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Micropaleontological Analysis of the Stratigraphic Relationship between the Bentang Formation and the Halang Formation in Margajaya Village, Sukadana Sub-district, Ciamis Regency, West Java Province

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ABSTRAK

Formasi Halang dan Formasi Bentang yang tersingkap di daerah Margajaya, Kecamatan Sukadana, Kabupaten Ciamis, Jawa Barat, mencerminkan sistem pengendapan yang kontras di dalam Cekungan Busur-Belakang Bogor. Penelitian ini bertujuan untuk menganalisis hubungan stratigrafi antara kedua formasi tersebut menggunakan analisis mikropaleontologi foraminifera planktonik dan bentonik. Metode penelitian mencakup pengamatan lapangan, pengambilan sampel batuan, preparasi mikropaleontologi, dan identifikasi foraminifera. Penentuan umur relatif didasarkan pada *First Appearance Datum* (FAD) dan *Last Appearance Datum* (LAD) foraminifera planktonik mengikuti skema zonasi Blow (1969), sedangkan lingkungan pengendapan diinterpretasikan menggunakan batimetri foraminifera bentonik menurut Barker (1960). Hasil penelitian menunjukkan bahwa Formasi Halang diendapkan pada kala Miosen Tengah hingga Akhir (N14–N16) di lingkungan laut dalam zona batial atas dan dicirikan oleh endapan batupasir serta batulanau turbiditik. Sebaliknya, Formasi Bentang, yang didominasi oleh litologi batulempung, diendapkan pada kala Miosen Akhir (N16) di lingkungan laut dangkal zona neritik luar hingga tengah. Tumpang tindih umur relatif antara kedua formasi tersebut, dikombinasikan dengan lingkungan pengendapan yang kontras, mengindikasikan adanya transisi fasies lateral di dalam sistem cekungan. Kondisi ini menunjukkan kemungkinan adanya hubungan saling menjari (*interfingering*) antara Formasi Halang dan Formasi Bentang selama kala Miosen Akhir.

ABSTRACT

The Halang and Bentang Formations exposed in the Margajaya area, Sukadana District, Ciamis Regency, West Java, represent contrasting depositional systems within the Bogor Back-Arc Basin. This study aims to analyze the stratigraphic relationship between the two formations using planktonic and benthic foraminiferal micropaleontological analyses. The research methods included field observations, rock sampling, micropaleontological preparation, and foraminiferal identification. Relative age determination was based on the First Appearance Datum (FAD) and Last Appearance Datum (LAD) of planktonic foraminifera following the zonation scheme of Blow (1969), whereas depositional environments were interpreted using benthic foraminiferal bathymetry according to Barker (1960). The results indicate that the Halang Formation was deposited during the Middle–

Late Miocene (N14–N16) within an upper bathyal deep-marine environment and is characterized by turbiditic sandstone and siltstone deposits. In contrast, the Bentang Formation, which is dominated by claystone lithology, was deposited during the Late Miocene (N16) within outer to middle neritic shallow-marine settings. The overlap in relative age between the two formations, combined with contrasting depositional environments, suggests a lateral facies transition within the basin system. This condition indicates a possible interfingering relationship between the Halang and Bentang Formations during the Late Miocene.

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1. INTRODUCTION

The study area is administratively located in Margajaya Village, Sukadana District, Ciamis Regency, West Java, Indonesia. Regionally, the area belongs to the Bogor Zone, which forms part of the Bogor Back-Arc Basin, a sedimentary basin that developed as a result of the subduction of the Indo-Australian Plate beneath the Eurasian Plate from the Paleogene to the Neogene (Martodjojo, 1984). This tectonic activity controlled basin development, sedimentation, and structural deformation throughout western Java. The Bogor Basin evolved as a sedimentary basin dominated by deep-marine turbidite deposits during the Miocene, characterized submarine fan systems influenced by tectonic activity and volcaniclastic sediment supply.

The Bogor Basin consists of deep-marine to shallow-marine sedimentary successions that record both lateral and vertical facies variations in response to basin evolution and sea-level fluctuations during the Neogene. These sedimentary facies variations reflect complex depositional dynamics, particularly related to the development of turbidite deposits and shallow-marine shelf environments in West Java (Abdurrokhim et al., 2022)Based on the regional geological map of the Tasikmalaya Sheet, the study area is included within the physiographic zone of the Southern Mountains of West Java (Budhistrina, 1986). Two major stratigraphic units in the Bogor Basin are the Halang and Bentang formations. The Halang Formation consists mainly of interbedded turbiditic sandstone, siltstone, and claystone deposited in deep-marine, bathyal environments within active submarine fan systems during the Middle to Late Miocene. Sedimentary structures, including normal grading, parallel lamination, and Bouma sequences, indicate deposition by high-energy turbidity currents.

In contrast, the Bentang Formation developed as a shallow-marine sedimentary unit dominated by sandstone and claystone lithologies. The formation is interpreted to have been deposited within shelf environments characterized by suspension-dominated sedimentation and relatively lower-energy marine currents compared to those of the Halang Formation. Regionally, the Bentang Formation is Late Miocene in age and developed following the deep-marine sedimentation phase represented by the Halang Formation. Differences in lithological characteristics and

depositional environments between the Halang and Bentang Formations reflect sedimentary changes controlled by basin evolution, sea-level fluctuations, and sediment supply dynamics during the Neogene (Maharani & Idarwati, 2024). Although formed during broadly similar intervals, the stratigraphic relationship between the Halang and Bentang formations remains significant, particularly regarding lateral facies changes during basin evolution. Their overlapping ages and contrasting depositional environments suggest a transition from deep- to shallow-marine settings, potentially forming an interfingering relationship between Halang turbidites and Bentang shallow-marine deposits during the Late Miocene.

