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GEOLOGY OF CIBEUREUM AND SURROUNDING AREAS, CIBEUREUM DISTRICT, KUNINGAN REGENCY, WEST JAVA PROVINCE, INDONESIA

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ABSTRACT

This study compiled a comprehensive geological map of Cibeureum and its surrounding areas in Cibeureum District, Kuningan Regency, West Java, using primary data and systematic geological methods, including field observations, data sampling, and laboratory analysis. Geographically, the area is located at 108º 42' 33.75"–108º 45' 16.8" East Longitude and 7º 02' 10.31"–7º 04' 52.20" South Latitude. The main purpose of this study is to identify the geological characteristics and phenomena that might have occurred in the past as well as in the future. In this study, geomorphological analysis was carried out, based on morphography, morphometry, and morphogenetic interpretations; stratigraphic analysis, based on interpretation of rock units, ages, and depositional environments; and analysis of geological structures, based on interpretation of DEM data and field observations. The results showed that the study area consists of very fine-coarse sandstones with carbonate and non-carbonate properties, claystone, and tuff. The geomorphological units are divided into four, namely Volcanic Stepping Hills, Structural Stepping Hills, Denudational Plains, and Denudational Slightly Steep Low Hills. Geological structures found in the field are folds, faults and joints. Based on the distribution of lithology, reconstruction of strike-dip patterns, and biostratigraphy analysis, the depositional of informal lithostratigraphy units in the study area began in the Middle Miocene and continued into the Quartenary, starts from Sandstone Units (Tmpbp) in N10 to N21, Claystone Unit (Tmpbl) in N12 to N21, Interbedded Claystone and Sandstone Unit (Tmpblbp) in N16 to N19, and continued with the deposition of Tuff Unit (Qt).

Keywords: Cibeureum, Geological Mapping, Geomorphology, Geological Structure, Lithological Distribution, Biostratigraphy

INTRODUCTION

Astronomically, the study area is located between 108°42'33.75" East Longitude to 108°45'16.8" East Longitude and 7°02'10.31" South Latitude to 7°04'52.20" South Latitude. Meanwhile, administratively, it belongs to the Cibeureum District, Kuningan Regency, West Java Province. Based on Kastowo and Suwarna (1996), regionally, this area has distinctive landscape characteristics, various rock formations, complex geological structures, as well as geological age and history, which are still being debated among previous researchers. This is an objective and a special interest for the author to carry out detailed geological mapping in this area with the hope of revealing geological phenomena that occur in this area, which can later be useful for various purposes of further research-application.

In this study, geomorphological, geological structure, and stratigraphic aspects of the Cibeureum area and its surroundings are discussed. These aspects are used to reconstruct geological characteristics and phenomena related to the study area. In addition, information regarding geological resources and geological hazards are also discussed.

LITERATURE STUDY

Regional Physiography

Based on Van Bemmelen (1949), the physiographic zones of West Java can be divided into five (Figure 1), which are Coastal Plain of Batavia, Bogor Zone, Bandung Zone, Bayah Mountain Zone, and Southern Mountain Zone.

1. Coastal Plain of Batavia

This zone is composed of alluvial deposits in the form of rivers and beaches and quaternary volcanic deposits in the form of lava and pyroclastic.
2. Bogor Zone
This zone is an anticlinorium track of strongly folded and intensively intruded Neogene layers.
3. Bandung Zone
This zone is the peak of the Java Geanticline, which consists of volcanic complexes that were destroyed during the late Tertiary period.

4. Bayah Mountains Zone
This zone consists of lowlands that extend along the south coast, around estuaries and river valleys.
5. Southern Mountains Zone
This zone is the southern part of the Java Geanticline, which is experiencing a period of shrinkage and is sloping southward towards the Indian Ocean.
The study area is included in the Bogor Zone, which is an anticlinorium track of strongly folded and intensively intruded Neogene layers. The core of the anticlinorium is composed of layers of Miocene rock with wings of the Pliocene to the Pleistocene age. The rocks in this zone consist of sandstone, clay, and breccia lithology originating from turbidite deposits, hypabyssal intrusions, conglomerates, and volcanic deposits. In addition, local limestone lenses were also found.

Regional Structural Geology
The regional structure in the study area can be interpreted based on the structural patterns found on Java Island. This structural pattern is expected to affect the presence of structures in the study area. Based on Pulunggono and Martodjojo (1995), there are several main structural patterns formed on the island of Java, which are Meratus Pattern, Sunda Pattern, and Jawa Pattern.
1. Meratus Pattern
This pattern is composed of regional faults trending southwest-northeast that was formed 80–53 million years ago (Late Cretaceous–Early Eocene) due to convergent interactions between the Indian Ocean and Australian Plates. Represented by the Cimandiri Fault in West Java, which has a sinistral horizontal shift orientation. It stretches from the Pelabuhan Ratu area (Sukabumi) to the Meratus Mountains in East Kalimantan.
2. Sunda Pattern
This pattern is composed of North-South trending regional faults and formed 53–32 million years ago (Early Eocene–Late Oligocene). Based on seismic data, it is estimated that this pattern reactivates the Meratus Pattern and controls the formation of sedimentation basins around it, including limiting the Asri Basin, Sunda Basin, and Arjuna Basin. The route that this pattern took continued through Bogor, Sukabumi, and Banten areas.

3. Jawa Pattern
This pattern is composed of East-West trending regional faults and formed in early Tertiary to Late Tertiary. Represented by the Baribis Fault, which stretches from Purwakarta to Majalengka.

