Limestone Microfacies Punung Formation at Bangbang River, Sumbermanjing Wetan, Malang, East java

By Winarti -

Available on line at:
http://ijwem.ulm.ac.id/index.php/ijwem

ISSN: 2354-5844 (Print)
ISSN: 2477-5223 (Online)

Limestone Microfacies Punung Formation at Bangbang River, Sumbermanjing Wetan, Malang, East java

WINARTI [1], HERNING DYAH KUSUMA WIJAYANTI [2] AND ODHI FEBRIARTO [3]

[1] Geology Department, Faculty of Mineral Technology, Institut Teknologi Nasional Yogyakarta, Sleman Yogyakarta, Indonesia

ABSTRACT

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

Keywords: population projections, clean water demand, water quality

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 in the lower part and carbonate sediments in the upper part.

Based on the lithostratigraphic concept, the Southern Mountains of East Java are composed of the Besole Formation (dacite, tonalite, dacitic tuff, and andesite), the 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) the Jaten Formation (breccias, agglomerate, tuffaceous sandstone, silt, and limestone) (Sartono, 1964), (Nahrowi *et al*., 1979).

Correspondence: Winarti, Geology Department, Faculty of Mineral Technology, Institut Teknologi Nasional Yogyakarta, Jl. Babarsari, Caturtunggal, Depok, Sleman, Yogyakarta 55281, Indonesia, winarti.itny@gmail.com
.

-----Accredited by Directorate General of Higher Education Indonesia, No. 21/E/KPT/2018, Valid until 9 July 2023-----

ISSN: 2354-5844 (Print)
ISSN: 2477-5223 (Online)

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

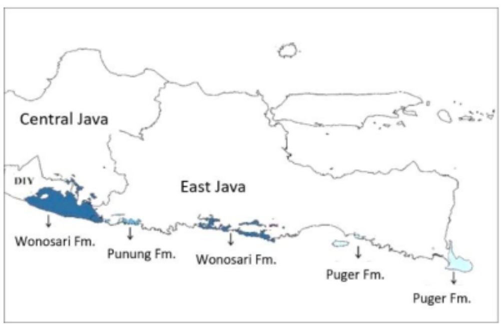

Figure 1. Recapitulation graph of population projections Projecting population growth for 5, 10, 15, and 20 years.

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

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

MATERIAL AND METHODS

Regional Geology

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

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

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

Journal of Wetlands Environmental Management
Vol 9, No 2 (2021) 33-44
http://dx.doi.org/ 10.20527/jwem.v9.v2.254

-----Accredited by Directorate General of Higher Education Indonesia, No. 21/E/KPT/2018, Valid until 9 July 2023-----

ISSN: 2354-5844 (Print)
ISSN: 2477-5223 (Online)

The 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. The carbonate facies of the Middle to Upper Miocene are comprised of reef limestone, bioclastic limestone, sandy limestone, and marl. The two faces have an interfengering relationship (Sartono, 1964). Moreover Sundawa (2012) also notes that the Punung Formation is made up of calcirudite, calcilutite, reef limestone, and calcarenite with lignite intercalation.

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

The Wonosari Formation is composed of reef limestone, crystalline limestone, sandy limestone, sandy marl, and bluish claystone intercalation (Sujanto *et al*., 1992). Other facies recognized in this formation are grainstone, foraminiferal-rudstone, packstone, foraminiferal-algal, and chalky limestone (Asy'ari, 2014).

Wonosari limestone, which is found in the Pacitan area, consists of reef limestone, calcareous claystone, and sandy limestone that have an unconformity relationship with the sandstone of the Jaten Formation. These limestones were deposited in the inner to middle Neritic and were deposited from the Late Miocene to the Early Pliocene (N17-N18) (Sulandari *et al*., 2014).

Microfacies of Carbonate Rocks

Limestone is a kind of carbonate rock up of 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 two aspects: deposition of sedimentary rocks and the formation of the 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 environments under control.

Microfacies based on thin sections divide carbonate rocks into facies based 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). The SMF was correlated to the facies zone (FZ) model for the rimmed carbonate platform. The depositional environment is determined by integrating the SMF with the FZ model, which is commonly used by the Wilson (1975) model.

