EDITOR/AUTHOR CORRESPONDENCE

Editor
2021-09-04 04:10 PM

Subject: [jwem] Editor Decision DELETE

Journal of Wetlands Environmental Management (JWEM)
Winarti Winarti:

We have reached a decision regarding your submission to Journal of Wetlands Environmental Management, "LIMESTONE MICROFACIES PUNUNG FORMATION AT BANGBANG RIVER, SUMBERMANJING WETAN, MALANG, EAST JAVA".

Our decision is: Revisions Required

Irfan Prasetia
Lambung Mangkurat University
iprasetia@ulm.ac.id

Reviewer A:

Overall it's good, but there are a few items that need to be improved:
1. References use Journal, Books, Chapter in a Book, Conference Proceeding, Thesis or Dissertation, and Electronic Journal. Blog writing is not recommended.
2. In Figure 2. the font size (Reef Limestone, Calcarenite, etc) is too big, adjust the font size of the legend with the others.
3. the discussion section is too little. Please, add a paragraph or two more. Provide related references to strengthen your research results, poor references in this section.

Less talk, write more

Author
2021-09-24 06:36 PM

Subject: LIMESTONE MICROFACIES PUNUNG FORMATION AT BANGBANG RIVER, SUMBERMANJING WETAN, MALANG, EAST JAVA DELETE

Journal of Wetlands Environmental Management (JWEM)
Dear EditorJWEM

I submitted the revised manuscript with the title: LIMESTONE MICROFACIES PUNUNG FORMATION AT BANGBANG RIVER,SUMBERMANJING WETAN, MALANG, EAST JAVA" , and the revised matrix-form, according to the reviewer.

Thank you

Regards,
Winarti
Less talk, write more

Editor
2021-10-12 06:35 AM

Subject: [jwem] Editor Decision DELETE

Journal of Wetlands Environmental Management (JWEM)
Winarti Winarti:

We have reached a decision regarding your submission to Journal of Wetlands Environmental Management, "LIMESTONE MICROFACIES PUNUNG FORMATION AT BANGBANG RIVER, SUMBERMANJING WETAN, MALANG, EAST JAVA".

Our decision is to: Accept Submission

Irfan Prasetia
Lambung Mangkurat University
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Less talk, write more

Close

Matrix-Form Revision:

Title: Limestone Microfacies Punung Formation at Bangbang River, Sumbermanjing Wetan, Malang, East Java

Authors: Winarti, Herning Dyah Kusuma Wijayanti and Odhi Febriarto

No	Reviewers	Author
1	References using Harvard referencing style (author-date system)	Done
2	Figure 2 referensi dari mana? Blog is not recommended for scientific writing, please citation relevant sources with strong references (journals, book, Chapter in a Book, Conference Proceeding, Thesis or Dissertation, Electronic Journal)	The reference has been fixed, citing Febriarto (2018)
3	Figure 2: The font size in circle is too big, adjust the font size with others	The font size has been adjusted
4	This section is too little discussion. Please, add a paragraph or two more. Provide related references to strengthen your research results, poor references in this section.	The discussion has been expanded by linking the research results and references in several paragraphs.
5	Grammar that needs to be corrected	Grammar was clear

LIMESTONE MICROFACIES PUNUNG FORMATION AT BANGBANG RIVER, SUMBERMANJING WETAN, MALANG, EAST JAVA

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ABSTRACT

Malang and Wonosari areas are located in Southern Mountains of Java, and their rock variations are comparable. Study focuses on limestone found at Sumbermanjing Wetan, Malang, that has been identified as part of Wonosari Formation. This place is closer to Punung area as viewed from the type location. Limestone microfacies approach is used to determine whether the limestone belongs to Wonosari or Punung formations. Methods used to identify standard microfacies types and facies zone are measured stratigraphy, petrographic analysis, and microfossil analysis. Measured stratigraphy was conducted along Bangbang River, and seven limestone samples were collected for analysis. Findings showed three standard microfacies types: SMF−5 characterized by packstone or rudstone with a mudstone matrix, SMF−8 characterized by wackstone or floatstone with complete fossils, and SMF−18 characterized by grainstone or packstone with abundant foraminifera or algae. Limestone belongs to facies zone (FZ) 7 − 8, which is characterized by presence of packestone, wackestone, clay sized limestone, and benthic algae foraminifers. Limestone ages range from Middle to Upper Miocene (N12 − N16), were formed in an inner Neritic. Limestone is equivalent to Wonosari and Punung Formations, based on standard microfacies type, facies zone, and age range. When lignite intercalation are present, the limestone is equivalent to the Punung Formation.

