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Miocene to Pleistocene Biostratigraphy of Rembang Zone Based on Nannofossil, Nglebur River section, Blora, Central Java

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Abstract. Nannofossil analyses of Miocene to Pleistocene, the section of Nglebur River, Jiken, Blora of Central Java included of Rembang Zone, North East Java Basin. This study uses 70 samples from this section. The result of this analysis consists of 18 genus was obtained with 57 species of nannoplankton. The research method used in field study (measure section) quantitative analysis. The samples from taken include fine-grain stone (marl, shale) and carbonaceous. The river section that has been selected consist of a continuous sediment sequence from Miocene (Wonocolo, Ledok, and Mundu Formation) to Pleistocene (Lidah Formation). The sample preparation uses the smear slide method and species determination uses Nannotax3 determination. The biostratigraphy consist of 11 zones, and there consists of 2 Partial Zones and 9 Interval Zones. These Zone are *Discoaster hamatus* Partial Zone/NN9, Interval Zone of *Discoaster hamatus–Discoaster quinqueramus* /NN10, Zone of *Discoaster quinqueramus* /NN11, Zone of *Discoaster quinqueramus–Ceratolithus rugosus*/NN12, Zone of *Ceratolithus rugosus–Discoaster asymmetricus*/NN12, Zona of *Discoaster asymmetricus–Pseudoemiliania lacunosa*/NN14, Zona of *Pseudoemiliania lacunosa* with *Reticulofenestra pseudoumbilicus*/ NN15, Zona of *Reticulofenestra pseudoumbilicus* with *Discoaster surculus*/NN16, Zona of *Discoaster surculus–Discoaster asymmetricus*/NN17, Zona of *Discoaster asymmetricus–Discoaster brouweri*/NN18, and Partial Zone *Discoaster brouweri* and *Gephyrocapsa caribbeanica*/NN19.

Keywords: Biostratigraphy, nannofossil, Rembang Zone

INTRODUCTION

The located of this research is in the Rembang Zone, is part of the physiography of the North East Java Basin, which extends from the northern part of Purwodadi to Madura Island. Composed of Anticlinorium with the longitudinal axis is West–East, with an average length of anticline reaching 100 km. Based on the location of the existence of Anticlinorium, Rembang divided into two different locations, North and South Rembang [1]. The two anticlinoriums are separated by the Lusi River valley on the west side, and the Kening River valley (tributary of the Bengawan Solo river) on the east side. Sedimentation of Mandala Rembang is a deposition a shelf, rich in carbonate deposits like carbonate claystone, shale, marl, limestone and almost no pyroclastic deposits, the deposits sloping to the south, and the thickness can reach around 1500 m.

Pringgoprawiro [2] has argued that the research area has stratigraphy sequence from Late Miocene to Pleistocene: there are Wonocolo Formation, which is composed with sandy marl and repeated with marl with the insertion of calcarenite limestone and claystone. The lithology comprising the Ledok Formation consists of alternating between calcarenite or sandy limestone and calcareous sandstone, and more abundant glauconite minerals. Mundu Formation, massive grayish- green and white marl. Lidah Formation consists of blue-

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carbonate claystone, and side-grained carbonate sandstone and shells of molluscs. The arrangement by continuous stratigraphy. The continuously deposited sediment generally has ideal rock stratigraphy correlation. There is three-part to observed in determining the stratigraphy, including lithostratigraphy, chronostratigraphy, and biostratigraphy. Stratigraphic analysis based on the fossil is called biostratigraphy. As we know that Rembang is a large and thick sedimentary carbonate basin, therefore Rembang area was chosen as the research area because in this area it has rock units which are a characteristic of the marine depositional environment which is an ideal area for the abundance of nannoplankton. Biostratigraphic research based on nannoplankton is carried out so that in determining the age limit in the rock unit, the study area can be more detailed and accurate, in addition to the small size of nannoplankton. Nannoplankton has a rapid morphological change, the small number of species, analysis needed in small sample, faster preparation, so that can be more comfortable in the biostratigraphic analysis. This area also has attractive geological conditions for further research.

METHOD

Research Area: The studied section is in Nglebur River section located in Nglebur, Jiken District, Blora Regency, Central Java Province, Indonesia. Geographically it is located at UTM coordinate 560186 mE–565186 mE and 9222852 mN – 9217852 mN. On the RBI Map (Rupa Bumi Indonesia), included in sheet 1508-533 Sambongpojok. Notes: mE (meter East and mN (meter North) (**FIGURE 1**).

Field mapping observation & preparation: This research method uses two-steps, and There are field mapping and microscope base quantitative analysis. Field mapping consists of lithology observation, measuring section and rock sampling. Observation of lithology in a representative manner, and taking rock samples by spot sampling. The measure section was carried out on the track line, to get more detailed and measurable observations. Paleontological analysis requires detail and systematic observations, for the results obtained can describe more accurately. However, both observations were sample was taken selected. Rock sample consisting of fine-grain stone as marl, shale, and calcareous.