Methods

The research was carried out with fieldwork to create a measured stratigraphy cross section supported by microfossil and petrographic analysis. Stratigraphy was measured using the Brunton and Tape method (Fritz & Moore, 1988), and microscopic carbonate rock was classified using Dunham (1962) and Embry &

ISSN: 2354-5844 (Print)
ISSN: 2477-5223 (Online)

Klovan (1971) classifications.

Stratigraphy measured on a section of the Bangbang River is 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 for petrography analysis, such as calcirudite (sample code 29A), calciluti (sample code 29B), fossilized calcilutite (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 AND DISCUSSION

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 composed of 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 fossils. 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 Typ-18

SMF-18 is characterized by grainstone or packstone with an abundance 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 types, limestone facies zone in the research region belongs to facies zone (FZ) 7-8 (Figure 3), which is characterized by the presence of packestone, wackestone, claystone, and benthic algal foraminifers (Figure 4).

Petropraphic Analysis

Calcirudite

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, calcirudite is an SMF-5.

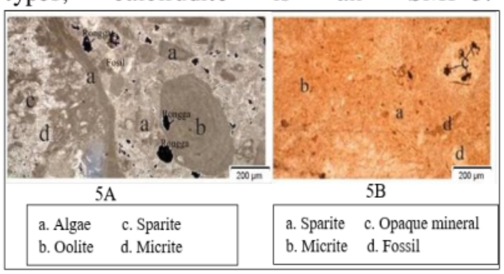

Figure 5. Photomicrograph of fragments and matrix that form calcirudite (sample code 29A). 5A. packstone or rudstone as a fragment and 5B. mudstone as a matrix

Calcilutite

Calcilutite has good layering in general. Petrographic analysis reveals that the texture is mud-supported, dominated by micrite, with minor

-----Accredited by Directorate General of Higher Education Indonesia, No. 21/E/KPT/2018, Valid until 9 July 2023-----

ISSN: 2354-5844 (Print)
ISSN: 2477-5223 (Online)

amounts of sparite, feldspar, and fossils, so that the rock is classified as mudstone (Figure 6A). Based on standard microfacies types, calcilutite is an SMF-8.

Fossilized Calcilutite

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

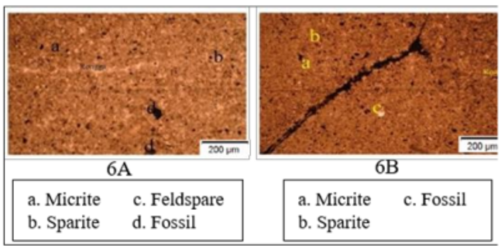

Figure 6. Photomicrograph of calcilutite identified as mudstone (sample code 29B) (6A) and fossilized calcilutite identified as mudstone (sample code 29C) (6B)

Calcarenite

Calcarenite has a layered and laminated structure, as well as a fossil shell. These rocks 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. Based on standard microfacies types, calcarenite is an SMF-8.

Crystalline Limestone

Crystalline limestone of crystalline pertography (Figure 7B) has a massive structure and is dominated by calcite.

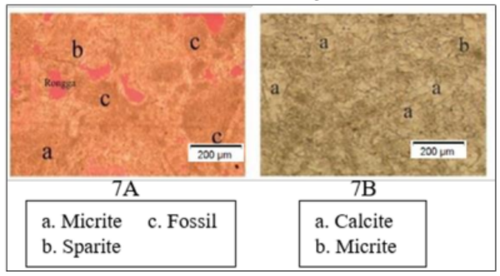

Figure 7. Photomicrograph of calcarenite identified as wackstone or floatstone (sample code 29D) (7A) and crystalline limestone identified as crystalline (sample code 77) (7B)

Reef Limestone

Reef limestone with a nonclastic 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).

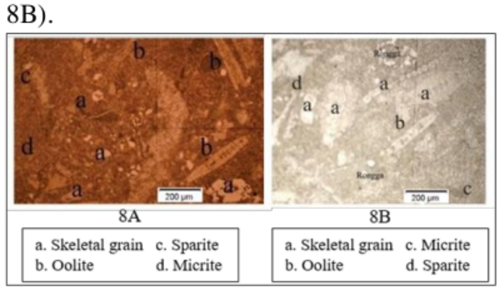

Figure 8. 8A. Photomicrograph of reef limestone identified as framestone (sample code 76) (8A) and layered reef (8B)

ISSN: 2354-5844 (Print)
ISSN: 2477-5223 (Online)

