Quaternary nannoplankton in the Northeast Java Basin

Rubiyanto Kapid¹, Wahyu Dwijo Santoso², and Halmi Insani³

¹Department of Geology, Institut Teknologi Bandung

²Exploitation Division, Pertamina EP

³Geology Museum, Bandung

ABSTRACT

In Indonesia, nannofossils are commonly used for age estimation on Miocene marine sediment, but they are rarely performed on Quaternary sediment. This paper introduces two nannofossil biozones, Martini (1971) and Backman et al. (2012) and the comparison between the two biozones. An uninterrupted interval of marine sediments was described and picked for quantitative nannoplankton analysis. The samples were taken from Ledok Formation to Lidah Formation in Pati Region, Northeast Java Basin. The samples were prepared by quick smear slides method and analyzed by quantitative field of view method. Martini (1971) biozone can be used to subdivide the Late Miocene–Pleistocene sediments into 5 biozones, but Backman et al. (2012) can be used to classify the same sediments into 8 biozones. The biozone subdivision from Backman et al. (2012) is more detailed than that of Martini (1971) because an updated dating and biozone in the three new dating zone data.

Keywords: nannoplankton, biozones, Quaternary, Northeast Java Basin

Copyright ©2021. FOSI. All rights reserved.

A Special Publication of abstracts and extended abstracts from the conference in honor of the retirement of Prof. Yahdi Zaim, IPU (22-23 March 2021).

DOI: [10.51835/bsed.2021.47.3.357](https://doi.org/10.51835/bsed.2021.47.3.357)

Figure 1. East Java Physiographic Map. Research area in black box (van Bemmelen, 1949).

INTRODUCTION

Calcareous nannofossils are a heterogeneous group of marine living organisms and calcareous fossil structures, generally smaller than 30 μm in size. A single nannofossil is called a coccosphere and is covered in many calcite plates (usually between 5 and 10 micrometres across) known as coccoliths. They first appeared in the Late Triassic and were restricted to the low latitudes. Calcareous nannofossils are extremely useful in the biostratigraphy of marine sediments of Jurassic to Recent ages. This is because they are abundant, rapidly evolving, and cosmopolitan. In addition, their small size means that they can be studied from very small rock chips. In Indonesia, nannofossils are common for age estimation in Miocene marine sediment, but they are still rarely performed on Quaternary sediment. This paper introduces two nannofossil biozones, Martini (1971)

and Backman et al. (2012) and compares the two biozones to investigate which one is more suitable to use in Indonesia.

METHODOLOGY

An uninterrupted interval of marine sediments was described and sampled for the purpose of this study. The outcrops are from Ledok Formation to Lidah Formation in Pati Region, Northeast Java Basin. The study area is situated within latitude $06^{\circ} 52' 30'' - 06^{\circ} 54' 09''$ S and longitude $111^{\circ} 03' 00'' - 111^{\circ} 05' 30''$ E. Based on the Physiographic Map of East Java, Gunungpanti area belongs to the Rembang Zone (Figure 1).

Sampling in this study were obtained by measuring section in continuous outcrops. For measuring section in the Northeast Java Basin, it was performed on three traverses, namely Sungai Kedunglawah Traverse, Sungai

Figure 2. Traverse and Sampling.

Tambar – Sungai Nggaber Traverse, and Sungai Kedungkembang Traverse (Figure 2). Sample preparation was done by using quick smear slides method and quantitative method for analysis. Nannoplankton analysis observations were accomplished by the commonly-used Field of View (FOV) method. The standard-sized cover glass is $\pm 120 \times 250 \mu\text{m}$.

Two of nannofosils biozones, Martini (1971) and Backman et al. (2012) were used for biozone analysis. Martini (1971), with NN code refers to Nannofosils Neogene, subdivides Plio – Pleistocene interval into 9 biozones (NN-12 – NN-21 biozones). However, Backman et al. (2012) subdivides Plio – Pleistocene interval into 11 biozones (CNPL-1 – CNPL11 biozones) which

means the advantage of Backman et al. (2012) biozone is that it can provide more detailed age subdivision for Pleistocene epoch.

RESULTS

Based on Backman et al. (2012) biozone, Ledok Formation to Lidah Formation can be subdivided into 8 biozones (Figure 3). The detail biozones consist of:

- Partial Range Zone *Ceratholithus rugosus*. It is marked by the appearance of *Ceratholithus rugosus* which similar with CNM-19 – CNM-20.
- Concurrent Range Zone *Ceratholithus rugosus* -

Figure 3. Backman et al. (2012) biozones of Ledok Formation to Lidah Formation.

Sphenolithus abies. It is characterized by the appearance of *Ceratolithus rugosus* and LAD *Sphenolithus abies* which similar with CNPL 1 - CNPL 2.

- c. Base Zone *Sphenolithus abies* - *Reticulofenestra pseudoumbilica*. It is marked by two LAD of nannofosils datum plane, *Sphenolithus abies* - *Reticulofenestra pseudoumbilica*. It is similar with CNPL-3
- d. Taxon Range Zone *Discoaster pentaradiatus*. It is marked by specific FAD and LAD *Discoaster pentaradiatus*. It is similar with CPNL-4 - CPNL-5.
- e. Base Zone *Discoaster pentaradiatus* - *Discoaster brouwerii*. It is marked by two LAD of nannofosils datum plane, *Discoaster pentaradiatus* and *Discoaster brouwerii*. It is similar with CNPL-6 - CPNL-7
- f. Concurrent Range Zone

Discoaster brouwerii - *Gephyrocapsa*. It is characterized by the appearance of LAD *Discoaster brouwerii* and appearance of *Gephyrocapsa* which similar with CNPL-8

- g. Concurrent Range Zone *Gephyrocapsa* - *Emiliana huxleyi*. It is marked by appearance of *Gephyrocapsa* - *Emiliana huxleyi* which similar with CPNL-9 - CPNL-10.
- h. Partial Range Zone *Emiliana huxleyi*. It is marked by the appearance of *Emiliana huxleyi* which similar with CPNL-11.