Sampling method: Sampling method in the study area that has a thick cross-section with the same relative type of rock is uses the interval sampling, which measure at a determined distance and sampling regularly. In this cross-section has a total length about 3 km, where the cross-section consists of 3 lines from the younger to older (South–North) (**FIGURE 1**). Cross-section arranged in a continuous stratigraphic form from Late Miocene to Pleistocene, namely Wonocolo Formation to Lidah Formation. The interval sampling is average set in every 40 to 45 m. Therefore, the total sample obtained was 70 samples which, will then be analyzed by fossils. Taking samples to analyze fossils is done carefully to avoid contamination with other fossils. The systematic sampling is to obtain detailed lithology and accurate thickness of the bedding. The shorter the sampling distance, the more detailed the analysis is carried out (**FIGURE 1).**

Preparation method: preparation for the nannofossils is used smear slide method. The smear slide is a preparation method that uses objective glass, and is determined by a polarizing microscope at 1000 x magnification. Nannofossil's observation was determined by two light microscopes, and there are parallel and cross Nicol. Quantitative analysis uses 3 part of the view and nannotax3 determination [3]. Whereas species were identified using taxonomic remarks [3], [4], [5]. Biostratigraphy determination uses the basis of Nannoplankton's Biozonation [6].

RESULTS AND DISCUSSION

Geological Setting: East Java is divided into six physiographic zones in the following order from North to South (**FIGURE 2**); Alluvial Plain of North Java, Rembang Anticlinorium Randublatung Depression Zone, Kendeng Anticlinorium (Kendeng Mountains), Java Depression Central Zone (Zona Solo, Subzone Ngawi), Quaternary Volcanic Arc, and Southern Mountain [1] (**FIGURE 2**).

Stratigraphy of the North East Java Basin divided into two Mandalas, namely Mandala Kendeng and Mandala Rembang [2]. Mandala Rembang covers areas in the Randublatung Tectonophysiography zone, while Mandala Kendeng covers the Kendeng Tectonophysiography zone. The regional of Rembang Zone is divided into two, namely the North Rembang Anticlinorium and the South Rembang Anticlinorium. The research area located in the South Rembang Anticlinorium, also known as the Cepu Antiklinorium. The Lusi River basin separate that anticlinorium zones.

Sediments in the Rembang Zone: Rembang Zone shows dominant rocks of sand content in addition to carbonate rocks and pyroclastic deposits are absence. These zone sediments are interpreted to be deposited on the sea not far from the coast, with the seabed not same in terms of depth due to block faulting. As a result, facies changes are found on this path. The offshore area of the Java Sea is generally occupied by sedimentary exposures, which consist almost entirely of carbonate deposits [2]. The lithology in this zone is sandstone and carbonate sediments with intercalation of marl and claystone. This lithology is thought to have been deposited in continental shelf. The Rembang Zone has more coarse-grained sedimentary capacity than fine-grained sediments, with deposition rates slower than the rate of basin depletion. The sequence of lithostratigraphy units is presented in **FIGURE 3**.