Regional Stratigraphy
Based on the Majenang Sheet Regional Geological Map (Kastowo and Suwarna, 1996), stratigraphy units that were included as part of the research in the study area are Pemali Formation, Halang Formation, River Terraces, Aluvial Deposit, Sill and Dikes (Figure 2).
1. Pemali Formation
Consist of blue and gray-green *Globigerina* marl, poorly-well bedded. In several locations, outcrops were found with the insertion of tuffaceous sandstone and also limestone with a blue-gray color. Sedimentary structures found in this formation include parallel lamination, cross-bedding, convolute, and ripple marks. It is estimated that the age of this formation is Early Miocene, with a thickness of approximately 900 meters which made this the oldest formation in the study area.
2. Halang Formation
Composed of generally turbidite sedimentary material with various lithologies, including tuffaceous sandstones, conglomerates, marl, and claystone, which are interbedded with layers that are categorized as well sorted. The sandstones in this formation are generally of the Wacke type, with andesitic rock fragments in several locations. At the bottom part, breccias with andesite fragments are found, while limestone containing reefs at the top (Marks, 1957).
3. River Terraces
The maximum thickness of this unit reaches 20 meters and composed of sedimentary material in the form of dark gray sand with fragments in the form of gravel and cobbles.
4. Alluvial deposits
Containing sedimentary material in the form of gravel, sand, and clay with a gray color that is deposited along the floodplains of the major rivers around the unit. There is also the result of swamp deposits in the form of black clay deposits which have a relatively rotten odor. It is estimated that the thickness of this unit is up to 5 meters.
5. Sills and Dikes

This unit is thought to have formed from subsurface intrusions composed of pyroxene basalts.

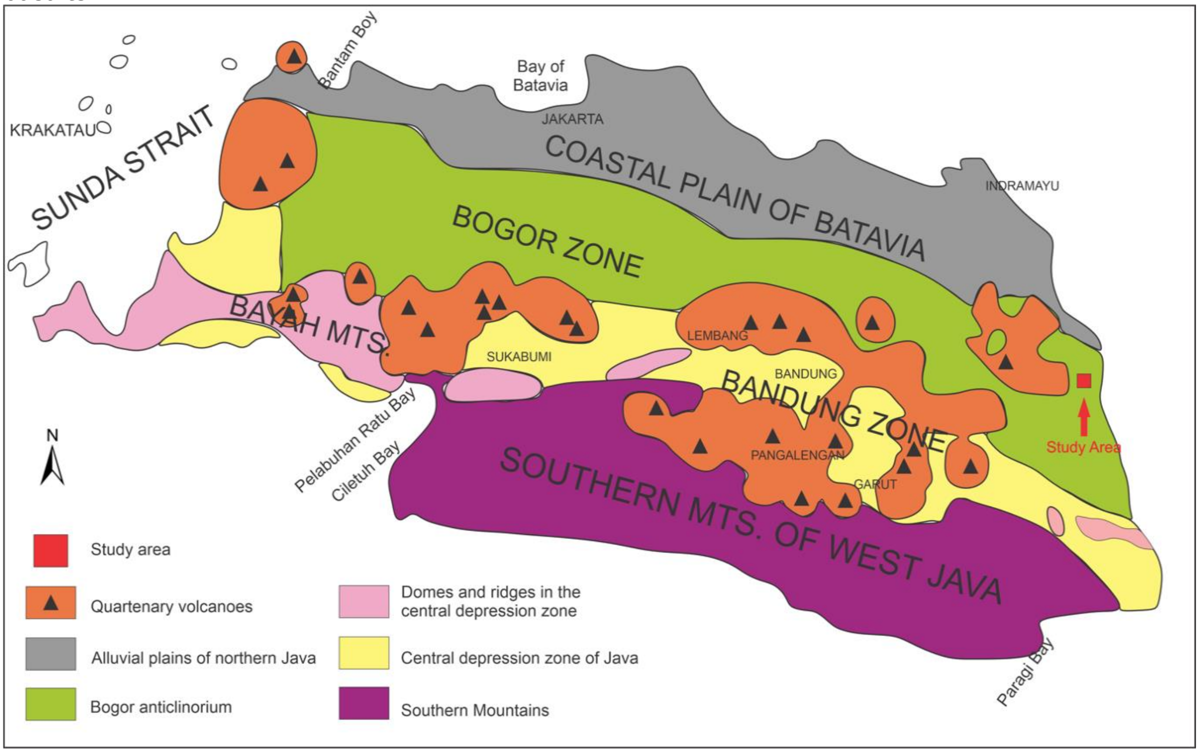


Figure 1. Physiographic map of West Java (modified from Van Bemmelen, 1949)