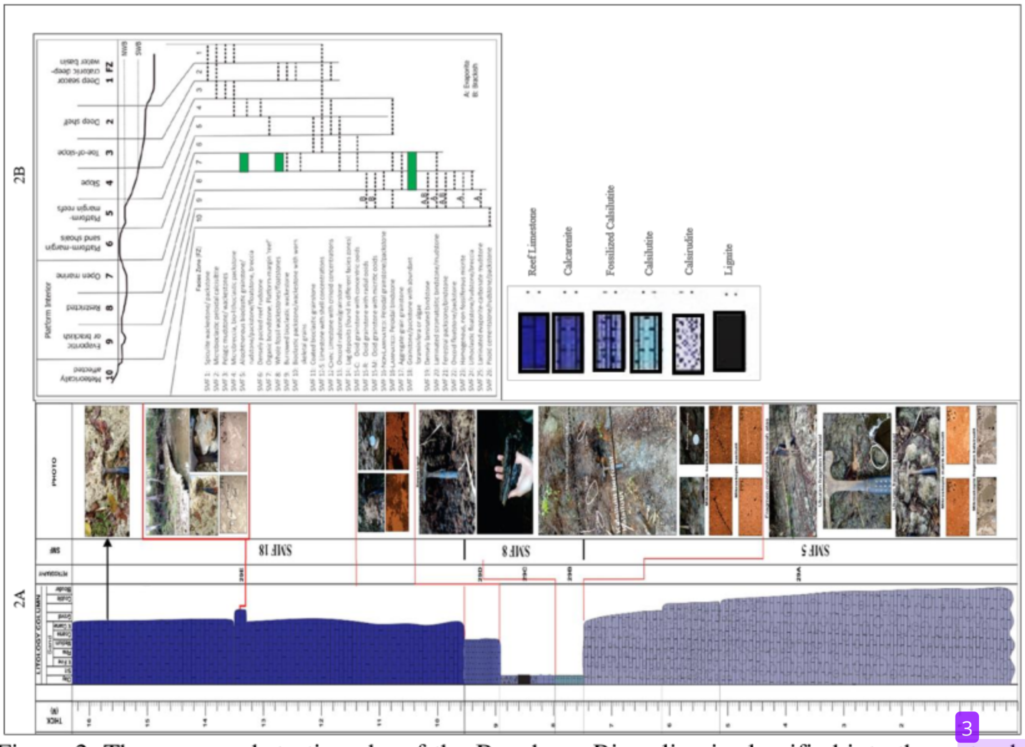

Figure 2. The measured stratigraphy of the Bangbang River line is classified into three standard microfacies types: SMF-5, SMF-8, and SMF-18 (2A) and petrographic analysis was performed to examine the position of standard microfacies types (2B).

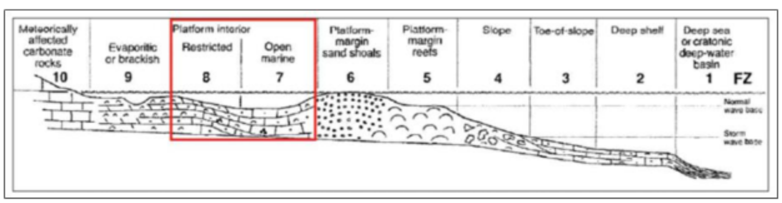

Figure 3. The measured stratigraphy of the Bangbang River line is classified into three standards

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

Journal of Wetlands Environmental Management
Vol 9, No 2 (2021) 33-44
http://dx.doi.org/ 10.20527/jwem.v9.v2.254

ISSN: 2354-5844 (Print)
ISSN: 2477-5223 (Online)

limestone identified as bafflestone (sample code 29E)

Microfossil Analysis

According to a microfossil study, the age range of limestone is from Middle to Upper Miocene (N12-N16), according to a 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.

Regionally stratigraphically, limestone in the Malang area is part of the Wonosari Formation. The Punung Formation, on the other hand, shares the same age and rock association as the Wonosari Formation. Distinguish the two formations by the presence of lignite, which is found only in the Punung Formation.

The field study revealed that the variations in limestone consist of packstone or rudston, mudstone, wackestone or floatstone, packstone or rudstone, crystalline limestone, and calcirudite. Lignite intercalation was discovered in a few places. As a result of the facies zone, limestone is included in FZ 7 to FZ 8, which is deposited in between the toe of the slope and the ploat form interior restrained, which indicates the open marine environment. The age of the limestone ranges from the Middle to Late Miocene (N12-N16).