One of the most effective approaches for determining the relative age and depositional environment of sedimentary rocks is micropaleontological analysis using planktonic and benthic foraminifera. Biostratigraphic and micropaleontological analyses have been widely applied to determine relative age, depositional environments, and stratigraphic relationships of sedimentary units within the Bogor Basin (Rachman & Winantris, 2022). Planktonic foraminifera are characterized by rapid evolutionary rates and wide geographic distribution, making them reliable tools for biostratigraphic analysis based on the First Appearance Datum (FAD) and Last Appearance Datum (LAD) of index species according to the zonation scheme (Blow, 1967). In addition, benthic foraminifera are widely used for depositional environment and bathymetric interpretations because of their sensitivity to water-depth variations (Barker, 1960). This study aims to analyze the stratigraphic relationship between the Halang and Bentang Formations based on planktonic and benthic foraminiferal micropaleontological analyses. Specifically, the study focuses on determining the relative age of each formation, interpreting depositional environments, and evaluating the possibility of an interfingering facies relationship between the two formations in the Margajaya area, Sukadana District, Ciamis Regency, West Java, Indonesia.

One of the most effective approaches for determining the relative age and depositional environment of sedimentary rocks is micropaleontological analysis. Planktonic and benthic foraminifera provide important information regarding relative age and bathymetric conditions. Petrographic analysis also provides important information on mineral composition and microscopic characteristics of sedimentary rocks, which can support the interpretation of depositional and post-depositional processes (Gusti, 2026). The integration of paleontological and petrographic analyses can provide complementary evidence for interpreting depositional environments and the geological evolution of sedimentary successions (Yunizar et al., 2026). Therefore, the integration of micropaleontological and petrographic data can provide a more comprehensive basis for evaluating the stratigraphic relationship between the Halang and Bentang Formations.

2. METODE PENELITIAN

This study on the stratigraphic relationship between the Halang and Bentang Formations was conducted through field observations, rock sampling, micropaleontological preparation, and planktonic and benthic foraminiferal analyses to determine relative age, depositional environments, and sedimentary facies relationships between the two formations (Prabowo, 2020).

Field observations were conducted in the Margajaya area, Sukadana District, Ciamis Regency, West Java, to obtain geological data including lithological characteristics, sedimentary structures, stratigraphic relationships, and outcrop distribution. Rock samples were systematically collected based on stratigraphic succession from outcrops containing potential foraminiferal fossils. The samples consisted of sandstone and siltstone from the Halang Formation and claystone from the

Bentang Formation. Micropaleontological preparation was carried out to separate foraminiferal fossils from sedimentary material. Rock samples were crushed into small fragments and soaked for approximately 24 hours using a hydrogen peroxide (H_2O_2) and distilled water mixture with a ratio of 2:3 to accelerate sediment disintegration The samples were subsequently washed and sieved using graded sieves to obtain 50–100 mesh fractions, then dried at room temperature prior to the picking and identification processes).

Micropaleontological analysis was performed through picking and identification of planktonic and benthic foraminifera using a binocular microscope based on shell morphology and Neogene planktonic foraminiferal taxonomy. Relative age determination was conducted using the planktonic foraminiferal N-zone zonation of Blow (1969) based on the First Appearance Datum (FAD) and Last Appearance Datum (LAD) of index species. Depositional environment interpretation was conducted based on benthic foraminiferal assemblages and bathymetric distribution according to the ecological characteristics of benthic foraminifera. Bathymetric conditions were determined using the classification of Barker (1960) to interpret the depositional environments of the Halang and Bentang Formations and evaluate the sedimentary facies relationship between the two formations.

Petrographic analysis was conducted through thin-section preparation and polarized-light microscope observation to identify mineral composition and characterize the microscopic properties of sedimentary rocks (Gusti, 2026). Petrographic analysis was conducted to characterize the mineralogical composition, grain size, texture, matrix, cement, and microfabric of the sedimentary rocks through thin-section observations under a polarizing microscope. The analysis involved observations under plane-polarized light (PPL) and cross-polarized light (XPL) to identify individual mineral components and textural relationships within the rock. Petrographic observations included the identification of quartz, feldspar, lithic fragments, skeletal grains, opaque minerals, matrix, and cement, as well as the assessment of grain morphology, sorting, packing, and grain-to-matrix relationships. Thin-section petrography is useful for distinguishing lithological characteristics and evaluating variations in sediment composition that may reflect differences in sediment source and depositional processes (Pratomo et al., 2026). The integration of petrographic observations with micropaleontological data provides a more comprehensive basis for interpreting depositional environments and stratigraphic relationships in sedimentary successions (Al Ula et al., 2026).

3. HASIL DAN PEMBAHASAN

Based on field observations and laboratory analyses, the study area located in Margajaya Village, Sukadana District, Ciamis Regency, West Java Province, is composed of two main lithostratigraphic units, namely the Halang Formation and the Bentang Formation. The Halang Formation is characterized by sandstone and siltstone lithologies that exhibit typical deep-marine turbidite depositional features, whereas the Bentang Formation is predominantly composed of claystone deposited within a shallow-marine environment.

3.1 Halang Formation Sandstone Samples

The Halang Formation sandstone in the study area exhibits an incomplete Bouma sequence of Ta–Tb–Ta–Te, indicating deposition by turbidity currents within a submarine fan system. Megascopically, the sandstone is gray in fresh conditions and weathers to a brownish color. The rock is predominantly medium-grained sandstone, locally interbedded with fine- and coarse-grained sandstone layers, exhibiting sub-rounded grain morphology and relatively well-cemented

characteristics (Figure 1). Several outcrops display sedimentary structures including parallel bedding, parallel lamination, and spheroidal weathering structures.