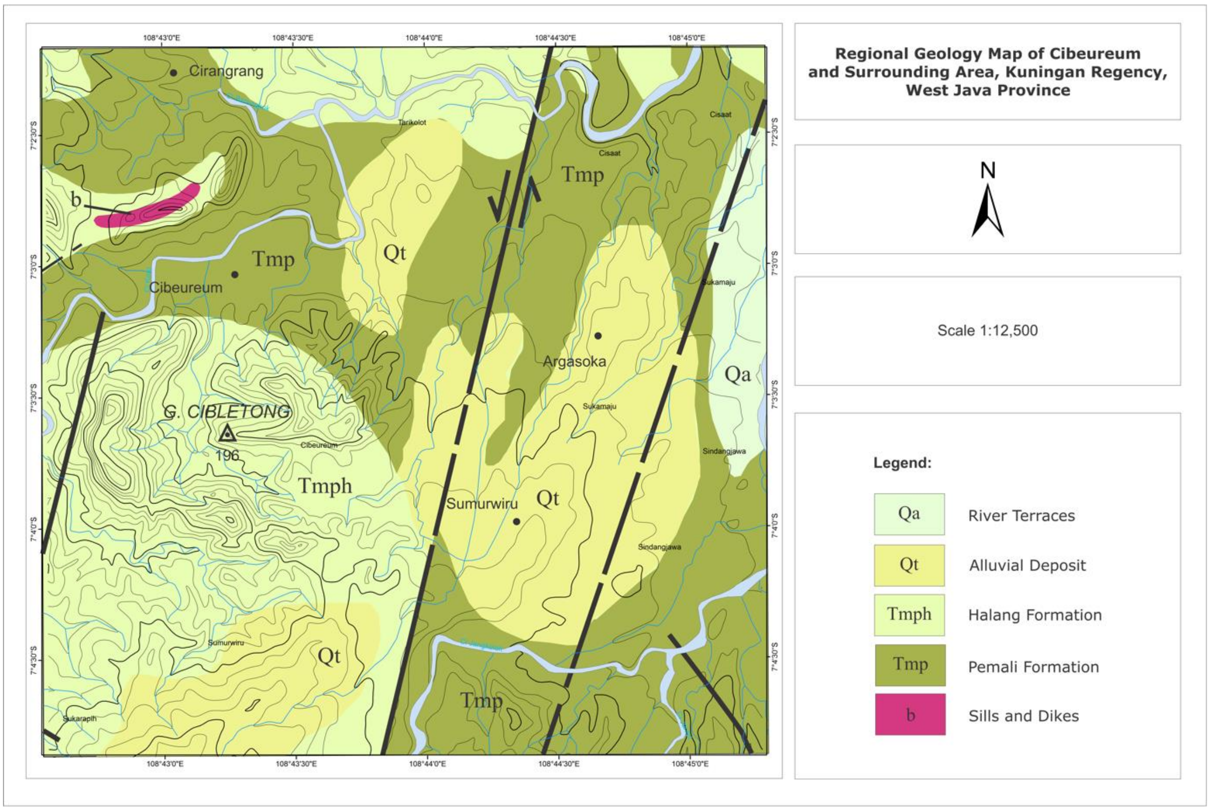


Figure 2. Regional Geology of the study area (modified from Kastowo and Suwarna, 1996)

METHODOLOGY

This research implies a systematical geological mapping method that observed elements of geomorphology, lithology, stratigraphy, geological structures, geological history, and geological resources.

Tools

The main tools that were used in this study are; basic field tools including navigation, sampling, measurement, and note-taking tools; laboratory analysis tools, including microscopes and sample preparation tools; and studio analysis tools including software and laptop.

Research Steps

The implementation of geological mapping activities is systematically divided into five stages, namely:

1. Preparation Stage

Includes maps collection, geological structures interpretation, tentative geomorphological maps construction, literature investigation, field work plans discussion, and obtaining permits.

2. Field Work Stage

Includes outcrop data inventorisation, such as contact or lithological changes observation, rock units identification, lithological logs depiction, stratigraphic sections measurement, and sample collection.

3. Studio Work Stage

Includes analysis of stratigraphy, geological structure, geological history, potential geological resources, and geological hazard that may occur in the study area.

4. Laboratory Work Stage

Includes fossil and petrographic analysis of rock samples obtained from field observations.

5. Report Preparation Stage

Includes data reconstruction and presentation in the form of systematic geological mapping report.

RESULT AND DISCUSSION

Geomorphology

Based on the analysis of morphography, morphometry, and morphogenetic aspects, the study area can be divided into four geomorphological units (Figure 7), namely:

1. Volcanic Steep Hills Unit

Represented in red, with a dominance of ±5% in the study area. Has a radial centrifugal river flow pattern with hilly landforms and a dominant U-shaped valley. Judging from the contours and height measurements in the field, the unit is in the altitude range of 100–150 m and is categorized as a steep hill with a 15%–30% or 8°–16° slope. This formation was generated from two processes, which are volcanic activity as the endogenous process, the exogenous process is represented by erosion and weathering activity, hence the domination of tuff outcrop are identified (Figure 3).

Figure 3. Volcanic Steep Hills Unit Outcrop

2. Structural Steep Hills Unit

Represented in purple, with a dominance of ±20% in the study area. Has a radial centrifugal river flow pattern with hilly landforms and a dominant V-shaped valley. Judging from the contours and height measurements in the field, the unit is in the altitude range of 100–200 m and is categorized as a steep hill with a 15%–30% or 8°–16° slope (Figure 4). This formation was generated from two processes, which are tectonic activity as the endogenous process, with the evidence of slicken side and the exogenous process is represented by erosion and weathering activity. The domination of sandstone and claystone outcrop are identified.

Figure 4. Structural Steep Hills Unit

3. Denudational Plain Unit

Represented in dark brown, with a dominance of ±50% in the study area. Has a parallel river flow pattern with plain landforms along with U and V shaped valley. Based on contours and height measurements in the field, the unit is in the altitude range of 25–125 m and is categorized as a gentle plain with a 2%–7% or 2°–4° slope (Figure 5). This formation was generated from two processes, which are tectonic activity as the endogenous process, with the evidence of slicken side and the exogenous process is represented by erosion and weathering activity. The domination of sandstone and claystone outcrop are identified.

Figure 5. Denudational Plain Unit

4. Denudational Slightly Steep Low Hills Unit

Represented in light brown, with a dominance of ±25% in the study area. Has a subparallel river flow pattern with lowland landforms along with U and V shaped valley. Based on contours and height measurements in the field, the unit is in the altitude range of 100–250m and is categorized as a quite steep low hill with a 7%–15% or 4°–8° slope (Figure 6). This formation was generated from two processes, which are tectonic activity as the endogenous process, characterized by the shape of the river, outcrop conditions, and strike patterns that showing continuity of a fault from the upper unit of its location while the exogenous process is represented by erosion and weathering activity. The domination of sandstone and claystone outcrop are identified.