Based on field data, facies zone analysis, and age, the limestone can be classified as either the Punung Formation or the Wonosari Formation. However, the presence of lignite inserts indicates that the limestone in the study area is part of the Punung Formation. Lignite is generally formed in a transitional environment to the neritic. This depositional environment is supported by benthic fossil analysis, which reveals an inner Neritic depositional at depths of 0 to 20 meters. Furthermore, lignite is a characteristic of the open marine environment.

CONCLUSSION

According to the age range, the limestone at Sumbermanning Wetan is equivalent to either the Wonosari Formation or the 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 in order to verify that limestones dispersed in the Malang area are equivalent to those in the Wonosari or Punung Formation.

ACKNOWLEGEMENT

The author would like to thank Institut Teknologi Nasional Yogyakarta for the laboratory facilities and financial support

REFERENCES

Asy’ari M. 2014. Relationship Between Porosity Evolution and Diagenesis Characteristics of the Wonosari Formation in

-----Accredited by Directorate General of Higher Education Indonesia, No. 21/E/KPT/2018, Valid until 9 July 2023-----

Ponjong District, Gunung Kidul Regency, DIY Province. In: Proceedings of National Earth Seminar 7th; October 2014; UGM, Yogyakarta, p 721-732.

Bagus I, Agastya O. 2018. Basement Structures Controlled Neogene Post-Volcanism Basement Structures Controlled Neogene Post-Volcanism Carbonates in Southern Mountain of East Java. Conference Paper. https://www.researchgate.net/publication/328565347.

Brown J.S. 1943. Suggested Use to the Worl Microfacies. Econ. Geol. 38 (4): 325.https://doi.org/10.2113/gsecongeo.38.4.325.

Cuvillier J. 1952. La Notion de" Microfaciès" et Ses Applications. VII Convegno Nationale del Metano et del Petrolio, Prestampa, Sezione, p 3–7.

Dunham RJ. 1962. Classification of Carbonate Rocks According to Depositional Texture, In: Ham, W. E. (ed.), Classification of Carbonate Rocks. American Association of Petroleum Geologists Memoir, p 108-121.

Embry AF, Klovan JE. 1971. A Late Devonian Reef Tract on North-Eastern Banks Island North West Territory. Bull. of Canadian Petroleum Geol. 19, p 730-781.

Febriarto O. 2018. Geology and Limestone Characteristics of Sumbermanjing Wetan and Surrounding Areas, Sumbermanjing Wetan District, Malang Regency, East Java. [thesis]. Yogyakarta: Sekolah Tinggi Teknologi Nasional.

Feng ZZ. 2019. A review on the Definitions of Terms of Sedimentary Facies. J. of Palaeogr. 8:32. https://doi.org/10.1186/s42501-019-0045-3.

Flugel E. 2004. Microfacies of Carbonate Rocks. Analysis, Interpretation and Application. New York: Springer-Verlag.

Fritz WJ, *Moore* JN. *1988*. Rocks Descriptions and Stratigraphic Columns. In: Basics of Physical Stratigraphy and Sedimentology, Print book. New York: Wiley. P 133-149.

Nahrowi TY, Suratman, Namida S. Hidayat S. 1979. Geology of the Southern Mountains of East Java. In: IAGI Meeting Scientific; Bandung, Exploration Section of PPTMGB Lemigas Cepu.

Prasetyadi C, Ign Sudarno, Indranadi VB, Surono. 2011. Pattern and Genesis of the Geological Structure of the Southern Mountains, Special Region of Yogyakarta and Central Java Province. J. Geol. and Min. Resources 21(2): 91-107. http://dx.doi.org/10.33332/jgsm.2011.v21.2.91-107.

Rahardjo W, Sukandarrumidi, Rosidi HM. 1977. Geological Map Yogyakarta Sheet, Java 1:100.000. Bandung: Geological Research and Development Centre.

Reijers TJ, Hsu KS. 1986. Manual of Carbonate Sedimentology. United States: Academic Pr.

Sartono S. 1964. Stratigraphy and Sedimentation of the Easternmost Part of Gunung Sewu, East Djawa. Indonesia: Department of Basic Industry and Mining.

Sujanto, Hadisantono R, Kusnama, Chaniago R, Baharudin R. 1992 Geological Map Yogyakarta Sheet, Turen, East Java 1: 100.000. Bandung: Geological Research and Development Centre.

