower Kalipucang Formation which area used to draw interpretations

Table 1. Compared to those from Middle Miocene of South Sumatra and East Kalimantan, these samples actually yield low abundant palynomorphs. Only two samples contain rich recovery including LKP-4 and LKP-5. The other two samples (LKP-1 and LKP-3) are considered to be poor recovery. Both brackish (mangrove and back-mangrove) and freshwater taxa are well represented within samples LKP-4 and 5. In addition, key palynomorphs for zone construction and age analysis occur in these samples. Palynomorphs are classified on the basis of their ecology as defined by Morley (1990).

A. *Pollen zone*

The occurrence of pollen *Florschuetzia meridionalis* through the upper section indicates the zone of *F. meridionalis* (Rahardjo, et al., 1994). The absence of this taxon in the lower part of the section (sample numbers LKP-1 and LKP-3) may have been caused by low recovery. However, the zonal boundaries cannot be determined within the zone of *F. meridionalis* because of two major obstacles. Firstly, the first occurrence of *F. meridionalis* marking the lower boundary of the zone is not found in the section. Secondly, the spore *Stenochlaenidites papuanus* indicating the upper boundary is absent from the section. After all it is inferred that the Lower Kalipucang Formation has a pollen zone of *F. meridionalis*.

B. *Age analysis*

Apparently, the age-restricted taxa appearing in the samples are *F. meridionalis* and *F. trilobata*. *F. meridionalis* has stratigraphic range from basal Middle Miocene up to Pleistocene whilst *F. trilobata* ranges from mid Middle Eocene to top Middle Miocene (Morley, 1991). In fact, the last occurrence of pollen *F. trilobata* is applied to determine the Middle/Late Miocene boundary in Southeast Asian region (Morley, 1991). Based on the presence of these pollen it is interpreted that the age of the Lower Kalipucang Formation is Middle Miocene (Table 1).

V. PALAEOENVIRONMENT

Based on their ecology as defined by Morley (1991), palynomorph are divided into mangrove, back-mangrove, riparian, peat swamp, freshwater swamp, freshwater u n differentiated and montane taxa (Table 1). However, some palynomorphs occur to represent unknown ecology. Most of them have never been described by the previous authors, therefore, they need proper description. The description includes morphology, comparison with the existing palynomorph, botanical affinity and ecological category. Unfortunately, this paper is not intended

Table 1
Palynomorgh assemblage of the Lower Kalipucang Formation which occurs in the area of study

LOWERKALIPUCANG				FORMATION
F. MERIDIONALIS				POLLEN ZONE
MIDDLE MIOCENE				AGE
LKP4	LKP3	LKP2	LKP1	SAMPLE NUMBER
				MANGROVE
		○	○	*Avicenia type*
		○	○	*Zonocostites ramonae*
		○	○	*Florschuetzia meridionalis*
		○	○	*Camptostemon*
				BACK-MANGROVE
		○	○	*Acrostichum spp.*
		○	○	*Spinizonocolpites echinatus*
		○	○	*Oncosperma*
○		○	○	*Florschuetzia trilobata (oval forms)*
○	○		○	*Florschuetzia trilobata (lobate form)*
		○		*Florschuetzia levipoli*
		○		*Discoidites sp. (small form)*
		○		*Discoidites novaguenensis*
				RIPARIAN
		○	○	*Margnapollis concinus form1*
			○	*Striatricolpites catatumbus*
		○	○	*Ilexpollenites auriculoides*
			○	*Canthium ricocarpum*
				PEAT SWAMP
		○		*Sapotaceoidaepollenites sp.1*
		○	○	*Sapotaceoidaepollenites sp.2*
			○	*Sapotaceoidaepollenites sp.3*
		○	○	*Calophyllum type (medium reticulate)*
		○	○	*Calophyllum type (coarse reticulate)*
○				*Camnosperma*
		○	○	*Blumeodendron*
			○	*Durio type (psilate)*
		○		*Shorea type*
				FRESHWATER SWAMP
○				*Dicolpopollis sp. (medium reticulate)*
		○	○	*Verrucatosporites usmensis*
				FRESHWATER UNDIFFERENTIATED
			○	*Dipterocarpus*
			○	*Casuarina*
			○	*Nenga type*
		○	○	*Lanagiopollis nanggulanensis*
		○		*Gardenia*
		○		*Lanagiopollis sp.*
○	○	○	○	*Laevigatosporites spp.*
○		○	○	*Pteris type*
	○	○	○	*Palmaepollenites spp.*
		○	○	*Verrucatosporites spp.*
				MONTANE
		○		*Podocarpus type*
				UNKNOWN ECOLOGY
	○	○	○	*Matonisporites sp.*
			○	*Warkalipollenites enttmani*
		○		*Mastixia*
		○	○	*Retitricolporites sp. (small forms)*
		○	○	*Psilatriporites sp.*
	○		○	*Psilatricolporites sp. (small form)*
		○	○	*Retitricolpites sp. (coarse reticulate)*
			○	*Retitriporites sp. (coarse reticulate)*
		○	○	*Echitriporites sp.*
			○	*Psilatricolpites sp.*
		○		*Monoporites sp.*
		○	○	*Psilatricolporites sp.*