Figure 6. Denudational Slightly Steep Low Hills Unit

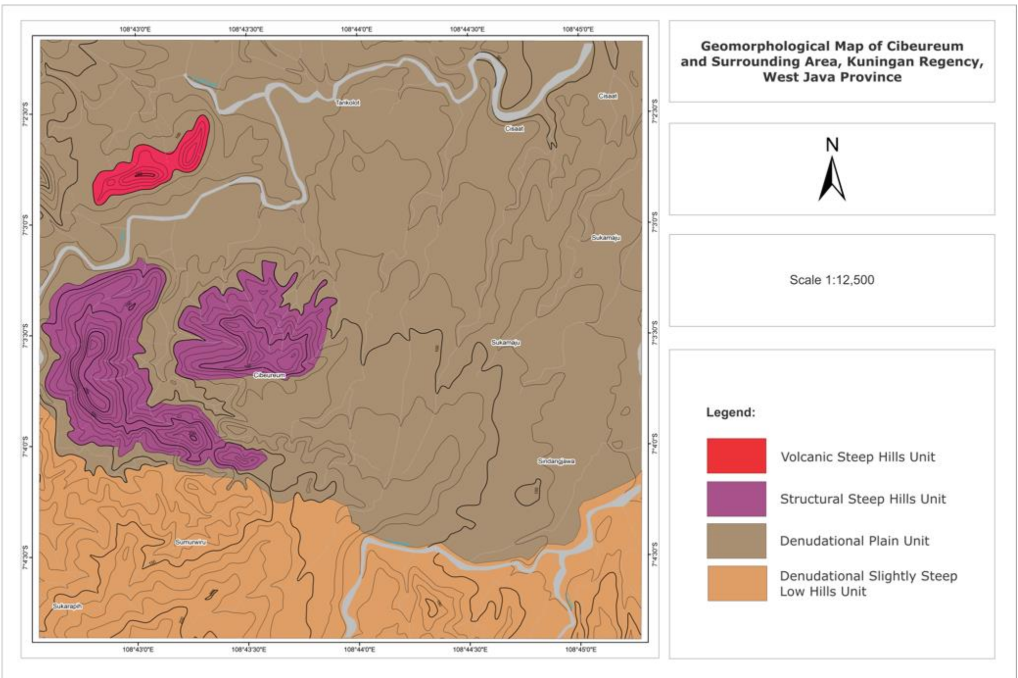


Figure 7. Geomorphology map of the study area

Stratigraphy

Based on the Indonesian Stratigraphic Code (1996), rock units in the study area are grouped and named using an unofficial lithostratigraphic unit nomenclature, which is divided into four units, from the oldest to the youngest, namely the Sandstone Unit (Tmpbp), Claystone Unit (Tmpbl), Interbedded Claystone and Sandstone Unit (Tmpblbp), and Tuff Unit (Qt). These four units are then grouped into a stratigraphic column (Table 1) and their distribution is depicted on a geological map (Figure 12).

Table 1. Stratigraphic Column of the study area (Ahmadjayadi, 2022)

AGE			ROCK UNITS	REGIONAL COMPARISON (Kastowo and N. Suwarna, 1996)
Period	Epoch			
Quartenary	Holocene		Qt	River Terrace
	Pleistocene			
Tertiary	Pliocene	Late	Tmpbl	Halang Formation (?)
		Early	Tmpblbp	Halang Formation
	Miocene	Late		
		Middle	Tmpbp	
		Early		Pemali Formation

1. Sandstone Unit (Tmpbp)
Covers ±40% of the western to southern parts of the study area. Composed of sandstone, claystone inserts, and interbedded sandstone and claystone with the dominance of bedded sandstone outcrops (Figure 8). The sandstone has the characteristic of fresh grayish white to blackish gray color and weathered brownish gray to blackish brown. Has a grain size of fine-coarse (1/8–1mm), angular to rounded grain shape, moderate sorting, a closed fabric, a hard to brittle hardness level, and is carbonaceous. Meanwhile, the claystone has the characteristic of grayish black fresh color and greenish brown weathered color, clay grain size (<1/256mm), brittle hardness level, and carbonaceous.

Figure 8. Sandstone Unit Outcrop

Based on petrography analysis, sandstone lithology in this unit could be classified as Feldspathic Graywacke (Pettijohn, 1975) with a 20% matrix and clay type cement. It has the *grain morphology* of subrounded to subangular grain shape, low to medium sphericity roundness, poor sorting, and grain supported. The mineralogy of the rock incisions shows 80% of fragment composition, comprises of Plagioclase (35%), K-feldspar (10%), Quartz (10%), Rock Fragment (10%), Sericite (10%), iron oxide minerals (5%), glass (5%) and 20% matrix of clay minerals.
Based on fossil analysis, the age of this unit is N10-N21 (Middle Miocene to Late Pliocene), as determined by the appearance of the *Globoquadrina dehiscens, Orbulina universa, and Globoquadrina conglomerate* (Table 2). In addition, fossils of *Amphistegina sp., Bolivina sp., and Operculina sp.* were also found, showing deposition evidence in the deep neritic zone (Table 3).