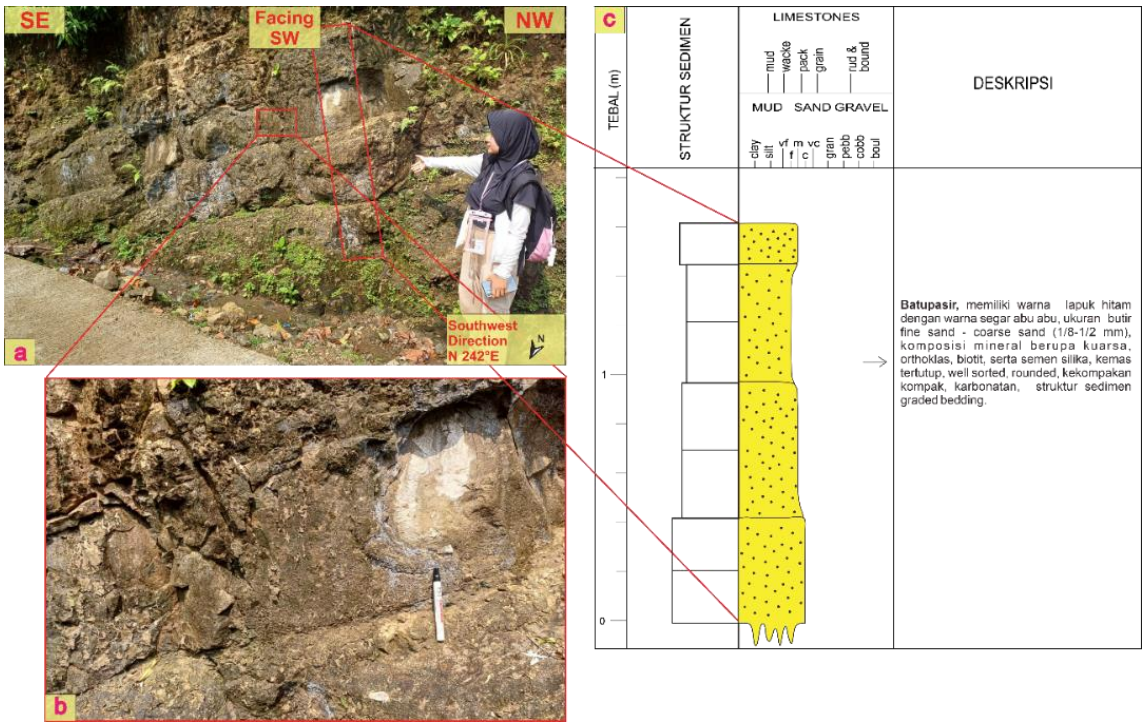


Figure 1. a) A Halang Formation sandstone outcrop in Margajaya Village, b) howing medium grain size (1/4–1/2 mm) and parallel bedding, c) A profile of the Halang Formation sandstone outcrop at Research Site 13.

Petrographic analysis reveals that the Halang Formation sandstone consists of grains ranging from 0.11 to 1.74 mm in size (very fine sand to very coarse sand). The rock is composed of quartz, plagioclase, orthoclase, lithic fragments, opaque minerals, and skeletal fragments embedded within a relatively abundant clay matrix. Texturally, the sandstone is characterized by poor sorting, matrix-supported fabric, and angular to sub-rounded grain shapes (Figure 2). According to the classification, the sandstone is classified as an *allochemic sandstone* (Mount, 1985).

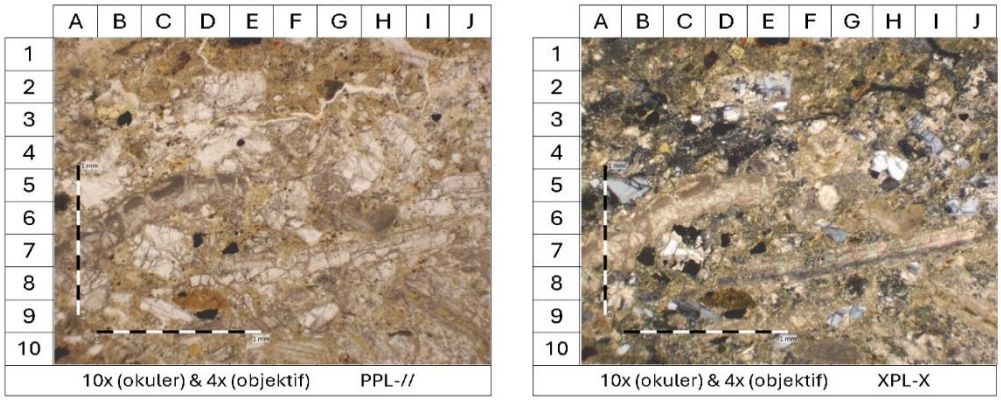


Figure 2. A thin section of the Halang Formation sandstone showing PPL and XPL features, with a mineral composition of skeletal grains (18%), micrite (14%), and fragments (33%), classified as Allochemic Sandstone according to Mount (1985)

Micropaleontological analysis identified several planktonic foraminiferal species, including (A) *Globigerinoides immaturus*, (B) *Sphaeroidinella subdehiscens*, (C) *Orbulina universa*, (D) *Globigerinoides bollii*, (E) *Hastigerina aequilateralis*, and (F) *Globigerinoides altiaperturus* (Figure 3). Based on the planktonic foraminiferal assemblage and the zonation scheme, the Halang Formation sandstone is assigned an age ranging from the Middle Miocene (N14) to the Late Miocene (N16), as illustrated in Table 1 (Blow, 1967).

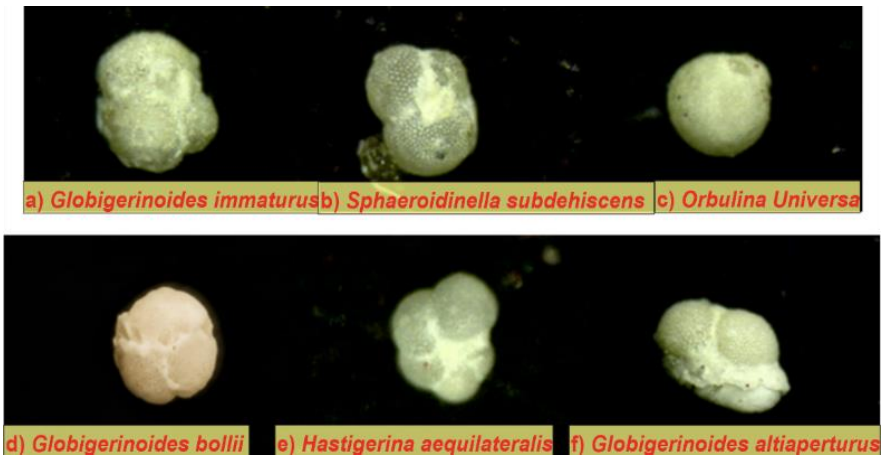


Figure 3. Planktonic foraminifera in samples from the Halang Formation sandstone

Table 1. The relative age of the Halang Formation sandstone is Middle Miocene (N14) to Late Miocene (N16)