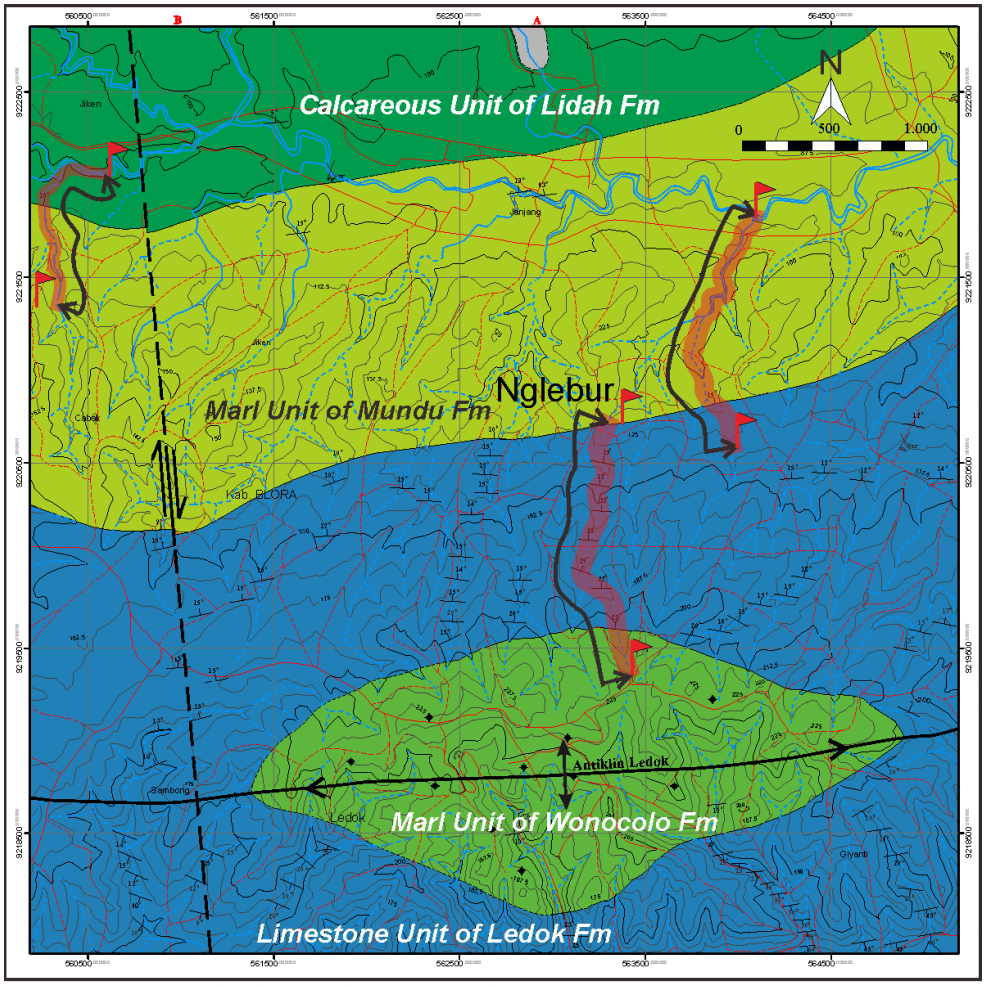


FIGURE 1. Geological Map of Nglebur Area, Njiken, Blora, Central Java and Research Area of Central Java, Indonesia

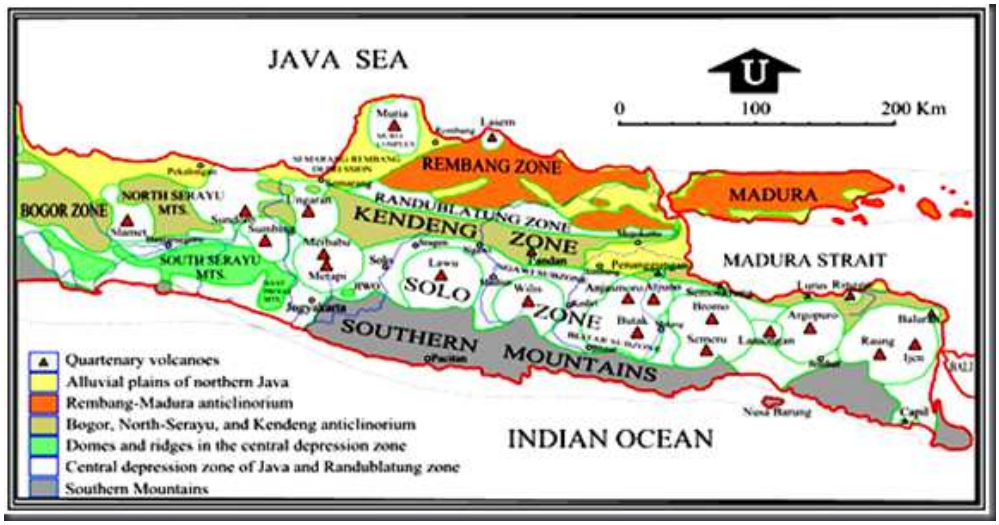


FIGURE 2. Physiography of East Java [1]

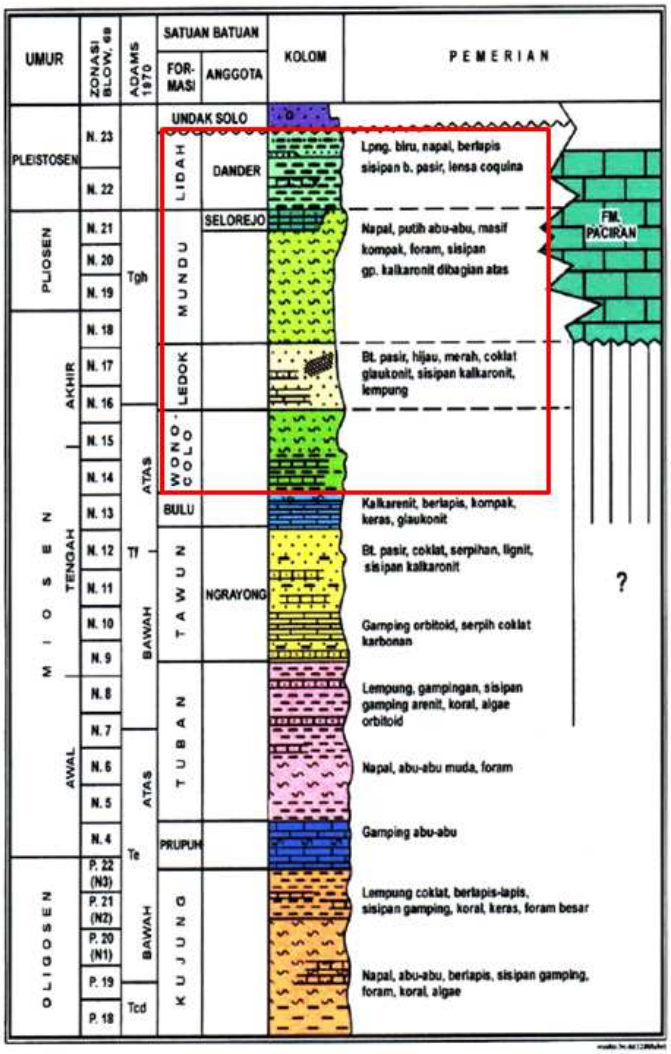


FIGURE 3. Stratigraphy of Rembang Zone [2]

Stratigraphy: The local stratigraphy of the research area is composed of four units, in the older to younger are Marl Unit Wonocolo Formation, Limestone Unit of Ledok Formation, Marl Unit of Mundu Formation, and Calcareous-claystone Unit of Lidah Formation (**FIGURE 4**).