Key words: microfacies, standard microfacies types, facies zone, lignite

INTRODUCTION

The Southern Mountains of Central Java – East Java range from Yogyakarta in the west to Banyuwangi in the east and are divided into three administrative areas: Yogyakarta, Central Java, and East Java. The Southern Mountains are composed of volcanic rocks on lower part and carbonate sediments on upper part.

Based on the lithostratigraphic concept, Southern Mountains of East Java are composed of Besole Formation (dacite, tonalite, dacitic tuff, and andesite), Jaten Formation (conglomerate, quartz sandstone, fossilized claystone, and thin lignite intercalation), and the Wuni Formation (breccia, agglomerate, tuffaceous sandstone, and silt), Nampol Formation (conglomerate, tuffaceous sandstone, intercalated siltstone, tuffaceous sandstone, carbon shale and lignite intercalation) and Punung Formation (breccias, agglomerate, tuffaceous sandstone, silt, and limestone) (Sartono, 1964), (Nahrowi et al., 1979).

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Sujanto et al. (1992) state that regional stratigraphy of Southern Mountains of East Java is composed of Mandalika Formation (andesite lava, basalt, dacite, andesite breccia, and andesite tuff) Wuni Formation (breccia, and lava), Nampol Formation (tuffaceous sandstone, claystone, sandy marl, calcareous sandstone, and black silt), Wonosari Formation (limestone, sandy marl, and bluish claystone intercalation), and Alluvial Deposits (coarse tuff with pumice, and andesite fragments).

The presence of limestone becomes particularly important as a result of the regional stratigraphy proposed by previous researchers. Punung Formation is Middle to Upper Miocene in age and has its type location in Punung to Pacitan area (Sartono, 1964), (Nahrowi et al., 1979), whereas Wonosari Formation is Early to Middle Miocene in age and has its type location in Wonosari area of Yogyakarta (Sujanto, et al., 1992). Puger Formation is also composed of limestone, but it is located at easternmost region of Southern Mountains of East Java and is characterized by presence of marble. The distribution of limestone from three formations is shown in Figure 1.

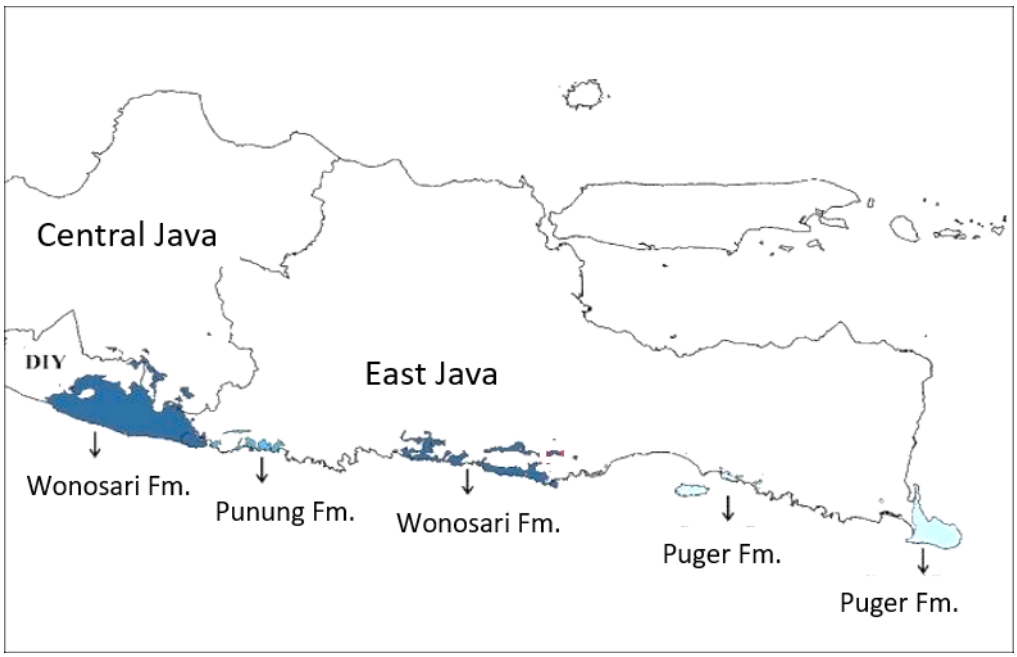


Figure 1. Distribution of Wonosari Formation, Punung Formation, and Puger Formation in Southern Mountains of East Java (All in one, 2018[h1])

Limestones distribution at Malang area are included in Wonosari Formation, according to the regional geological map of Turen sheet (Sujanto et al., 1992), while limestones are closer to Punung area based on type location.