Using Martini (1971) biozone, the sediments of Ledok Formation - Lidah Formation can be subdivided into 5 biozones (Figure 4):

- a. Partial Range Zone *Ceratolithus rugosus*. It is marked by the appearance of *Ceratolithus*

Figure 4. Martini (1971) biozones of Ledok Formation to Lidah Formation.

rugosus which similar with NN-11 – NN-12.

- b. Concurrent Range Zone
Ceratholithus rugosus -
Reticulofenestra pseudumbilica.
It is characterized by the
appearance of *Ceratholithus*
rugosus and LAD *Sphenolithus*
abies which similar with NN-13 –
NN-15.
- c. Taxon Range Zone *Discoaster*
pentaradiatus. It is marked by
specific FAD and LAD of
Discoaster pentaradiatus. It is
similar with NN-15 – NN-17.
- d. Concurrent Range Zone
Discoaster pentaradiatus -
Emiliana huxleyi. It is
characterized by the appearance
of LAD *Discoaster pentaradiatus*
and appearance of *Emiliana*
huxleyi which similar with NN-18
– NN-20.
- e. Partial Range Zone *Emiliana*

huxleyi. It is marked by the
appearance of *Emiliana huxleyi*
which similar with NN21 –
younger.

The result of Backman et al. (2012)
gives the more detailed result than
Martini (1971) biozone (Figure 5). The
new detail Backman et al. (2012) was
proposed by using new data dating
from Marine Isotopes Stages (MIS)
data. The three new biozones are CNPL
1 – CNPL 2 (5.2 - 4 Ma) which uses
Sphenolithus neoabies datum plane,
CNPL -3 (4.0 – 3.8 Ma) which uses
Reticulofenestra pseudumbilica datum
plane, and CNPL- 6 (2.4 – 2.0 Ma)
which uses *Discoaster brouweri* datum
plane.

For the further research, quantitative
analysis of *Emiliana huxleyi* can give
the new detail biozone boundary. It can
subdivide NN-21a and NN-21b

Figure 5. Comparison between Martini (1971) and Backman et al. (2012) biozone. Backman et al. (2012) biozone gives more detailed result than Martini (1971).

(Martini, 1971 zone) or CPNL-11a and CPNL-11b (Backman et al., 2012 biozone). The biozone NN21a/NN21b boundary is marked by an abrupt increase of *Emiliana huxleyi* within the relatively warm stage MIS 3 at 50 ka. A further increase and considerable fluctuations *Emiliana huxleyi* are recognized within warm stage MIS 1. This is thought to reflect continuous climate variability during this stage in the Late Glacial - Holocene. In the NE Java Basin, it can be applied in the Lidah Formation. We must take the detail samples from Lidah Formation to know the the boundary of CPNL-11a and CPNL-11b.

CONCLUSION

Our research can be used to compare two biozones between Backman et al. (2012) and Martini (1971) from Ledok

Formation to Lidah Formation in the sediments of Northeast Java Basin. Late Miocene - Pleistocene sediments using Martini (1971) subdivides into 5 biozones but Backman et al. (2012). can classify into 8 biozones. An update biozone from Backman et al. (1971) gives the more detail result than Martini (1971). It can be applied for the marine deposits in the Northeast Java Basin, so possibly it can also be applied in another basin in Indonesia. For the further research, the quantitative analysis of *Emiliana huxleyi* must be performed to get more details about zone boundary in the Pleistocene age (NN-21a and NN-21b or CPNL-11a and CPNL-11b).

ACKNOWLEDGEMENT

This research was performed by using personal funding and support from

Micropaleontology Laboratory,
Department of Geology, Institut
Teknologi Bandung. We thank
Paleontology and Quaternary Geology
Research Group, Department of
Geology, Faculty of Earth Science and
Technology, Institut Teknologi
Bandung. We send our gratitude to the
conference committee of Prof. Yahdi
Zaim's Retirement.

REFERENCES

- Backman, J., Raffi, I., Rio, D.,
Fornaciary, D. and Palike, H., 2012.
Biozonation and biochronology of
Miocene through Pleistocene
calcareous nannofossils from low and
middle latitudes, Newsletter on
Stratigraphy.
- Martini, E., 1971. Standard Tertiary
and Quaternary calcareous
nannoplankton zonation. *In*: A.
Farinacci (Ed.), Proceedings of 2nd
International Conference Planktonic
Microfossils Roma: Rome (Ed.
Tecnosci.) 2, 739–785.
- Perch-Nielsen, K., 1985. Cenozoic
Calcareous Nannofossils. *In*: H.M.
Bolli, J.B. Saunders, and K. Perch-
Nielsen (Eds.), Plankton Stratigraphy.
Cambridge University Press.
Cambridge.
- Pringgoprawiro, H., 1983.
Biostratigrafi dan Paleogeografi
Cekungan Jawa Timur Utara Suatu
Pendekatan Baru, Disertasi Doktoral
ITB (unpublished).
- Triantaphyllou, M.V., 2015.
Calcareous nannoplankton dating of
the Late Quaternary deposits in Greece
and the eastern Mediterranean: Case
studies from terrestrial and marine
sites, Journal of Palaeogeography.
- van Bemmelen, R.W., 1949. The
Geology of Indonesia, Netherland:
Martinus Nyhoff, The Hague