2. Claystone Unit (Plate)
This unit dominates approximately 32% with Covers ±32% of the northwestern to southeastern parts of the study area. Composed of sandstone, claystone inserts, and interbedded sandstone and claystone with the dominance of massive claystone outcrops (Figure 9). The claystone has the characteristic of fresh whitish grey and brownish black weathered color. Has a grain size of clay (<1/256mm), brittle hardness level, and is carbonaceous. Meanwhile, the sandstone has the characteristic of grayish white to grayish black fresh color and brownish green to blackish brown weathered color, very fine grain size (<1/16-1/4 mm), subangular to subrounded grain shape, moderately sorted, closed fabric, brittle hardness level, and carbonaceous.

Figure 9. Claystone Unit Outcrop

Based on petrography analysis, limestone lithology in this unit could be classified as Mudstone (Pettijohn, 1975) with 85% matrix, clay cement type, clay grain size, moderate sorting, and is classified as mud supported. The mineralogy of the rock incisions shows the composition of 15% fragments, including 10% rock fragments, and 5% oxide minerals, while matrix composition has the percentage of 85%, which is composed of clay minerals.
Based on fossil analysis, the age of this unit is N12-N21 (Middle Miocene to Late Pliocene), as determined by the appearance of the *Globigerinoides immaturus*. in sandstone lithology (Table 4), while in claystone lithology *Globigerinoides immaturus, Globigerinoides trilobus, Globorotalia tumida, Globigerina angulisuturalis, Globigerina venezuelana, and Globigerinoides rube*r. (Table 5). In addition, fossils of Heterolepa sp. and Quinueloculina sp. were also found, showing deposition evidence in the deep to middle neritic zone (Table 6).

3. Interbedded Claystone and Sandstone Unit (Tmpblbp)
Covers ±10% of the noertheastern part of the study area. Composed of sandstone, claystone inserts, and interbedded sandstone and claystone. In this unit, the rock outcrops are dominated by interbedded claystone and sandstone outcrops, with a greater percentage of claystone occurrence than sandstone (Figure 10).The claystone has the characteristic of fresh brownish grey and greyish white weathered color. Has a grain size of clay (<1/256mm), brittle hardness level, and is carbonaceous. Meanwhile, the sandstone has the characteristic of grayish white to grayish black fresh color and brownish gray to blackish brown weathered color, fine grain size (<1/8-1/4 mm), subangular to subrounded grain shape, well sorted, closed fabric, hard hardness level, and carbonaceous.

Figure 10. Interbedded Claystone and Sandstone Unit Outcrop

Based on petrography analysis, limestone lithology in this unit could be classified as Mudstone (Pettijohn, 1975) with 85% matrix, clay cement type, clay grain size, moderate sorting, and classified as mud supported. The mineralogy of the rock incisions shows the composition of 5% fragments, including quartz , 2% opaque minerals, and 95% matrix composition, which is composed of clay minerals.
Based on fossil analysis, the age of this unit is in N16-N19 (Middle Miocene to Late Pliocene), as determined by the appearance of *Orbulina universa, Globigerina ampliapertura, Globigerinoides conglobatus, Globigerina boweri, Globigerina praebulloides , Globigerinoides immaturus, Globorotalia mayeri, and Globigerina bulloides* in sandstone lithology (Table 7), while in claystone lithology, *Trilobatus immaturus, Globigerinoides immaturus, Globorotalia crassaformis, Globorotalia mayeri, Globigerina triloculinoides, Globigerina praebulloides, Globorotalia scitula, Globigerina ampliapertura, and Orbulina universina* (Table 9). In addition, the discovery of *Lenticulina sp.* and *Cibicides sp*, showing deposition evidence in the deep to middle neritic zone (Table 8).

4. Tuff Unit
This unit dominates approximately 40% with a location from the west to the south of the study area. Composed of tuff rock as the main lithology composing this unit with characteristics of fresh color yellowish brown-reddish brown, weathered color white brownish-brown black, grain size of fine-coarse ash (1/8-1mm), angular grain shape, brittle hardness level, composition consists of lithic, crystal, and glass.

Figure 11. Tuff Unit Outcrop

Based on the results of petrographic analysis, the rock that makes up this unit is Lithic Tuff (Schmid, 1981) with a supported matrix fabric and poor selection. Composed of a fragment composition with a percentage of 30% consisting of lytic fragments (20%), crystal/mineral fragments in the form of sericite (8%), glass fragments (2%), opaque minerals, and matrix composition in the form of glass with a percentage of 70%.

Table 2. Analysis of Planktic Foraminifera Fossils on sandstones lithology at the Tmpbp Unit.

Foraminifera Planktonik	Oligosen			Miosen Awal					Miosen Tengah						Miosen Akhir				Pliosen			Kuater	
	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19	N20	N21	N22	N23
Globoquadrina dehiscens																							
Orbulina universa																							
Globoquadrina conglomerata																							

Table 3. Analysis of Benthic Foraminifera Fossils on sandstones lithology at the Tmpbp Unit.

Foraminifera Bentonik	Transisi	Neritik			Batial		Abyssal
		Dalam	Tengah	Luar	Atas	Bawah	>4.000
		20-50	50-100	100-200	200-1.000	1.000-4.000	
Amphystegina sp.							
Bolivina sp.							
Operculina sp.							

Table 4. Analysis of Planktic Foraminifera Fossils on sandstones lithology at the Tmpbl Unit.