Sample / Formation	: SSHL 13 / Tmph	Rock Type	: Sedimentary Rock
Location	: Margajaya Village	Age Range	: Middle Miocene - Late Miocene
Rock Name	: Allochemic sandstone	Analyzed by	: Felisha Myra Adelia

Age	Oligocene			Miocene														Pliocene	
	Late			Early					Middle						Late				
	e. 1 - 4			e.5					f.1		f.2		f.3			g		h	
Planktonic Foraminifera (Blow, 1969)	N1 P20	N2 P21	N3 P22	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19
Globigerinoides immaturus (C)																			
Sphaeroidinella subdehiscens (A)																			
Orbulina universa (A)																			
Globigerinoides bollii (A)																			
Hastigerina aequilateralis (A)																			
Globigerinoides altiaperturus (C)																			

In addition, benthic foraminiferal species identified from the samples include (A) *Parvicarinina altocamerata*, (B) *Planulina foveolata*, (C) *Otellina labyrinthica*, (D) *Spirophthalmidium acutimargo*, (E) *Hyperammina friabilis*, (F) *Carpenteria monticularis*, (G) *Alveolophragmium scitulum*, and (H) *Dentalina inornata* (Figure 4). Based on the benthic foraminiferal assemblage and environmental interpretation following Barker (1960), the Halang Formation sandstone was deposited in an Upper Bathyal environment at an estimated paleobathymetric depth ranging from 503 to 1,235 m as illustrated in Table 2 (Barker, 1960).



Figure 4. Benthic foraminifera in sandstone samples from the Halang Formation

Table 2. A bathymetric environment of the Halang Formation sandstone revealed the Upper Batial (503–1,235 m)

Sample / Formation	: SSHL 13 / Tmph	Rock Type	: Sedimentary Rock
Location	: Margajaya Village	Bathymetric Environment	: Middle Miocene - Late Miocene
Rock Name	: Allochemic sandstone	Analyzed by	: Felisha Myra Adelia

Bathymetric Environment, feet depth	Transitional	Neritic			Bathyal		Abyssal
		Inner	Middle	Outer	Upper	Lower	
Benthic Foraminifera (Barker, 1960)	0	20	100	200	500	2000	4000
Parvicarinina altocamerata (A) 275ft					•		
Planulina foveolata (A) 435ft					•		
Otellina labyrinthica (C) 440ft					•		
Spirophthalmidium acutimargo (R) 675ft					•		
Hyperammina friabilis (R) 542ft					•		
Carpenteria monticularis (C) 420ft					•		
Alveolophragmium scitulum (R) 542ft					•		
Dentalina inornata (R) 435ft					•		

3.2 Halang Formation Siltstone Samples

The Halang Formation siltstone in the study area exhibits *parallel bedding* sedimentary structures, indicating suspension-settling sedimentation within a deep-marine environment that remained influenced by turbidity-current activity in a submarine fan system. Megascopically, the siltstone is characterized by gray to dark brown coloration, silt-sized grains, a compact nature, and the presence of well-developed *parallel bedding* structures (Figure 5).

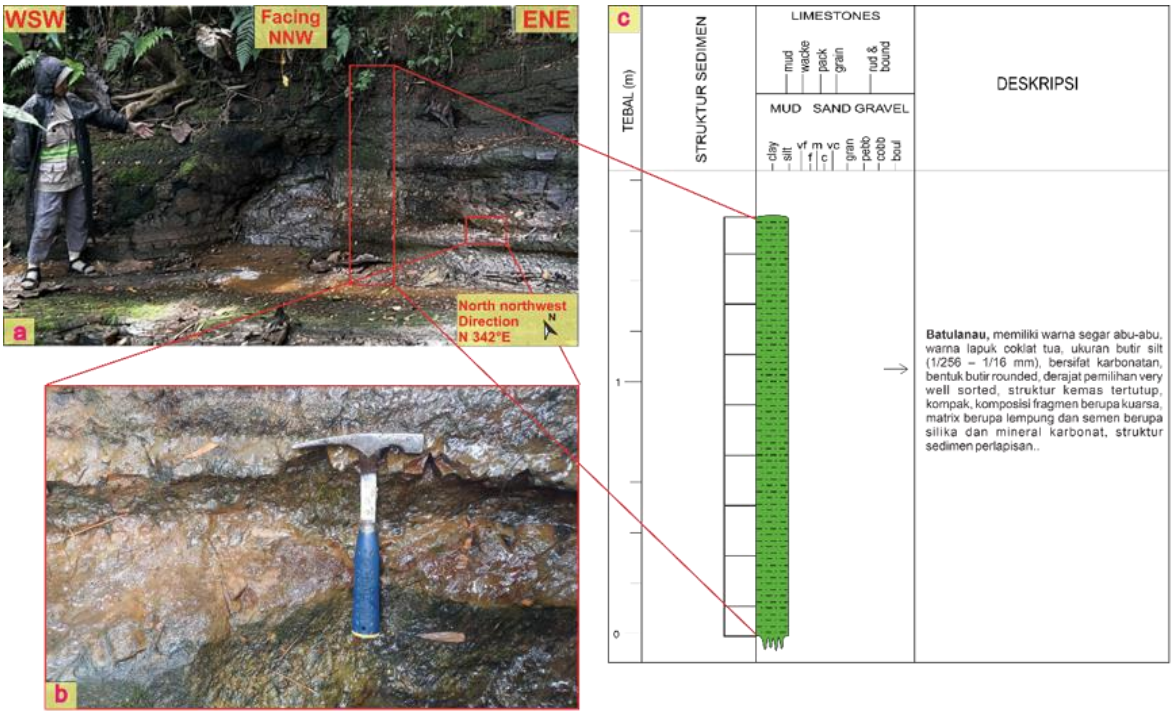


Figure 5. a) Siltstone outcrop of the Halang Formation in Margajaya Village, b) showing silt grain size (1/256 – 1/16 mm) and parallel bedding, c) A profile of the Batulanau outcrop of the Halang Formation at Research Site 67