Sukisman YRS, Mulyaningsih S, Hidayah AR. 2021. Hydrothermal Alteration and Ore Metal Mineralisation at Temon, Pacitan, East Jawa, Indonesia. J. of Geoscience, Engin. Environment, and Technol. 6(1):24–33. doi: 10.25299/jgeet.2021.6.1.6368.

Sulandari B, Soesilo J, Daryono SK. 2014.

ISSN: 2354-5844 (Print)
ISSN: 2477-5223 (Online)

Geology and Provenance Study of Jaten Sandstone Unit at Bungur and Surrounding Area, Tulakan District, Pacitan Regency, East Java Province. J. Pangea. 1(2):35-41.

http://repository.upnyk.ac.id/view/creators/Sulandari=3ABrahmeswari=3A=3A.html

Sundawa A. 2012. Geology and Lithofacies Spread Study of the Limestone Punung Formation in Girikikis and Surrounding Areas, Giriwoyo District, Wonogiri Regency, Central Java Province. [Theses]. Yogyakarta: Universitas Pembangunan Nasional "Veteran".

Wilson JL. 1975. Carbonate Facies in Geologic History. Berlin: Springer Verlag.

Yarmohammadi S., Kadkhodaie A. 2020. Carbonate Rocks Microfacies Analysis by Using Images Processing and Classification Algorithms: an Example From the Salman Oil and Gas field, Persian Gulf, Iran. Geopersia 10(2):277-287. DOI: 10.22059/GEOPE.2019.287542.648496.

Limestone Microfacies Punung Formation at Bangbang River, Sumbermanjing Wetan, Malang, East java

ORIGINALITY REPORT

12%
SIMILARITY INDEX

PRIMARY SOURCES

1	ijwem.ulm.ac.id Internet	170 words — 6%
2	www.scbaghdad.edu.iq Internet	39 words — 1%
3	Microfacies of Carbonate Rocks, 2004. Crossref	16 words — 1%
4	Sari Bahagiarti Kusumayudha. "Chapter 16 Coastal Groundwater and Its Supporting Role in the Development of Gunungsewu Geopark, Java, Indonesia", Springer Science and Business Media LLC, 2013 Crossref	14 words — < 1%
5	Sugiarto Kadiman, Oni Yuliani, Trie Handayani. "Teaching power system stabilizer and proportional-integral-derivative impacts on transient condition in synchronous generator", Bulletin of Electrical Engineering and Informatics, 2021 Crossref	14 words — < 1%
6	Saeed Yarmohammadi, David A. Wood. "Integrated microfacies interpretations of large natural gas reservoirs combining qualitative and quantitative image analysis", Elsevier BV, 2022 Crossref	13 words — < 1%

7 Didit Setyo Pamuji, Nizam Effendi, Daru Sugati. "Numerical study on the performance and flow field of varied conical basin for efficient gravitational water vortex power plant", AIP Publishing, 2019 — 9 words — < 1%
Crossref

8 interesjournals.org — 9 words — < 1%
Internet

9 Abdel Galil A. Hewaidy, Haitham M. Ayyad, Mohamed W. Abd El-Moghny, Osama Gameel. "Sequence stratigraphy and biozonation of the Upper Eocene Anqabiya Formation, Gebel Anqabiya, Egypt", Geosciences Journal, 2018 — 8 words — < 1%
Crossref

10 Erik Flügel. "Microfacies of Carbonate Rocks", Springer Science and Business Media LLC, 2010 — 8 words — < 1%
Crossref

11 doku.pub — 8 words — < 1%
Internet

12 igj-iraq.org — 8 words — < 1%
Internet

13 research.vu.nl — 8 words — < 1%
Internet

14 scholarworks.sjsu.edu — 8 words — < 1%
Internet

15 www.tandfonline.com — 8 words — < 1%
Internet

16 Qorri, Ana. "Microfacies Analysis and Diagenetic Settings of Upper Cretaceous Shallow Water — 7 words — < 1%

Carbonates from the Borizana Section (Kruja Zone, Albania)",
Academic Journal of Interdisciplinary Studies, 2015.
Crossref

17	livrosdeamor.com.br Internet	6 words — < 1%

EXCLUDE QUOTES	ON	EXCLUDE MATCHES	OFF
EXCLUDE BIBLIOGRAPHY	ON		