UMUR	OLIGOSEN			MIOSEN															PLIOSEN			KUARTER	
				Awal					Tengah						Akhir								
FORAMINIFERA PLANGTONIK	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19	N20	N21	N22	N23
Globigerinoides immaturus																							

Table 5. Analysis of Planktic Foraminifera Fossils on claystone lithology at the Tmpbl Unit

UMUR	**OLIGOSEN**			**MIOSEN**																**PLIOSEN**			**KUARTER**	
				Awal					**Tengah**						**Akhir**								
FORAMINIFERA PLANGTONIK	**N1**	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**N8**	**N9**	**N 10**	**N11**	**N12**	**N13**	**N14**	**N15**	**N16**	**N17**	**N18**	**N19**	**N20**	**N21**	**N22**	**N23**
Globigerinoides immaturus																							
Globigerinoides trilobus																							
Globorotalia tumida																							
Globigerina venezuelana																							
Globigerinoides ruber																							

Table 6. Analysis of Benthic Foraminifera Fossils on limestone lithology at the Tmpbl Unit.

Foraminifera Bentonik	**Transisi**	**Neritik**			**Batial**		**Abyssal**
		Dalam	**Tengah**	**Luar**	**Atas**	**Bawah**	**>4.000**
		20-50	**50-100**	**100-200**	**200-1.000**	**1.000-4.000**	
Heterolepa sp.							
Quinqueloculina sp.							

Table 7. Analysis of Planktic Foraminifera Fossils on claystone lithology at the Tmpblbp Unit.

Foraminifera Planktonik	**Oligosen**			**Miosen Awal**					**Miosen Tengah**						**Miosen Akhir**				**Pliosen**			**Kuater**	
	N1	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**N8**	**N9**	**N10**	**N11**	**N12**	**N13**	**N14**	**N15**	**N116**	**N17**	**N18**	**N19**	**N20**	**N21**	**N22**	**N23**
Trilobatus immaturus																							
Globigerinoides immaturus																							
Globorotalia crassaformis																							
Globorotalia mayeri																							
Globigerina triloculinoides																							
Globigerina praebulloides																							
Globorotalia scitula																							
Globigerina ampliapertura																							
Orbulina universa																							

Table 8. Analysis of Benthic Foraminifera Fossils on sandstones lithology at the Tmpblbp Unit.

Foraminifera Bentonik	**Transisi**	**Neritik**			**Batial**		**Abyssal**
		Dalam	**Tengah**	**Luar**	**Atas**	**Bawah**	**>4.000**
		20-50	**50-100**	**100-200**	**200-1.000**	**1.000-4.000**	
Lenticulina sp.							
Cibicides sp.							

Table 9. Analysis of Planktic Foraminifera Fossils on sandstone lithology at the Tmpblbp Unit.

Foraminifera Planktonik	Oligosen			Miosen Awal					Miosen Tengah						Miosen Akhir				Pliosen			Kuater	
	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N116	N17	N18	N19	N20	N21	N22	N23
Orbulina universa																							
Globigerina ampliapertura																							
Globigerinoides conglobatus																							
Globigerina boweri																							
Globigerina praebulloides																							
Globigerinoides immaturus																							
Globorotalia mayeri																							
Globigerina bulloides																							

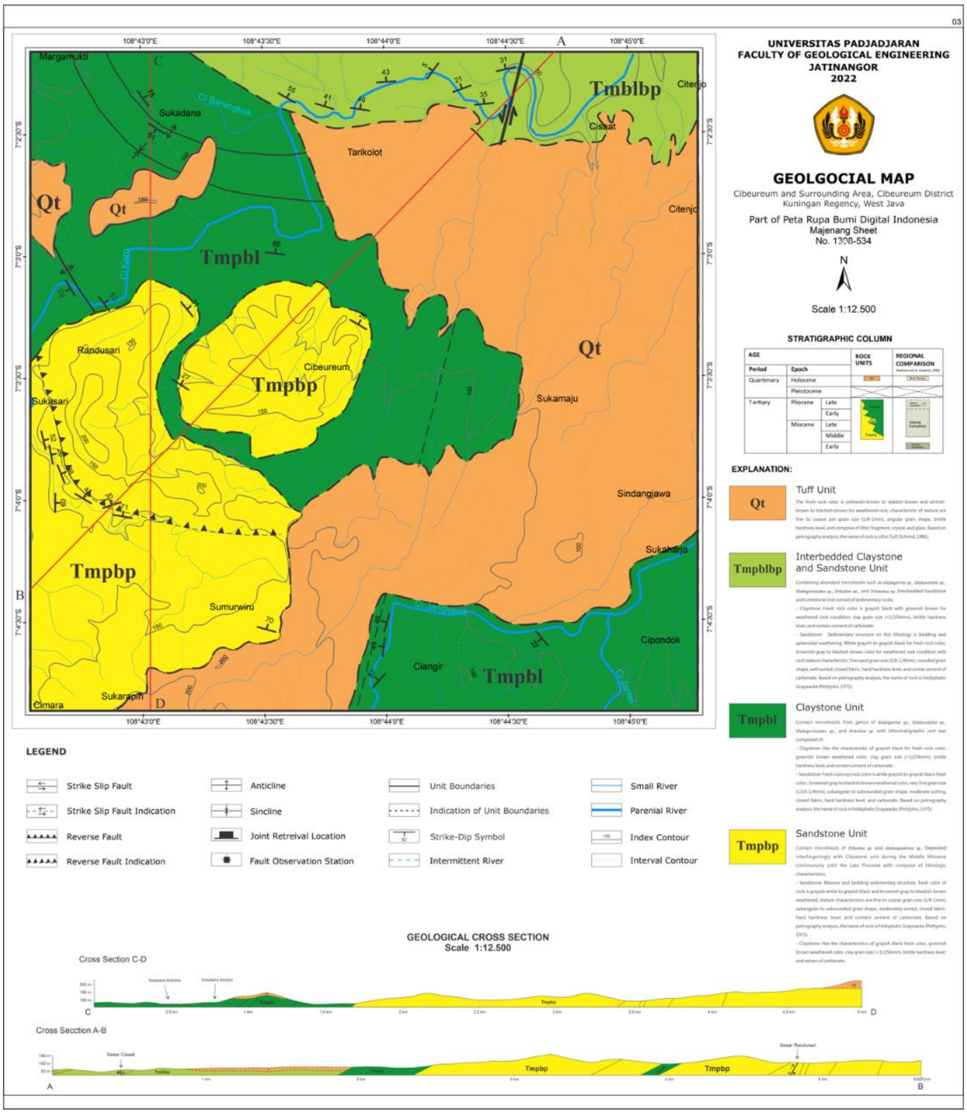


Figure 12. Geological Map of the study area.