Petrographic analysis indicates that the Halang Formation siltstone contains grains ranging from 0.08 to 0.37 mm in size (very fine sand to medium sand). The rock is composed of quartz, orthoclase, plagioclase, opaque minerals, and skeletal grains, embedded within a micritic matrix and clay cement. Texturally, the rock exhibits sub-rounded to rounded grain shapes, well-sorted grain distribution, and an open packing arrangement (*grain-supported fabric*) (Figure 6). According to the classification, this lithology is classified as an *allochemic sandstone* (Mount, 1985). Similar petrographic approaches have been applied to sedimentary rocks in West Java to characterize mineral composition, grain texture, matrix, cement, and lithic components, which can subsequently be related to variations in sediment provenance and depositional processes (Pratomo et al., 2026). Therefore, the petrographic characteristics of the Halang Formation sandstone, when integrated with its sedimentary structures and micropaleontological assemblage, provide complementary evidence for interpreting its deep-marine depositional setting.

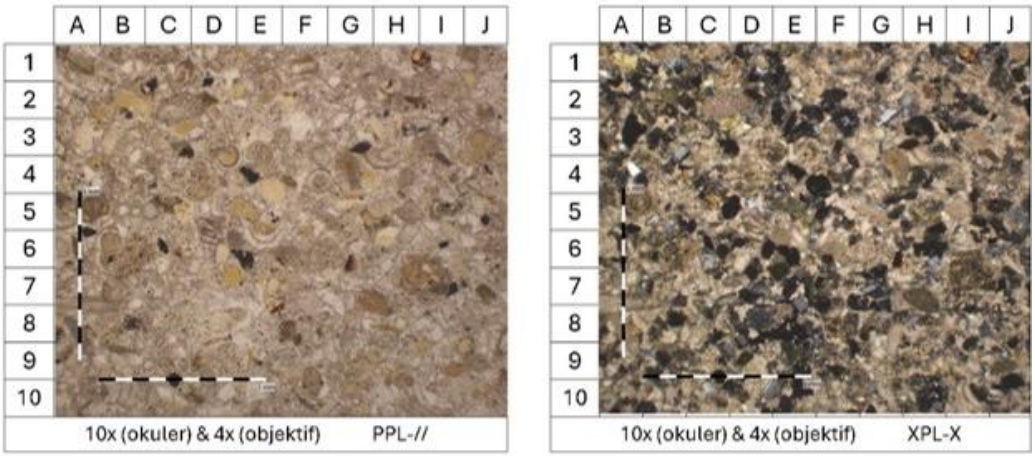


Figure 6. A thin section of the Batulanau Formation in the Halang Formation, showing PPL and XPL features, with a mineral composition of skeletal grains (13%), micrite (9%), and fragments (28%), classified as Allochemic Sandstone according to Mount (1985)

Micropaleontological analysis of the siltstone samples identified several planktonic foraminiferal species, including (A) *Globigerina praebulloides*, (B) *Globorotalia miocenica*, (C) *Globoquadrina altispira*, (D) *Orbulina bilobata*, (E) *Globigerina nepenthes*, and (F) *Hastigerina aequilateralis* (Figure 7). Based on the identified planktonic foraminiferal assemblage and the biostratigraphic zonation, the depositional age of the Halang Formation siltstone is interpreted to range from the Middle Miocene (N14) to the Late Miocene (N16), as illustrated in Figure 10 (Blow, 1967).

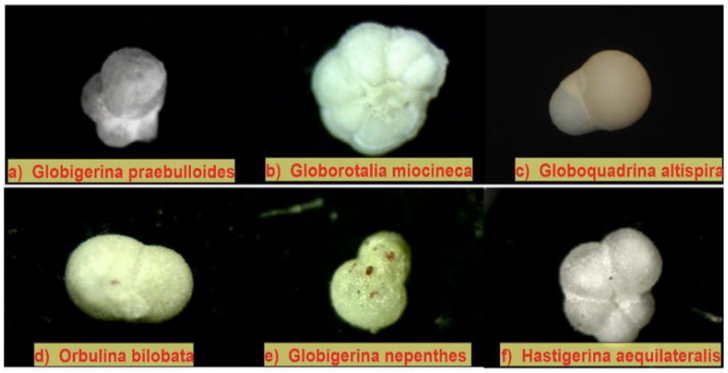


Figure 7. Foraminifera planktonik pada sampel Batulanau Formasi Halang

Table 3. The relative age of the Batulanau Member of the Halang Formation is Middle Miocene (N14) to Late Miocene (N16)

Sample / Formation	: LSHL 67 / Tmph	Rock Type	: Sedimentary Rock
Location	: Margajaya Village	Age Range	: Middle Miocene - Late Miocene
Rock Name	: Allochemic sandstone	Analyzed by	: Felisha Myra Adelia

Age	Oligocene			Miocene													Pliocene	
	Late			Early					Middle							Late		
	e. 1 - 4			e.5					f.1		f.2		f.3			g		h
Planktonic Foraminifera	N1	N2	N3	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
(Blow, 1969)	P20	P21	P22	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Globigerina praebulloides (A)																		



Furthermore, benthic foraminiferal species identified in the samples include (A) *Siphotextularia* sp., (B) *Siphonina bradyana*, (C) *Gyroidina broeckhiana*, (D) *Sigmoilopsis schlumbergeri*, (E) *Liebusella soldanii*, (F) *Gavelinopsis barleeanum*, and (G) *Hyperammina elongata* (Figure 8). Based on the benthic foraminiferal assemblage and paleoenvironmental interpretation following Barker (1960), the Halang Formation siltstone is interpreted to have been deposited in an Upper Bathyal environment with an estimated paleobathymetric depth ranging from approximately 713 to 1,152 m as illustrated in Table 4 (Barker, 1960).