to provide the appropriate description for new taxa. Therefore, these taxa will not beconsidered in the palaeoenvironmental analysis.

Mangrove and back-mangrove taxa exhibit moderate abundance and diversity. Some significant mangrove taxa appearing within the section are *Avicenia* type, *Zonocostites ramonae* and *Camptostemon* whilst back-mangrove taxa are represented by the presence of *Spinizonocostites echinatus* (*Nypa*), *Oncosperma*, *Florschuetzia trilobata* and *Acrostichum* sp. This condition suggests good development of brackish environment. In fact, molluscs with large size of the body and well development of ornamentation are often found within the section. It is predicted that these marine macrofossils must have lived in the inter-tidal environment with low energy of sedimentation such as mangrove environment. Lithologically, the studied section is dominated by clay containing calcareous material. This clay must have been deposited in the marine environment with low energy of deposition. On the other hand, peat swamp palynomorphs appear in moderate assemblage. One of peat swamp element called *Calophyllum* type (medium reticulate) presents with high abundance indicating good development of peat swamp environment. The evidence for the development of peat swamp is clearly seen in the lithological column where lignite is widely distributed along the column. The presence of freshwater swamp and freshwater undifferentiated taxa suggest the occurrence of these environment during deposition. Meanwhile, the appearance of riparian taxa indicates the occurrence of riparian environment along the riverside. Study on kerogen shows high abundance of well preserved resins indicating short distance of transportation from the pollen source. These resins may suggest mangrove environment.

To conclude the discussion of

palaeoenvironment, it is inferred that the Lower Kalipucang Formation was possibly deposited in the mangrove environment. This paper also reconstructs palaeoenvironment of the Lower Kalipucang Formation as demonstrated in Figure 4. Some imporpant palynomorphs mentioned within text are shown in Figure 5.

VI. CONCLUSION

A total of 60 different palynomorphs were recorded from the Lower Kalipucang Formation which is exposed in the small village called Tlogosari, Central Java. These palynomorphs consist of mangrove, back-mangrove, riparian, peat swamp, freshwater swamp and freshwater undifferentiated taxa. In addition, some taxa with unknown ecology also occur within this formation. Based on the appearance of *Florschuetzia meridionalis* the Lower Kalipucang Formation is interpreted to cover pollen zone of *F. meridionalis*. This formation is assumed to be Middle Miocene sediment based on the occurrence of pollen *F. meridionalis* and *F. trilobata*. On the other hand, the appearance of mangrove and back-mangrove taxa in moderate assemblage including *Avicenia* type, ment. This interpretation is supported by the occurrence of molluscs showing large test and excellent ornamentation.

VII. ACKNOWLEDGEMENT

I wish to thank Nurharyanto of the Sedimentology Group for his great help and support during fieldwork. I am grateful to Barlian Yulianto MSc. who is a leader of the South and Central Java Project for allowing me to use some materials from this project for publication.

RERERENCES

1. Bemmelen, R. W. van., 1949. *The Geology of Indonesia*. Vol. 1 A, The Hague, Martinus nijhoff, 732 pp.
2. Morley, R. J., 1990. Introduction to Palynology (with Emphasis on Southeast Asia). *Lemigas, unpublished*, 112 pp.
3. Morley, R. J., 1991. Tertiary stratigraphic palynology in Southeast Asia: Current status and new directions. *Bull. Geol. Soc. Malaysia, 28*, pp. 1-36.
4. Mulhadiyono, 1973. Petroleum Possibilities of the Banyumas Area. *Proceeding Indonesian Petroleum Association, 2nd Annual Convention*, pp. 121–129.
5. Rahardjo, A. T., Polhaupessy, A. A., Wiyono, S., Nugrahaningsih, I., and Lelono, E. B., 1994. Zonasi
6. Sujanto, F. X. and Roskamil. 1975. The Geology and Hydrocarbon Aspect of the South Central Java. *Proc. IAGI, 4th Annual Convention*