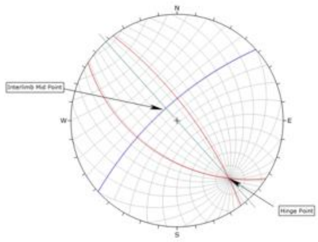
Structural Geology

Based on data obtained from field observations, the geological structure in the study area consists of two faults, one joint, two anticlines, and one syncline.

1. Sukadana Anticline

Located in the northwestern part of the study area which results in deformation of the claystone unit. Based on Fleuty's classification (1964), it could be classified as the *Close Moderately Plunging Gentle Fold.* (Table 11)

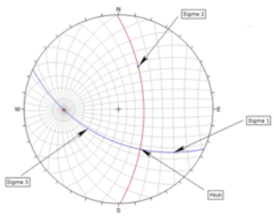
Table 11. Stereographic Projection of Sukadana Anticline.

Sukadana Anticline Stereography	Klasifikasi Lipatan (Fleuty, 1964)
	*Plunge* = *17* *Interlimb* = *56.20* *Dip of Axial Plane* = *76.09* ***Close Moderately Plunging Gentle Fold***

2. Randusari Anticline.

Found in the western part of the study area which results in deformation of the claystone unit. Based on Fleuty's classification (1964), it could be classified as the *Gentle Steeply Plunging Upright Fold.* (Table 12)

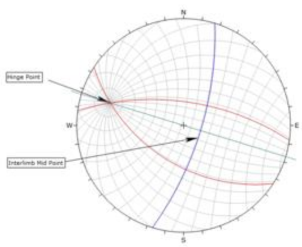
Table 12. Stereographic Projection of Randusari Anticline.

Randusari Fault Stereography	Klasifikasi Sesar (Rickard, 1972)
	*Strike/dip* = *359/60* *Pitch* = *46* - $\sigma 1$ = *128/16* - $\sigma 2$ = *24/37* - $\sigma 3$ = *237/47* ***Right Reverse Slip Fault***

3. Sukadana Sincline

Located in the northwestern part of the study area which results in deformation of the claystone unit and is a pair of The Sukada Anticline. Based on Fleuty's classification (1964), it could be classified as the *Close Moderately Plunging Gentle Fold.* (Table 13)

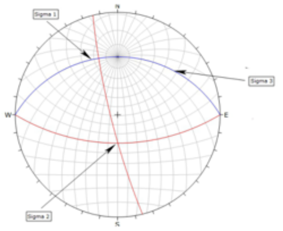
Table 13. Stereographic Projection of Sukadana Syncline.

Sukadana Syncline Stereography	Klasifikasi Lipatan (Fleuty, 1964)
	*Plunge* = *18* *Interlimb* = *67.23* *Dip of Axial Plane* = *82.39* ***Close Moderately Plunging Upright Fold***

4. Ciangir joint

This joint is found in the southern part of the study area recorded in sandstone lithology. Based on the results of the stereographic analysis, it indicates the formation of a horizontal fault (Table 14) (Anderson, 1951)., which could be corelated with the Cisaat Fault

Table 14. Stereographic Projection of Ciangir Joint.

<table>
<tr><th>Ciangir Joint Stereography</th><th>Klasifikasi Kekar (Anderson,1972)</th></tr>
<tr><td></td><td>Strike/Dip = N 359°E / 60°
Pitch = 46

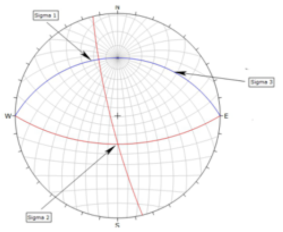
Trend / Plunge
- σ 1 = 334 / - σ1 = 28
- σ 2 = 179 / - σ2 = 59
- σ 3 = 51 / - σ3 = 60

Strike Slip Fault</td></tr>
</table>

5. Cisaat Fault

Slicken side was found in the northern part of the study area which is estimated to extend to the southern part, supported by the results of joint data processing, river flow patterns, and the direction of the strike and the slope of the rock layers. This fault intersects the Interbedded Claystone and Sandstone Unit. This fault reconstruction was carried out based on the collection of slicken side data in the northern part of the study area. Based on Rickard's classification (1972), this fault a *Left Slip Fault*. (Table 15)

Table 15. Stereographic Projection of Cisaat Fault.