The goal of this study is to identify microfacies types and limestone facies zones, and the results of which may be used to determine whether limestones spread around Malang area are equivalent to Punung Formation or Wonosari Formation.

MATERIAL AND METHODS

Regional Geology

The Island of Java features four structural patterns: Meratus pattern, Sunda pattern, Java pattern, and Sumatera pattern, with Meratus pattern (northeast – southwest direction) and Javanese pattern (E – W direction) meeting in Southern Mountains of Java (Prasetyadi et al., 2011). The E – W structural pattern is derived from East Java microcontinent which control the development of Wonosari depression, Wonosari Platform, and Jiwo High (Bagus & Agastya, 2018).

The constituent rocks of Southern Mountains, especially in the eastern part, composed a mix of clastic sedimentary rock, carbonate rock, and volcanic rock created by volcanic activity (Prasetyadi et al., 2011). Carbonate rock at Southern Mountain of East Java (SMEJ) were formed as a result of global sea level rise after volcanism at the end of Early to Late Miocene age in the high-low basin configuration (Bagus & Agastya, 2018).

Punung Formation has interfengering relationship with Nampol Formation, Wuni Formation, Jaten Formation, and unconformably overly with Besole Formation (Nahrowi et al., 1979). Mandalika Formation which has been heavily altered, is covered by Middle Miocene age Punung Formation (Sukisman et al., 2021).

Punung formation is divided into two facies: clastic facies and carbonate facies (Sartono, 1964). Clastic facies of Middle Miocene comprise tuffaceous sandstone, calcareous sandstone, siltstone, and shale. Carbonate facies of Middle to Upper Miocene comprise made up of reef limestone, bioclastic limestone, sandy limestone, and marl. The two faces have an interfengering relationship (Sartono, 1964). Moreover Sundawa (2012) recognize that Punung Formation comprises of calcirudite, calsilutite, reef limestone, and calcarenite with lignite intercalation.

Wonosari Formation is Middle to Late Miocene in age, this formation in the eastern part of Southern Mountains and uncoformable obove Nampol Formation and unconformable under the Quaternary Volcanic rock (Sujanto, et al., 1992). In the western part, Wonosari Formation is conformable above Sambipitu Formation and interfengering with Oyo and Kepek Formation (Rahardjo et al, 1977).

Wonosari Formation is composed of reef limestone, crystalline limestone, sandy limestone, sandy marl, and bluish claystone intercalation (Sujanto et al., 1992). Other facies recognaized in

this formation are grainstone, foraminiferal-rudstone, packstone, foraminiferal-algal, and chalky limestone (Asy'ari, 2014).

Wonosari limestone, which are found at Pacitan area, consist of reef limestone, calcareous claystone, and sandy limestone that have an unconformity relationship with sandstone of Jaten Formation. These limestones were deposited on inner to middle Neritic and was deposited from Late Miocene to Early Pliocene (N17 – N18) (Sulandari et al., 2014).

Microfacies of Carbonate Rocks

Limestone is kind of carbonate rock up to 95% calcium carbonate (Reijers & Hsu, 1986). Another definition states that limestone is a sedimentary rock mainly composed of calcium carbonate produced from the remains of marine organisms such as shells, sea slugs, and coral. Limestone is generated organically, mechanically, or chemically.

The term microfacies was first proposed by Brown (1943) and Cuvillier (1952) to refer only to petrographic and paleontological criteria studied on thin sections. Currently, the term microfacies includes all sedimentological and paleontological data that can be described and classified through thin sections, polished, sections and rock samples (Flugel, 2004). Field geology, including mapping and profiling is a prerequisite for successful microfacies analysis (Flugel, 2004). Facies or other names for sedimentary facies, cover to two aspects: deposition of sedimentary rocks and formation of sedimentary environment (Feng, 2019).