The Marl Unit of Wonocolo Formation: consists of marl interbedded with sandstone, abundant foraminifera and nannofossil, and contains a lot of glauconite minerals. The structure sediment are massive structure, parallel lamination, and beddings (**FIGURE 5**). Calcimeter analysis of the Marl Unit is 30% carbonate (CaCO3). The relative age of Marl Unit of Wonocolo is NN9 to NN10 (Middle to Late Miocene), based on Last Appearance (LA) *Discoaster hamatus.* The bathymetric of the unit is Upper Bathyal (200–500m) based on the presence of *Lagena striata* and *Lenticulina denticulifera*. The thickness of Marl Unit is 71 m.

AGE			LITOSTRATIGRAPHY	THICKNESS (m)	SYMBOL OF LITHOLOGY	DESCRIPTION
PLEISTOCENE		NN19	Calc.Claystone of Lidah Formation	43		Consists of bluish-green calcareous claystone with intercalation of siltstone, present shell fragments of molluscs, and contains of siderite mineral. The sedimentary structures is massive and bedding.
PLIOCENE	LATE	NN18	Marl of undu Formation	189		Consists of white marl and blue marl, and the addition of calcareous sandstone containing abundant foraminifera and nannofossil, and some shells of molluscs. At the top of the unit, there are interbedded of sandstone limestone, massive structures, and parallel beddings
		NN17				
		NN16				
		NN15				
	EARLY	NN14				
		NN13				
MIOCENE	LATE	NN12	Limestone of Ledok Formation	297		Consists of alternating between limestone and calcarenite, with the sandy-limestone, sandstone, marl, and contains abundant of glauconite content upwards, gradually increasing upward on the limestone thinning sandstone, and calcilutite. Sedimentary structures are bedding, bioturbation and mega cross bedding.
		NN11				
		NN10				
	MIDDLE	NN9	Marl of Wonocolo Formation	71		Consists of marl interbedded with sandstone, abundant foraminifera and nannofossils, and contains a lot of glauconite minerals, CacO3. The structure of sediment is massive structure, parallel lamination, and beddings.

FIGURE 4. Stratigraphy of Nglebur River section, Blora, Central Java

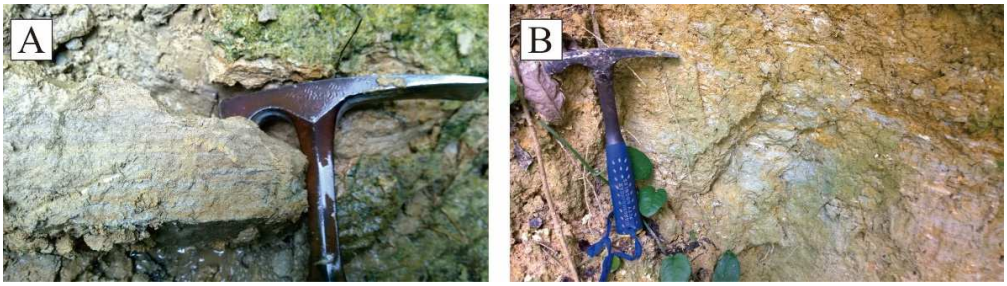


FIGURE 5. (A) Marl outcrop of Wonocolo with fine-grained sandstone, parallel lamination (B) Marl outcrop of Wonocolo, massive structure (photo by Nanda),

The Limestone Unit of Ledok Formation consists of alternating between limestone and calcarenite, with the sandy-limestone [8], sandstone, marl, and contains abundant of glauconite content upwards, gradually increasing upward on the limestone thinning sandstone, and calcilutite. The developing sedimentary structures are bedding, bioturbation and mega cross bedding (**FIGURE 6**). The relative age of this unit is NN10-NN12 (Late Miocene), based on Last Appearance (LA) *Discoaster hamatus* and (LA) of *Discoaster quinqueramus.* The unit is deposited in Outer Neritic (100–200) m [7], based on presence of *Oolinia apiculata* and *Pseudoclavulina humilis.* The thickness of the unit is 297 m.