<table>
<tr><th>Ciangir Joint Stereography</th><th>Klasifikasi Kekar (Anderson,1972)</th></tr>
<tr><td></td><td>Strike/Dip = N 359°E / 60°
Pitch = 46

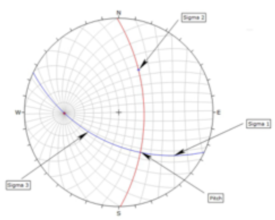
Trend / Plunge
- σ 1 = 334 / - σ1 = 28
- σ 2 = 179 / - σ2 = 59
- σ 3 = 51 / - σ3 = 60

Strike Slip Fault</td></tr>
</table>

6. Randusari fault

This fault is found in the western part of the study area. The evidence is supported by the results of joint data processing, river flow patterns, and the direction of the strike and the slope of the rock layers. This fault intersects The Sandstone Unit (Tmpbp). This fault reconstruction was carried out based on the collection of slicken slide data in the western part of the study area. Based on Rickard's classification (1972), this fault is a *Right Reverse Slip Fault*. (Table 16)

Table 16. Stereographic Projection of Randusari Fault.

<table>
<tr><th>Randusari Fault Stereography</th><th>Klasifikasi Sesar (Rickard, 1972)</th></tr>
<tr><td></td><td>Strike/dip = 359/60
Pitch = 46

- σ1 = 128/16
- σ2 = 24/37
- σ3 = 237/47

Right Reverse Slip Fault</td></tr>
</table>

Historical Geology

The geological history of the study area began during the Middle Meocene (N10) with the deposition of carbonate sedimentary material in the form of sand with strong currents and relatively high sedimentation energy to form sandstone units (Tmpbp). Occurs in the deep neritic bathymetry zone, which is characterized by the presence of Bolivina sp. fossils. and *Operculina sp.*

Furthermore, in the Middle Meocene (N12) when the process of deposition of sandstone units (Tmpbp) was still ongoing, sedimentary material dominated by clay was deposited again with strong currents and relatively lower sedimentation energy than before in the deep to middle neritic zone, marked by the discovery of fossils *Heterolepa s*p and *Quinquloculina sp* produce claystone units (Tmpbl).

Furthermore, during the Late Meocene to Early Pliocene (N16-N19), the process of deposition of sedimentary material again occurred with fluctuating depositional currents, and as a result, sedimentary material in the form of sand and clay was deposited to form interbedded claystone and sandstone (Tmblbp) units. This depositional process occurred in the outer neritic bathymetry zone with *Lenticulina* sp. As the characteristic fossils.

Meanwhile, the process of deposition of sedimentary material forming sandstone units (Tmpbp) and claystone (Tmpbl) continued simultaneously until the Late Pliocene (N21). The entire depositional process eventually forms interfinger contact with each other.

Furthermore, tectonic activity occurred in the form of the formation of the northeast-southwest trending Cisaat sinistral fault, which is the main structure in the study area. This fault intersects older units, namely interbedded claystone and sandstone. The formation of this fault was followed by the formation of other structures, namely the right-hand Randusari fault, the Sukadana anticline, and the Sukadana syncline.

Then, during the tertiary period, volcanic activity occurred, which led to the formation of volcanic tuff (Qt) deposits.

Geological Resources Potential

Several aspects of geological resources that were identified around the study area are plantation land, rice fields (Figure 13), and the excavation potential of sand material.

Figure 13. Rice field as the geological resource potential in the study area

Potential of sand material were found in the sandstone unit (Tmpbp) in the southwestern part of the study area, while the plantation and rice field sectors, distributed evenly, especially from the eastern part to the southern part, due to the favorable and strategic land that composed of volcanic material.

Geological Hazard Potential

The potential for geological hazard in the study area can take the form of landslides, volcanic eruptions, and earthquakes. Landslides are caused by the topography of the area, which usually consists of steep hills (Figure 14). Volcanic eruptions are possible when the Quaternary volcanoes in the vicinity of the study area show a very high level of activity, which endangers the surrounding environment. Meanwhile, the existence of a subduction zone in the southern part of the island of Java, namely the Indian Ocean, and quaternary volcanic activity affect earthquakes.

Figure 14. Landslide as the geological hazard potential in the study area

CONCLUSION

It can be concluded that the geological conditions of the Cibeureum area and its surroundings, Cibeureum District, Kuningan Regency, West Java Province.

1. The geomorphology of the study area is divided into four geomorphological units, namely the Volcanic Steep Hills Unit, the Structural Steep Hills Unit, Denudational Plains Unit, and Denudational Slightly Steep Low Hills Unit.
2. The rocks that make up the study area are grouped into four rock units, sorted from oldest to youngest, namely Sandstone Unit (Tmpbp), Claystone Unit (Tmpbl), Interbedded Claystone and Sandstone Unit (Tmpblbp), and Tuff unit (Qt).
3. The geological structures that develop in the study area consist of the Sukadana Anticline, Randusari Anticline, Sukadana Sincline, Ciangir Joint, Randusari Fault, and Cisaat Fault. Based on the results of stereographic analysis and classification according to Fleuty (1964), Rickard (1972), and Anderson (1972), the structures in the study area respectively are: *Close Moderately Plunging Gentle Fold, Gentle Steeply Plunging Upright Fold, Close Moderately Plunging Upright Fold, Reverse Right Slip Fault, and Lag Left Slip Fault.*
4. The geological history of the study area began with the formation of Sandstone Units (Tmpbp) in the inner neritic zone, then continued with the formation of claystone units (Tmpbl) in the inner to middle neritic zone and alternating claystone units (Tmpblbp) in the outer neritic zone at the same time period so as to form finger contacts. After that, a hiatus event occurred that is thought to have been filled with tectonic events that resulted in the formation of structures in the study area that were eventually covered with Tuff Unit (Qt) that were deposited most recently as a result of volcanism events in the study area.
5. There are several potentials in the research area based on several geological aspects. The research area is formed by fertile volcanic rocks, which makes this research area suitable for use as a plantation area and rice field. The research area also has several potential disasters, especially geological hazard such as earthquakes and landslides.

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