Microfacies are quantifiably identified using image processing and classification algorithms applied to hydrocarbon field analysis (Yarmohammadi & Kadkhodaie, 2020). Limestone facies are separated into microfacies depending on compositions that reflect depositional environment control.

Microfacies base on thin section divide carbonate rocks facies base on similar compositions that reflect certain depositional environmental controls. The distribution of microfacies is carried out according to the Standard Microfacies Types (SMF) guidelines. SMF summarizes microfacies with identical criteria including grain type, matrix type, fossil, fabric, and texture (Flugel, 2004). SMF was correlated to the facies zone (FZ) model for rimmed carbonate platform. Depositional environment is determined by integrating SMF with FZ model, which commonly use Wilson (1975) model.

Methods

The research was carried out with fieldwork to create a measured stratigraphy cross section supported by microfossil and petrographic analysis. Measured stratigraphy using the Brunton and

Tape method (Fritz & Moore, 1988), and microscopic carbonate rock were named using Dunham (1962) and Embry & Klovan (1971) classification.

Stratigraphy measured on section of Bangbang River has 75 meters thick. This location is quite representative because there are several variations of limestone along measurement. Six samples were collected for micropaleontological analysis in order to identify the age range and depositional environment of the rocks. A total of seven rock samples representing clastic limestone and reef limestone were collected petrography analysis, such as calsirudite (sample code 29A), calsiluti (sample code 29B), fossilized calsilutite (sample code 29C), calcarenite (sample code 29D), layered reef limestone (sample code 29E), reef limestone (sample code 76), and crystalline limestone (sample code 77).

RESULTS

Measured Stratigraphy

Based on the measured stratigraphy and petrographic analysis, microfacies types throughout measurement may be classified into three standard microfacies types (SMF), namely SMF–5, SMF–8, and SMF–18 (Figure 2A and Figure 2B), and each has the following characteristics:

Standard Microfacies Type–5

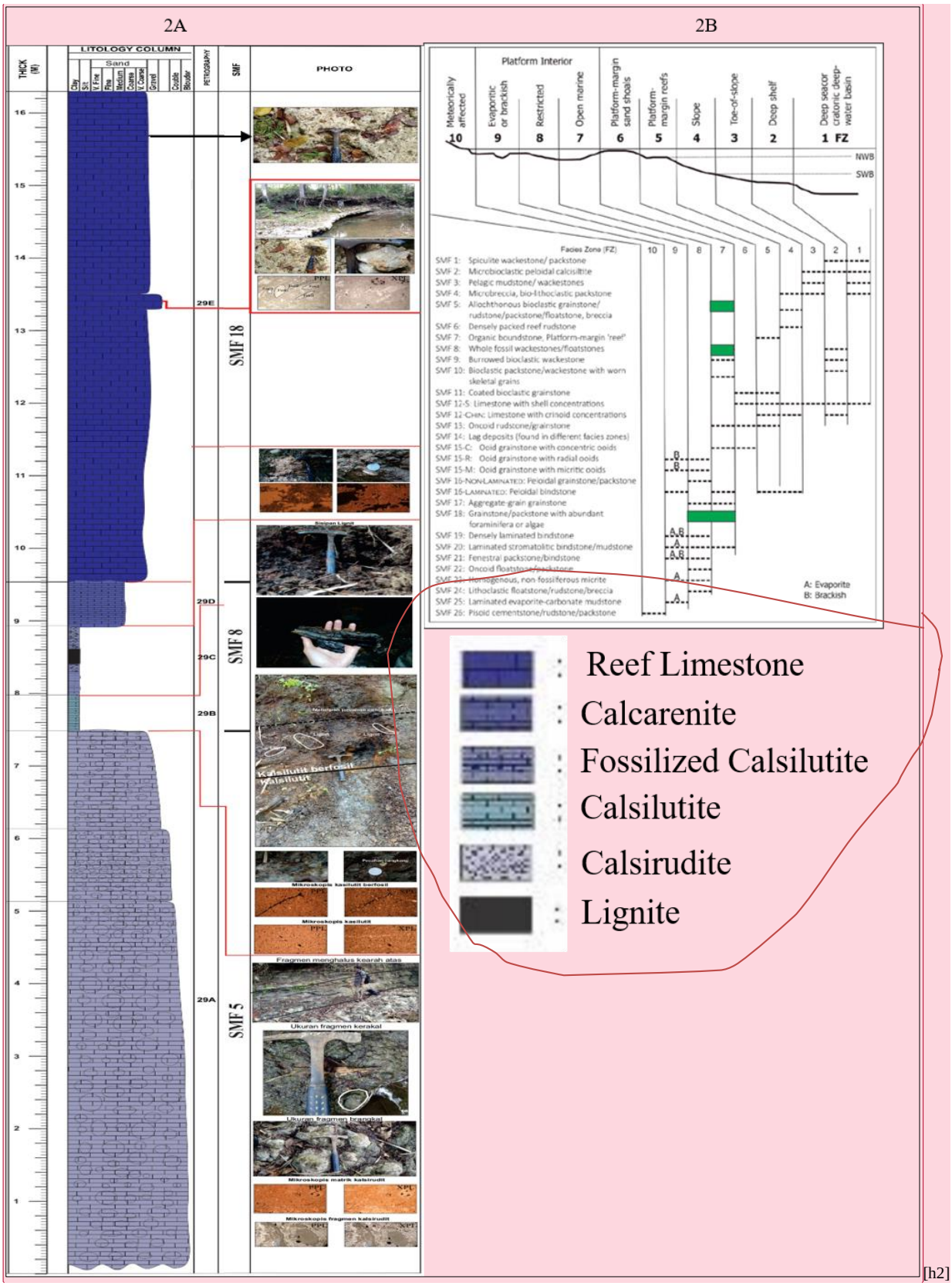
SMF–5 is present with alochthonous bioclastic grainstones, rudstones, packstones, floatstones, and breccias. In the measured stratigraphic line, calcirudite (sample code 29A) with a grain size characteristic of more than 2 mm, finening upwards, and the rock is identified as packstone or rudstone with a claystone matrix