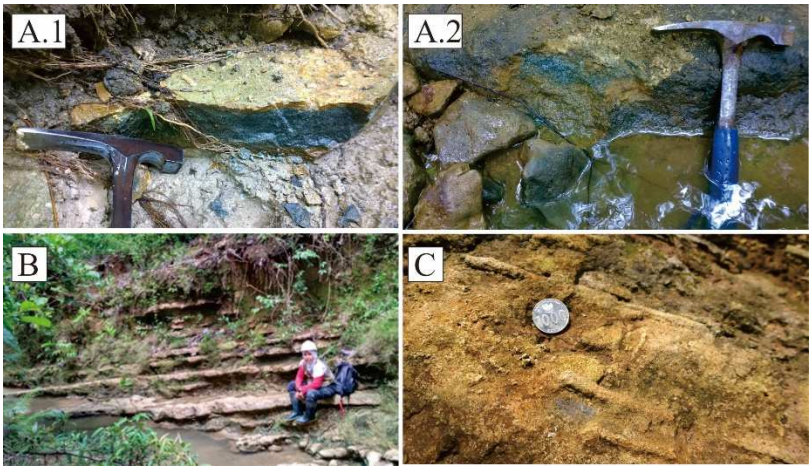


FIGURE 6 (A.1, 2) Outcrop of limestone**,** Ledok Formation (intercalation of calcarenite, calcilutite, sandy limestone (B) Outcrop calcarenite and sandy limestone, (C) Bioturbation (photo by Nanda)

The Marl Unit of Mundu Formation: consists of white marl and blue marl, and the addition of calcareous sandstone containing abundant foraminifera and nannofossil, and some shells of molluscs. At the top of the unit, there are interbedded of sandstone limestone, massive structures, and parallel beddings (**FIGURE 7**). Based on calcimeter analysis obtained of 42-60% CaCO3. Based on the (LA) of *Discoaster quinqueramus* and (LA) *Discoaster brouweri*, the relative age of this unit is NN12-NN18 (Early to Late Pliocene). Based on analysis of benthonic foraminifera, the bathymetry is divided into two-part, were deposited on the Lower to Upper Bathyal (200–400 m) based on presence of *Gyroidina soldanii, Bolivina spatulata,* and were superficial upward at Upper Bathyal to Outer Neritic (100–500 m) based on *Amphicoryna scalaris* [7]. The thickness of the unit based on measured stratigraphy cross-section is 189 m.

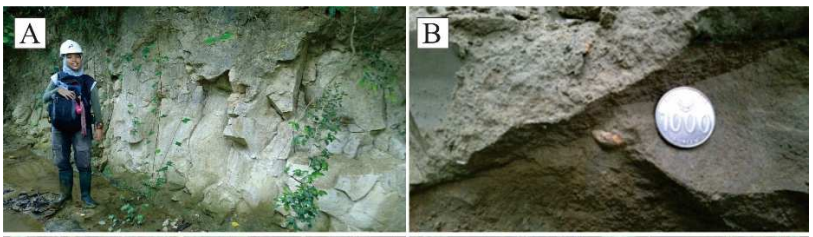


FIGURE 7. (A) Outcrop Marl of Mundu Formation, Massive marl, (B) Marl containing molluscs, and abundant of foraminifera (by Nanda)

The Calcareous-claystone Unit of Lidah Formation: consists of bluish-green calcareous claystone with intercalation of siltstone, present shell fragments of molluscs, and contains of siderite mineral. The sedimentary structures is massive and bedding (**FIGURE 8**). Based on calcimeter obtained of 8-24% CaCO3. The relative age of this unit is NN18-NN19 (Late Pliocene to Pleistocene) based on last appearance *Discoaster brouweri* and First Appearance (FA) *Gephyrocapsa caribbeanica*. Based on the presence of fossils *Elphidium advena, Cibicides praecinctus* is deposited in Middle Neritic (20–10 m) [7]. The unit thickness of the measured stratigraphic cross-section is 43 m.

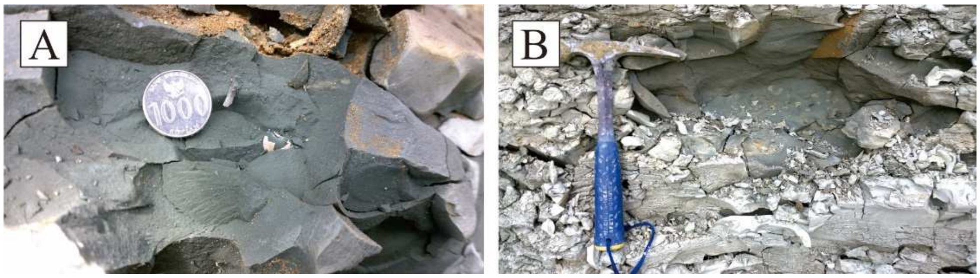


FIGURE 8. (A) Lidah claystone-carbonate, containing molluscs, (B) claystone-carbonate with abundant of molluscs, massive sedimentary structure

Regional Structure of East Java: Java Island has two different structural configurations. There are in the north with characterized by a tendency to follow the East-West direction. While the northeast-southwest pattern is thought to follow a basement configuration. The basement itself is thought to be part of a continental crust that is Pre-Tertiary, composed of continental crust types. This east-west trending structural pattern corresponds to the Tertiary volcanic arc which is also east-west trending [9]. In this inversion phase in the northern part of the basin, it has been elevated (Rembang Zone) while in the southern part it is still a deep-sea basin (Kendeng Zone). In the western part of the East Java basin, there is a tendency for east-west morphology and structure

Biostratigraphy: Biostratigraphic are studies to determine the relative age to correlation. Biostratigraphic analysis using fossil range data, datum. Biostratigraphic analysis in the study area was carried out based on sampling on the stratigraphic measurement or measuring section on the surface, obtaining as many as 70 samples from the Wonocolo to Lidah Formation. The results of nannoplankton analysis are in **TABLE 1**.