Figure 8. Benthic foraminifera in the Batulanau sample from the Halang Formation

Table 4. A bathymetric environtment of the Batulanau area in the Halang Formation revealed the Upper Batial (713–1,152 m)

Sample / Formation	: LSHL 67 / Tmph	Rock Type	: Sedimentary Rock
Location	: Margajaya Village	Bathymetric Environment	: Middle Miocene - Late Miocene
Rock Name	: Allochemic sandstone	Analyzed by	: Felisha Myra Adelia

Bathymetric Environment, feet depth	Transitional	Neritic			Bathyal		Abyssal
		Inner	Middle	Outer	Upper	Lower	
Benthic Foraminifera (Barker, 1960)	0	20	100	200	500	2000	4000
Siphotextularia (R) 435ft					•		
Siphonina bradyana (A) 390ft					•		
Gyroidina broeckhiana (A) 580ft					•		
Sigmoilopsis schlumbergeri (C) 630ft					•		
Liebusella soldanii (C) 435ft					•		
Gavelinopsis barleeanum (A) 390ft					•		
Hyperammina elongata (A) 390ft					•		

3.3 Bentang Formation Claystone Samples

The Bentang Formation claystone in the study area generally exhibits bedding to massive structures, reflecting deposition by suspension settling within a shallow-marine shelf environment. Megascopically, the claystone is characterized by a gray color in fresh conditions and a brownish-

gray color when weathered. The rock consists predominantly of clay-sized particles, is relatively unconsolidated, carbonate-rich, and exhibits a matrix-supported fabric with well-sorted grains and distinct bedding structures (Figure 9).

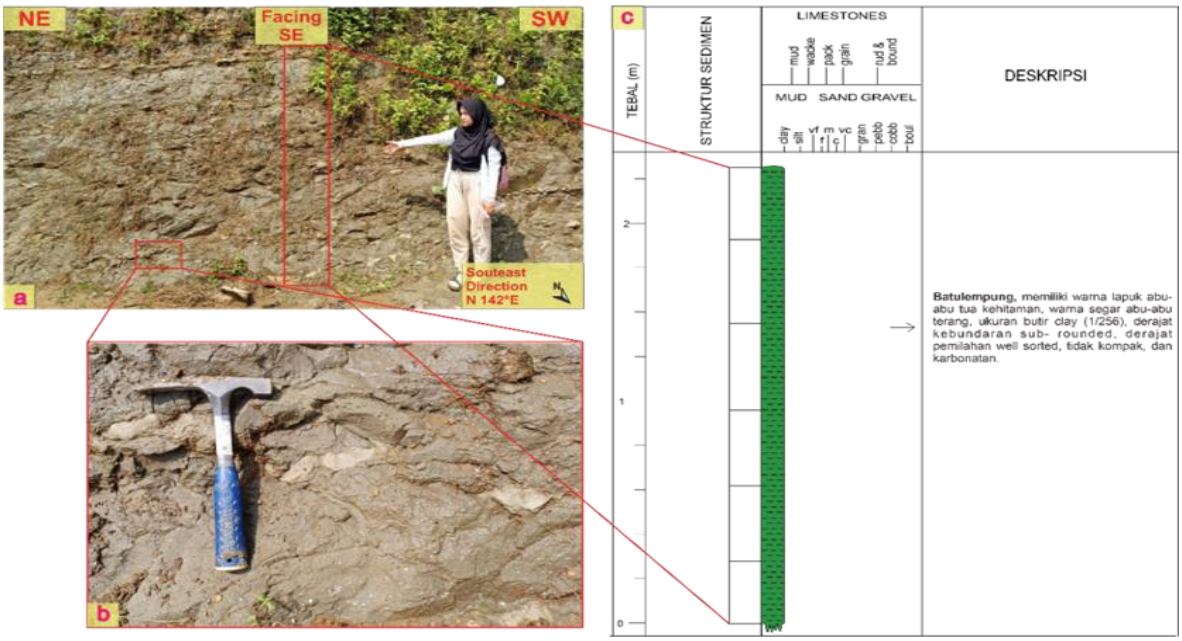


Figure 9. a) Bentang Formation claystone outcrop in Ciparay Village, b) view of the claystone showing clay grain size (<1/256 mm) and parallel bedding, c) A profile of the Bentang Formation claystone outcrop at Research Site 6

Petrographic analysis of the Bentang Formation claystone reveals a cream-colored appearance (PPL) and yellow interference colors (XPL). The rock contains grains ranging from 0.14 to 0.35 mm in size (fine sand to medium sand). Its composition includes quartz, orthoclase, plagioclase, opaque minerals, skeletal grains, and sericite, embedded within a microquartz matrix and cemented by clay minerals and sparite. Texturally, the rock exhibits sub-rounded to rounded grain shapes, well-sorted grain distribution, and a matrix-supported fabric (Figure 10). Based on the sandstone classification, the lithology is classified as a *calcareous feldspathic wacke* (Pettijohn, 1975).

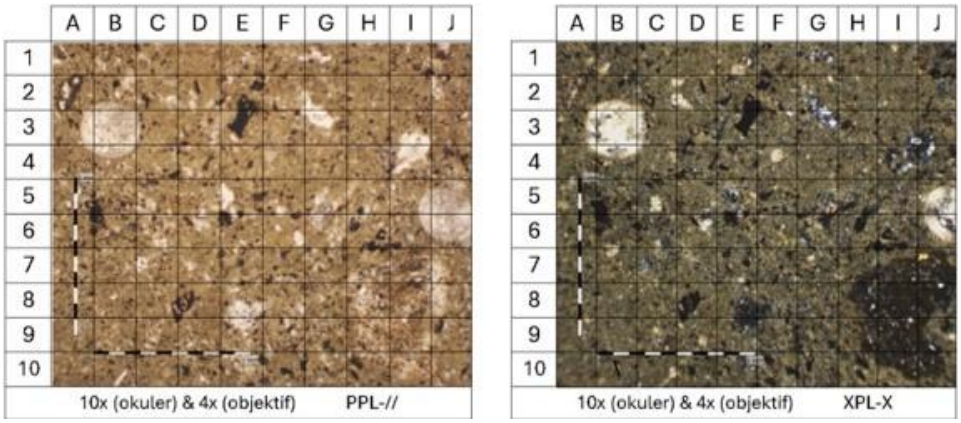


Figure 10. A thin section of the Bentang Formation's Batulempung Member showing PPL and XPL images, with a mineral composition of quartz (15%), lithic material (21%), skeletal grains (5%), and feldspar (4%), which falls under the Calcareous Feldspathic Wacke (Pettijohn,1975)

Micropaleontological analysis of the claystone samples identified several planktonic foraminiferal species, including (A) *Globigerinoides ruber*, (B) *Globoquadrina dehiscens*, (C) *Globigerinoides immaturus*, (D) *Orbulina bilobata*, and (E) *Orbulina universa* (Figure 11). Based on the identified planktonic foraminiferal assemblage and the biostratigraphic zonation, the Bentang Formation claystone is assigned to the Late Miocene (N16), as shown in Table 5 (Blow, 1967).