Standard Microfacies Type–8

SMF–8 is characterized by the presence of wackstone or floatstone with whole fossil. In the measured stratigraphic line, kalkareni (sample code 29D) was identified, which has a typical size of 1/16 – 2 mm arenite and has been characterized as wackestone or floatstone.

Standard Microfacies Type–18

SMF–18 is characterized by grainstone or packstone with an abundant of foraminifera or algae. The presence of layered reef limestone (code 29E) identified as bafflestone as evidence of SMF–18. According to the distribution of standard microfacies type, limestone facies zone in research region belongs to facies zone (FZ) 7 – 8 (Figure 3), which is characterized by resence of packestone, wackestone, claystone, and benthic algal foraminifers (Figure 4).



[h2]

Figure 2. 2A. The measured stratigraphy of Bangbang River line is classified into three standard microfacies type: SMF–5, SMF–8, and SMF–18
2B. Petrographic analysis was performed to examine the position of standard microfacies type

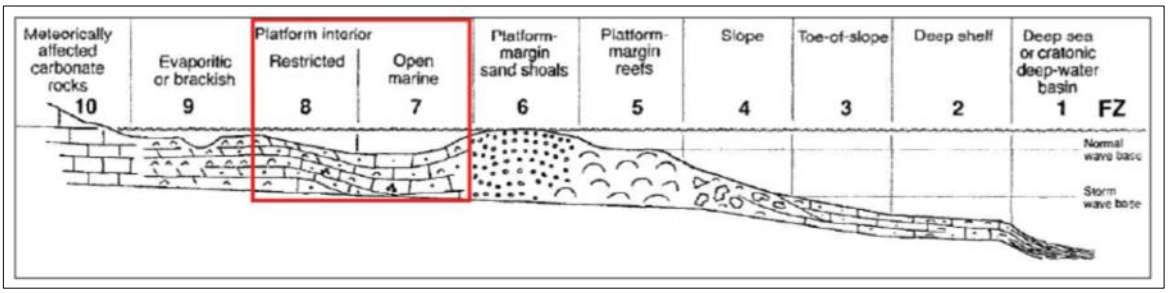


Figure 3. Facies zone showing if limestone belongs to FZ 7 – FZ 8

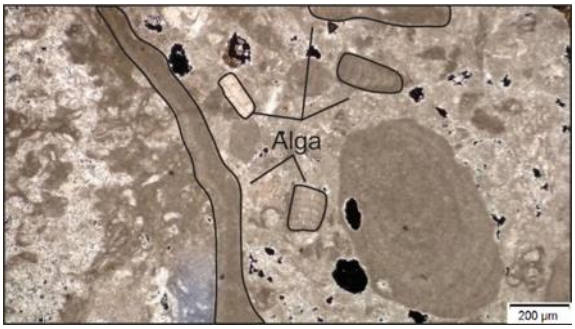


Figure 4. The presence of algae in calcirudite as a marker if rock is formed in the open ocean