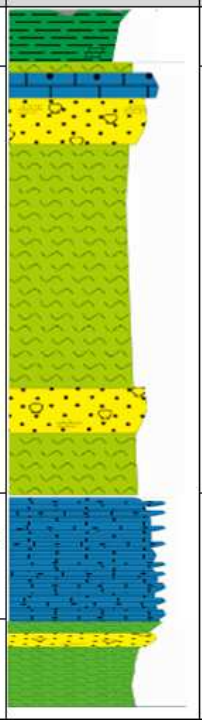
TABLE 1. The results of the nannoplankton analysis of the Nglebur area, Rembang Zone.

No	Species\ Sample code	Wonocolo Formation						LEDOK FORMATION																MUNDU FORMATION																				LIDAH FORMATION						
		Marl						Limestone																Marl																				Calcareous Claystone						
		Late Miocene																						Pliocene																				Pleistocene						
		NN 9		NN 10							NN11													NN 12			NN 13		NN14					NN 15			NN 16		NN 17					NN 18		NN 19						
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
1	*Cd. leptoporus*	R		R	R				R		R						R	R		R	R	R		R	R		R	R				R			R	R	R	R	R	F	R		F			F	R	R	R	R
2	*Cd. macintyrei*				R											R	R			R	C	R								R											R		F		R	R	R	R	R	R
3	*C. cristatus*																																											R			R			
4	***C rugosus *)***																								> R														R						R					
5	*Cc. pelagicus*	R		R	F						F		F		R		R	R				R	R	R		R		R	R	R			R	R							F	F	R	R	R	R	R	F	F	F
6	*Cy. nitescens*													R	F	R	R	R		R	R	R		R		R	R	F	F	R	R			F	R															
7	***D. asymmetricus *)***																										> R	R	R		R	R	R	R	R				R		R <									
8	*D. bellus*			R	R		R		R		R								R																															
9	*D. braarudii*	R							R					R																																				
10	***D. brouweri *)***		R		R		R		R		R	R				R						R	R		R	R	R	R	8	R	R		R	R	R	R		8	R	R	R	R	R <							
11	***D. hamatus *)***		R <																																															
12	*D. neohamatus*	R	R	R														R																																
13	*D. neorectus*			R					R																																									
14	*D. pansus*																																	R																
15	*D. pentaradiatus*								R								R	R		R	R	R		R						R	R	R	R	R	R				R											
16	***D. quinqueramus *)***										> R					R	R	R			R <																													
17	***D. surculus *)***																			R					R	R	R		R							R <														
18	*D. triradiatus*																															R											R						R	R
19	*D. variabilis*																			R	R	R		R		R						R	R				R		R											
20	***G. caribbeanica *)***																																											> R	R	R	R	R	R	R
21	*G. small*																																R		R	R		R		R		F	R	R	R	R	R	C		R
22	*Hy. perplexus*								R											R	R	R		R	R	R		R	R		R		R	R	R	R		R	R	R	R	R	R							
23	*H. carteri*		R	R			R		R					R			R	R			R	R	R	R	R	R		R				R						R	R				R				R	R	R	R
24	*H. sellii*																					R	R		R	R	R	R	R	R	R	R		F	R	R	R	R	F	R	F		R							
25	*H. wallichii*			R	R								R	R	R	R	R			R	R	R			R				R	R		R								R	R	R			R	R	R			
26	*Oo. fragilis*																															R		F	R	R	7		R		R	R		R	R	R	R	R	R	
27	*P. discopora*			R				R														R	R		R	R	R	R	R	R	R	R		R	R			R	R	R			R				R	R	R	
28	*P. japonica*																R			R	R	R			R										R		R		R											R
29	***Ps. lacunosa *)***																															> R	R	C	R	R	F	R	F	R	F		R	R	R	R	R		R	R
30	*R. minuta*	C	R	C	A	C	F	F	R	R	C	F	F	C	A	F	C	F	F	A	A	A	C	A	A	A	A	A	A	A	A	A	C	A	C	A	A	A	A	A	A	C	C	F	R	R	F	C	C	C
31	*R. minutula*	R			R	R			R	R					F	R	R		R	C	C	A	F	C	C	F	F	F	C	C		R	R	F	R	C	C	C	C	F	F	R	F	R		R	R	R	R	R
32	*R. pseudoumbilicus*														R						F	F	R	F	C	C	R	R	R	C	R	R	R	R <																
33	*Scy. globulata*																R				R	R	R	R		R	R		R	R			R	R																
34	*Scy.lagena*																	R																R		R														
35	*Scy. pulcherrima*																																							R	R			R	R			R	R	R
36	*S. abies*	R		R	F				R		F	C	F	C	C	R	F	R	R	C	C	C	F	C	C	C	C	C	C	F	F	R	C		C	F	R		R	R	R		R	R	R	R	R			R
37	*S. neoabies*								R	R	C	F	F	R	F	R	F	F	R	C	C	C	C	A	F	C	R	F	F	R	R		A	R	A	C														