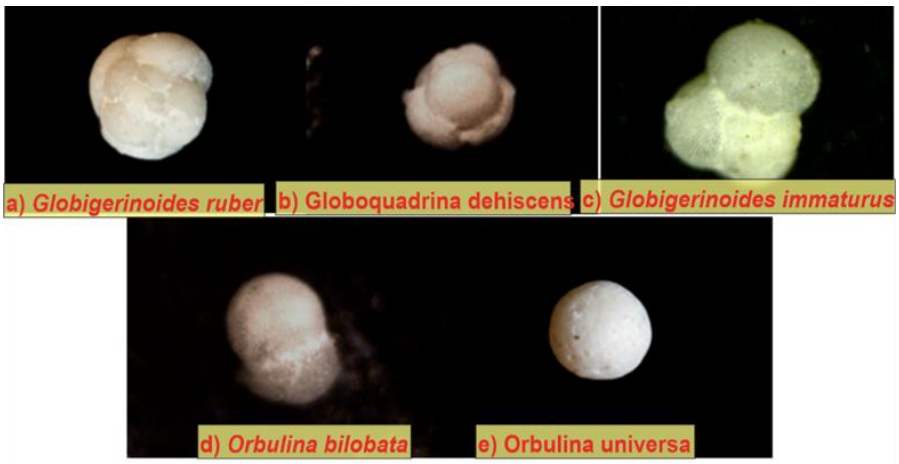


Figure 11. Planktonic foraminifera in the Batulempung sample from the Bentang Formation

Table 5. The relative age of the Batulempung Member of the Bentang Formation is Late Miocene (N16)

Sample / Formation	: CSBF 6 / Tmpb	Rock Type	: Sedimentary Rock
Location	: Ciparay Village	Age Range	: Late Miocene
Rock Name	: *Calcareous Feldspathic Wacke*	Analyzed by	: Felisha Myra Adelia

Age	Oligocene			Miocene														Pliocene	
	Late			Early				Middle							Late				
	e. 1 - 4			e.5				f.1		f.2		f.3			g			h	
Planktonic Foraminifera	N1	N2	N3	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
(Blow, 1969)	P20	P21	P22	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Globigerinoides ruber (A)																			
Globoquadrina dehiscens (A)																			
Globigerinoides immaturus (R)																			
Orbulina bilobata (C)																			
Orbulina universa (A)																			

In addition, the benthic foraminiferal assemblage consists of (A) *Amphistegina quoyii*, (B) *Eponides repandus*, (C) *Tubinella inornata*, (D) *Patellina corrugata*, (E) *Virgulina pauciloculata*, (F) *Amphistegina lessonii*, and (G) *Bigenerina nodosaria* (Figure 12). Based on the benthic foraminiferal association and paleoenvironmental interpretation, the Bentang Formation claystone is interpreted to have been deposited in an Outer Neritic environment with an estimated paleobathymetric depth ranging from approximately 29 to 164 m as illustrated in Table 6 (Barker, 1960).



Figure 12. Benthic foraminifera in the Batulempung sample from the Bentang Formation

Table 6. The bathymetric environtment of the Batulempung Formation in the Bentang area shows the Neritic Margin – Neritic Center (29–164 m)

Sample / Formation	: LSHL 67 / Tmph	Rock Type	: Sedimentary Rock
Location	: Margajaya Village	Bathymetric Environment	: Middle Miocene - Late Miocene
Rock Name	: Allochemic sandstone	Analyzed by	: Felisha Myra Adelia

Bathymetric Environment, feet depth	Transitional	Neritic		Bathyal			Abyssal
		Inner	Middle	Outer	Upper	Lower	
Benthic Foraminifera (Barker, 1960)	0	20	100	200	500	2000	4000
Amphistegina quoyii (A) 16-25ft							
Eponides repandus (C) 45-60ft							
Tubinella inornata (C) 20-60ft							
Patellina corrugata (A) 38-40ft							
Virgulina pauciloculata (R) 37ft							
Amphistegina lessonii (C) 16-25ft							
Bigenerina nodosaria (A) 90ft							

Micropaleontological analysis indicates that the Halang Formation ranges in age from the Middle to Late Miocene (N14–N16). This age interpretation is based on planktonic foraminiferal assemblages identified from sandstone and siltstone samples, including Globigerinoides immaturus, Sphaeroidinella subdehiscens, Orbulina universa, Globigerinoides bollii, Hastigerina aequilateralis, Globorotalia miocenica, Globoquadrina altispira, and Globigerina nepenthes. Benthic foraminiferal assemblages from the Halang Formation indicate an upper bathyal depositional environment, with estimated paleobathymetric ranges of approximately 503–1,235 m in the sandstone samples and 713–1,152 m in the siltstone samples. These data support the interpretation that the Halang Formation in the study area represents deep-marine deposits developed within a turbidite system, particularly in a submarine fan setting (Figure 13).