Petropraphic Analysis

Calsirudite

Grain supported calcirudite textures are known as packstone or rudstone (Figure 5A), whereas mudstone was identified as a matrix supported calcirudite texture (Figure 5B). According to standard microfacies types, calsirudite is an SMF–5.

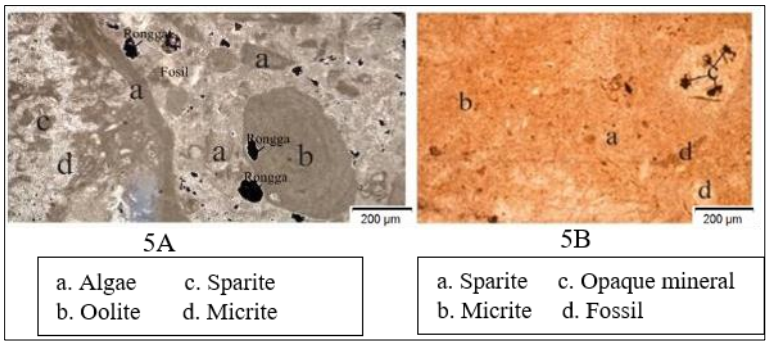


Figure 5. Photomicrograph of fragments and matrix that form calcirudite (sample code 29A)
5A. packstone or rudstone as a fragment and 5B. mudstone as a matrix

Calsilutite

Calsilutite has a good layering in general. Petrographic analysis reveals that texture is mud-supported, dominated by micrite, with minor amounts of sparite, feldspar, and fossils, so that rock is classified as mudstone (Figure 6A). Base on to standard microfacies types, calsilutite is an SMF–8.

Fossilized Calsilutite

There are layered characteristics in fossilized calsilutite, as well as lignite intercalation with a thickness of 20 cm and abundant pelecypoda fragments. Petrographic analysis results show that texture is mud-supported, mainly composed of micrite, with minor amounts of sparite and fossils, hence rock is classified as mudstone (Figure 6B). Base on to standard microfacies types, fossilized calsilutite is an SMF–8.

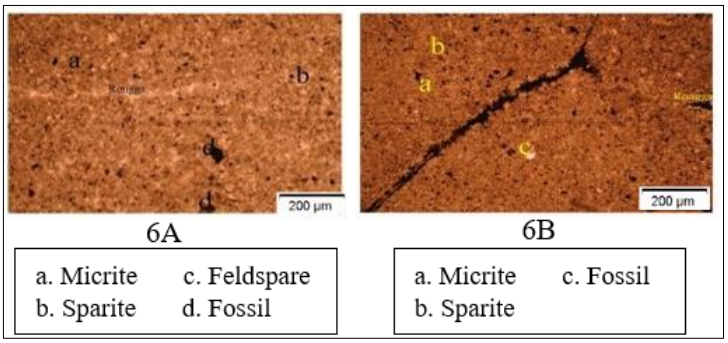


Figure 6. 6A. Photomicrograph of calsilutite identified as mudstone (sample code 29B)
6B. Photomicrograph of fossilized calsilutite identified as mudstone (sample code 29C)

Calcarenite

Calcarenite has a layered and laminated structure, as well as a fossil shell. These rock [h3]dominate in the study area. The observations of thin sections of mud-supported rock texture with a dominant composition of micrite, whereas sparites and fossils are rare (Figure 7A). In petrographic terms, this rock is classified as wackstone or floatstone. Base on to standard microfacies types, calcarenite is an SMF–8.

Crystalline Limestone

Crystalline limestone of crystalline pertography (Figure 7B) has an massive [h4]structure and is dominated by calcite.