Notes: *): Index of nannofossil (red box for determine of zonation biostratigraphy), > First Occurrence (FO) /First Appearance (FO), < Last Occurrence (LO) /Last Appearance (LO)
Abundance of Nannofossils species: A (Abundant), C (Commond), F (Few), R (Rare)

Biostratigraphic observations in this paper are based on 3 part of observations view per sample, which counts the fossils, and records abundance and diversity data. Then get an age by biozonation analysis, which based on the First Appearance (FA) or the First Occurrence (FO), and Last Appearance (LA) or Last Occurrence (LO) of the species of fossil contained in the identified sample. Each sample has different abundance and variety. This difference depends on the grain size and rock type. Rock types are generally influenced by the sedimentary environment and the basin where the rock was deposited. There are fine-grained to coarse. Pringgoprawiro [2] mentioned the existence of the factor microorganisms affected by seawater temperature, nutrition, salinity, depth, the turbidity of the water, waves, and currents. Biostratigraphy determination uses the basis of Nannoplankton's Biozonation [6]. Biozonation from old to young at Nglebur River in **TABLE 2**.

TABLE 2. Biozonation of Nannoplankton at Nglebur River, of Rembang Zone.

LITOSTRATIGRAPHY	SYMBOL OF LITHOLOGY	AGE		ZONE OF NANNOPLANKTON (Martini;1971)			
				NN	Zone of Nanno	Zonation	Biodatum
Calc.Claystone of Lidah Formation		PLEISTOCENE		NN19	Partial	*Discoaster brouweri and Gephyrocapsa caribbeanica*	*LO.Discoaster brouweri FO.Gephyrocapsa caribbeanica*
Marl of Mundu Formation		PLIOCENE	LATE	NN18	Interval	*Discoaster asymmetricus– Discoaster brouweri*	*LO.Discoaster brouweri LO.Discoaster asymmetricus*
				NN17	Interval	*Discoaster surculus– Discoaster asymmetricus*	*LO.Discoaster asymmetricus LO.Discoaster surculus*
				NN16	Interval	*Reticulofenestra pseudoumbilicus - Discoaster surculus*	*LO.Discoaster surculus LO.Reticulofenestra pseudoumbilicus*
				NN15	Interval	*Pseudoemiliania lacunosa - Reticulofenestra pseudoumbilicus*	*FO.Pseudoemiliania lacunosa LO.Reticulofenestra pseudoumbilicus*
			EARLY	NN14	Interval	*Discoaster asymmetricus– Pseudoemiliania lacunosa*	*FO.Pseudoemiliania lacunosa FO.Discoaster asymmetricus*
				NN13	Interval	*Ceratolithus rugosus– Discoaster asymmetricus*	*FO.Discoaster asymmetricus FO. Ceratolithus rugosus*
				NN12	Interval	*Discoaster quinqueramus– Ceratolithus rugosus*	*FO.Ceratolithus rugosus FO.Ceratolithus armatus*
Limestone of Ledok Formation		MIOCENE	LATE	NN11	Interval	*Discoaster quinqueramus*	*FO.Ceratolithus armatus LO.Discoaster quinqueramus*
				NN10	Interval	*Discoaster hamatus– Discoaster quinqueramus*	*LO.Discoaster hamatus FO.Discoasterquinqueramus*
Marl of Wonocolo Formation			MIDDLE	NN9	Partial	*Discoaster hamatus*	*LO.Discoaster hamatus +) FO.Discoaster quinqueramus +) FO.D.neorectus*

1. ***Discoaster hamatus*/NN9 Partial Zone,** This zone is represented by the Marl Unit of Wonocolo Formation (sample of 1-2). The lower boundary of this zone is unknown, while the upper boundary is determined based on the Last Occurrence (LO) *Discoaster hamatus*.
2. ***Discoaster hamatus* - *Discoaster quinqueramus*/NN10 Interval Zone,** This zone is represented in the marl of Wonocolo Formation and the limestone of Ledok Formation (Sample of 3-9), with a lower boundary determined by (LO) *Discoaster hamatus*, while the upper boundary is characterized by (FO) *Discosater quinqueramus.*
3. ***Discoaster quinqueramus* / NN11 Interval Zone** This zone is represented in the Ledok Formation limestone, on the rock sample 10-41, with a lower boundary characterized by (FO) *Discoaster quinqueramus*, and the upper boundary is characterized by (LO) *Discoaster quinqueramus.*
4. ***Discoaster quinqueramus* - *Ceratholuthus rugosus* / NN12 Interval Zone,** This zone is represented in the limestone of the Ledok Formation and Marl of Mundu (samples 42-44), with the lower boundary characterized by (LO) *Discoaster quinqueramus*, and the upper boundary is characterized by FO. *Ceratholithus rugosus*.