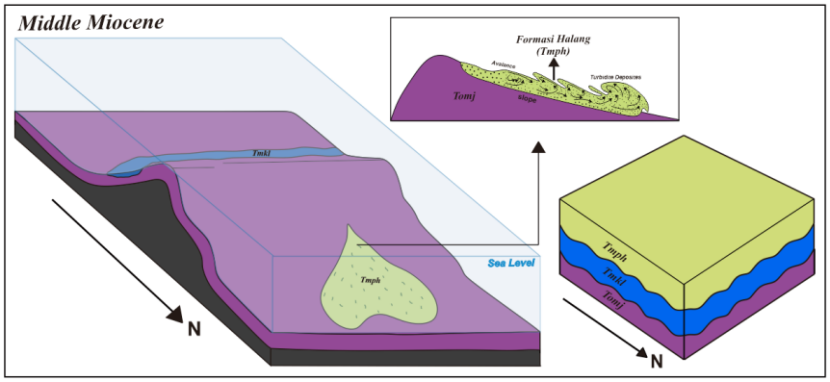


Figure 13 Depositional Model of the Halang Formation during the Middle Miocene

In contrast, the Bentang Formation is assigned to the Late Miocene (N16) based on planktonic foraminifera such as Globigerinoides ruber, Globoquadrina dehiscens, Globigerinoides immaturus, Orbulina bilobata, and Orbulina universa. Its benthic foraminiferal assemblage, including Amphistegina quoyii, Eponides repandus, Patellina corrugata, Amphistegina lessonii, and Bigenerina nodosaria, indicates an outer to middle neritic depositional environment with an estimated depth range of approximately 29–164 m. The shared relative age within the N16 zone between the Halang and Bentang Formations, together with their contrasting depositional environments, demonstrates a lateral sedimentary facies transition from deep-marine to shallow-marine systems. Based on the age relationship and bathymetric contrast, the Halang and Bentang Formations are interpreted to form an interfingering stratigraphic relationship, representing a lateral linkage between deep-marine turbiditic deposits and shallow-marine deposits during the Late Miocene.

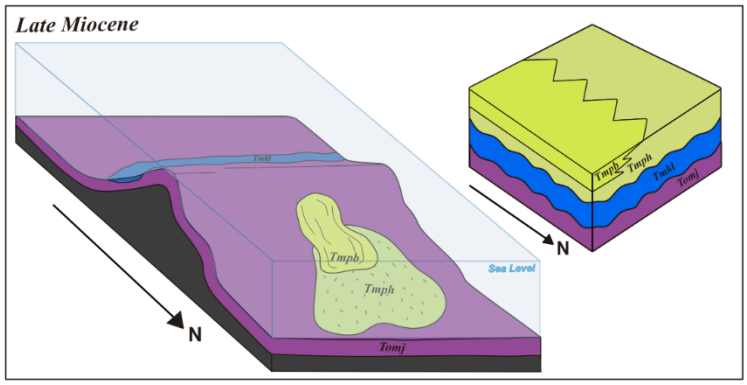


Figure 14. Interfingering Model between the Halang Formation and the Bentang Formation during the Late Miocene

In contrast, the Bentang Formation is assigned to the Late Miocene (N16) based on planktonic foraminifera such as Globigerinoides ruber, Globoquadrina dehiscens, Globigerinoides immaturus, Orbulina bilobata, and Orbulina universa. Its benthic foraminiferal assemblage, including Amphistegina quoyii, Eponides repandus, Patellina corrugata, Amphistegina lessonii, and Bigenerina nodosaria, indicates an outer to middle neritic depositional environment with an estimated depth range of approximately 29–164 m. The shared relative age within the N16 zone between the Halang and Bentang Formations, together with their contrasting depositional

environments, demonstrates a lateral sedimentary facies transition from deep-marine to shallow-marine systems. Based on the age relationship and bathymetric contrast, the Halang and Bentang Formations are interpreted to form an interfingering stratigraphic relationship, representing a lateral linkage between deep-marine turbiditic deposits and shallow-marine deposits during the Late Miocene.

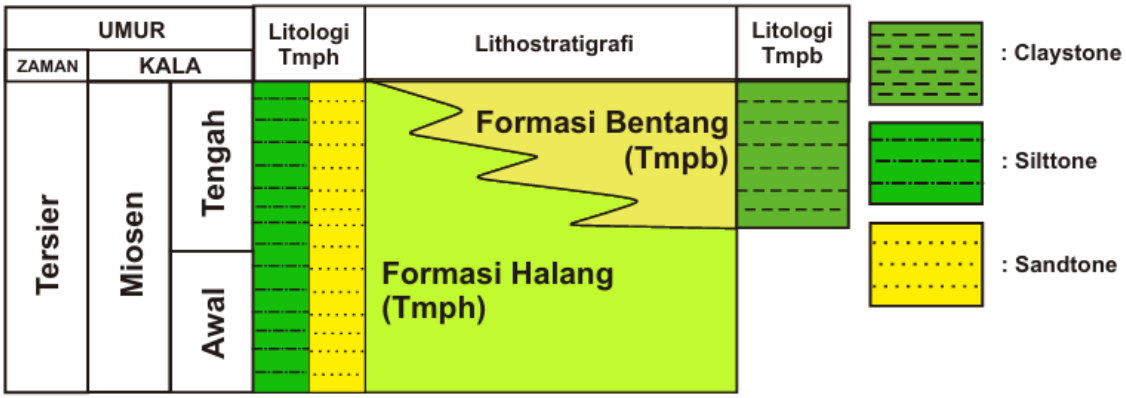


Figure 15. Stratigraphic relationship between the Halang Formation and the Bentang Formation in the Margajaya area, Ciamis, West Java

4. CONCLUSION

The study conducted in Margajaya Village, Sukadana District, Ciamis Regency, West Java Province, demonstrates that the Halang Formation consists of sandstone and siltstone deposited in an upper bathyal deep-marine environment, whereas the Bentang Formation is dominated by calcareous claystone deposited in a shallow-marine shelf setting. Planktonic foraminiferal analysis indicates that the Halang Formation was deposited during the Middle to Late Miocene (N14–N16), while the Bentang Formation was deposited during the Late Miocene (N16). Benthic foraminiferal assemblages further confirm that the Halang Formation accumulated in an upper bathyal setting, whereas the Bentang Formation developed within outer to middle neritic environments.

During the Late Miocene, the turbidite depositional system of the Halang Formation remained active while sedimentation of the Bentang Formation developed in a shallower marine setting. The shared relative age interval within the N16 zone and contrasting bathymetric conditions indicate an interfingering stratigraphic relationship between both formations, reflecting a lateral facies transition from deep-marine turbiditic deposits to shallow-marine deposits.

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