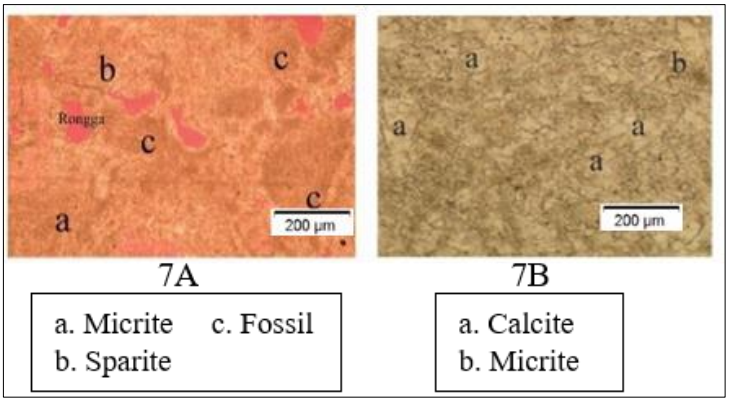


Figure 7. 7A. Photomicrograph of calcarenite identified as wackstone or floatstone (sample code 29D)
7B. Photomicrograph of crystalline limestone identified as crystalline (sample code 77)

Reef Limestone

Reef limestone with a non–clastic texture, composed primarily of corals and mollusks, develops an exsokarst morphology called lapies. This rock is classified into two types: massive reef limestone defined as framestone (Figure 8A) and layered reef limestone defined as bafflestone (Figure 8B).

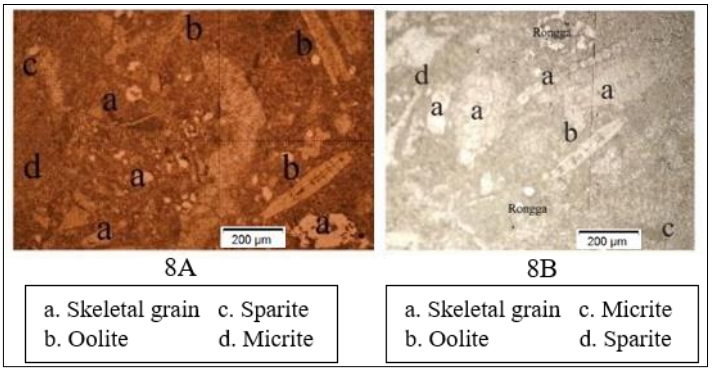


Figure 8. 8A. Photomicrograph of reef limestone identified as framestone (sample code 76)
8B. Photomicrograph of layered reef limestone identified as bafflestone (sample code 29E)

Microfossil Analysis

Age range of limestone is Middle to Upper Miocene (N12 – N16), according to microfossil study. This age range is supported by find of fossils: *Globigerina menardi, Globorotalia miocea, Orbulina universa, Globigerina praebulloides, Globigerinita insueta, Globorotalia speudomeocenica, Globigerina bulloides, Globigerina hadestribbus, Globigerina druryl, Globigerina venezualana, Globorotalia lenguaensis, Globorotalia lehnari, Globigerionides altiaperutus, Globorotalia siakensis, and Globigerionides trilobus.*

Based on the analysis of bentonic foraminifera, limestone was generated in an inner neritic depositional environment at a depth of 0 – 20 meters. This conclusion was reached after the finding of fossils: *Elphidium sp., Nodosaria sp., Bolivina sp., Bathysipon sp., Unigerina sp., Cibicides sp., and Rotalia sp.*

DISCUSSION

The limestone variations found in study area are consist of packstone or rudstone, mudstone, wackestone or floatstone, packstone or rudstone, crystalline limestone, and calcirudite with lignite intercalation, indicating that these limestones are part of Punung Formation, which formed in a transitional to inner neritic environment. This paleoenvironment also support with bentonic foraminifera analysis.

According to facies zone, limestone is included in FZ 7 to FZ 8, which is deposited in between toe of the slope to ploatform interior restrained, which in indicates the open marine environment. The age of limestone ranges from Middle to Late Miocene (N12 – N16). However, the age of this rock is equivalent to that of Punung and Wonosari formations.[h5]

CONCLUSSION

According to the age range, limestone at Sumbermanning Wetan is equivalent to Wonosari Formation and Punung Formation. However, by examining the presence of lignite as an intercalation, limestone can be identified as the Punung Formation. The measured stratigraphy of limestones that represent the bottom to top of the two locations (Wonosari and Punung) must be completed measured in order to verify that limestones dispersed at Malang area are equivalent to Wonosari or Punung Formation.

ACKNOWLEGEMENT

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