5. ***Ceratholithus rugosus* - *Discoaster asymmetricus* / NN13 Interval Zone,** This zone is represented in the marl of Mundu Formation (samples 45-46), with the lower boundary being characterized by (FO) *Ceratholithus rugosus* and the upper boundary are created by (FO) *Discoaster asymmetricus*.
6. ***Discoaster asymmetricus* - *Pseudoemiliania lacunosa* / NN14 Interval Zone,** This zone is represented in the marl of Mundu Formation, in the 47-51 rock samples, with the lower boundary being characterized by (FO) *Discoaster asymmetricus*, and the upper boundary is characterized by (FO) *Pseudoemiliania lacunosa*.
7. ***Pseudoemiliania lacunosa* - *Reticulofenestra pseudoumbilicus* / NN15 Interval Zone,** This zone is represented in the marl of Mundu Formation, in rock samples 52-54, with the lower boundary being characterized by FO. *Pseudoemiliania lacunosa*, and the upper boundary is characterized by (LO) *Reticulofenestra pseudoumbilicus*.
8. ***Reticulofenestra pseudoumbilicus* - *Discoaster surculus* / NN16 Interval Zone,** This zone is represented in the marl of Mundu Formation, in rock samples 55-56, with the lower boundary being characterized by (LO) *Reticulofenestra pseudoumbilicus*, and the boundary is characterized by LO. *Discoaster surculus.*
9. ***Discoaster Surculus* - *Discoaster asymmetricus* / NN17 Interval Zone,** This zone is represented in the marl of Mundu Formation, in rock samples 57-61, with the lower boundary being characterized by (LO) *Discoaster surculus*, and the upper boundary is characterized by (LO) *Discoaster asymmetricus.*
10. ***Discoaster asymmetricus* – *Discoaster brouweri* / NN18 Interval Zone,** This zone is represented in the marl of Mundu Formation, in rock samples 62-63, with the lower boundary being characterized by (LO) *Discoaster asymmetricus*, and the upper boundary is characterized by (LO) *Discoaster brouweri.*
11. ***Discoaster brouweri* and *Gephyrocapsa caribbeanica* / NN19 Partial Zone,** This zone is represented in the claystone-carbonate of Lidah Formation, in rock samples 64-70, with the lower limit characterized by (LO) *Discoaster broweri* and (FO) *Gephyrocapsa caribbeanica*, and the upper boundary is unknown.

The results of nannoplankton analysis of 70 samples, can be arranged 18 genera and 57 species. In this table, biostratigraphy of the research area can be arranged into 9 Interval Zones and 2 Partial Zones. Stratigraphy of the Rembang Zone at Nglebur area from older to younger, namely NN9-NN10 (Middle Miocene to Late Miocene) represent of Wonocolo Formation, NN10-NN12 (Late Miocene) represent of Ledok Formation, NN12-NN18 (Early Pliocene to Late Pliocene) represent of Mundu Formation, and NN18-NN19 (Late Pliocene to Pleistocene) represent of Lidah Formation.

CONCLUSIONS

Nannoplankton is very well used to identify the age of carbonate rocks because of their widespread and small. The Rembang Zone is composed of lithology which is dominated by marine rock, and has fine grains. The lithostratigraphic sequence consists of 4 unit lithology and formations. These sequences of sedimentary rocks have an old to young order namely are the Marl Unit of Wonocolo Formation (Middle Miocene to Late Miocene), has a parallel, massive, and laminated sedimentary structure. Limestone Unit of Ledok Formation is Late Miocene, has a layer of sedimentary structure, mega cross bedding, age of Marl Unit of Mundu Formation is Early Pliocene to Late Pliocene, have massive structures and bedding, Calcareous-claystone Unit of Lidah Formation is Late Pliocene to Plistocene, a massive sedimentary structure and bedding.

Based on biostratigraphic analysis of the Nglebur trajectory, the Rembang Zone consists of 11 zones, there are consistencies of 2 Partial Zones and 9 Interval Zones, from Late Miocene to Pleistocene. These Zone are *Discoaster hamatus* Partial Zone/NN9, Interval Zone of *Discoaster hamatus–Discoaster quinqueramus*/NN10, Zone of *Discoaster quinqueramus*/NN11, Zone of *Discoaster quinqueramus–Ceratolithus rugosus*/NN12, Zone of *Ceratolithus rugosus–Discoaster asymmetricus*/NN12, Zona of *Discoaster asymmetricus–Pseudoemiliania lacunosa*/NN14, Zona of *Pseudoemiliania lacunosa* with *Reticulofenestra pseudoumbilicus*/NN15, Zona of *Reticulofenestra pseudoumbilicus* with *Discoaster surculus*/NN16, Zona of *Discoaster surculus–Discoaster asymmetricus*/NN17, Zona of *Discoaster asymmetricus–Discoaster brouweri*/ NN18, Partial Zone *Discoaster brouweri* and *Gephyrocapsa caribbeanica*/NN19.

In the observations present are accompanying fossils where the most diversity is found in the Mundu Formation. Changes in the alignment of the lithostratigraphic Rembang Zone are proven by continuous Biostratigraphic analysis.

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