

Paleoenvironment of Limestone Based on Foraminifera Content of Ako Area, Pasangkayu Regency, West Sulawesi Province

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ABSTRACT

Introduction: In the marine environment there are types of Protista called foraminifera which are divided into 2 (two) which are called planktonic foraminifera and benthonic foraminifera, where planktonic foraminifera live by being anchored in mud or sediment. **Method:** The abundance of fossil planktonic foraminifera and benthonic foraminifera in the Ako area is very diverse, namely: 192 species of planktonic foraminifera and 381 species of benthonic foraminifera. **Results and Discussion:** The living environment of foraminifera in the study area is in the middle neritic zone with a depth of 30-100 m, where sunlight can still penetrate so that nutrients and oxygen for foraminifera are very sufficient. Salinity varies between 30-40‰ and temperature is divided into hot and warm climates. In hot climates, planktonic foraminifera such as *Globorotalia Tumida* and *Globorotalia Menardii* are found, while in warm climates *Orbulina bilobata* and *Globorotalia Dutertrei* are found. Benthonic foraminifera living at this depth include *Cibicides Wuellerstorfi* and *Lenticulina orbicularis*. Changes in the marine environment in the middle neritic zone are influenced by strong wave dynamics, as well as sea level fluctuations that cause regression and transgression, lifting sedimentary rocks to the surface. **Conclusion:** The foraminifera fossils in the Ako area are highly diverse, with 192 species of planktonic foraminifera and 330 species of benthonic foraminifera. The shells of foraminifera in this area are relatively large because nutrients from sunlight are abundant. Its paleoenvironment is in the middle neritic zone with a depth of 30-200 m, salinity of 3-30‰, and temperature divided into hot and warm climates. Changes in the marine environment in this zone are influenced by sea level fluctuations that cause a decrease (regression) and increase (transgression) of sea level, as well as the removal of sedimentary rocks to the surface.

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1. Introduction

Microorganisms are a branch of science that discusses organisms often referred to as microfossils. Microfossils generally have a very small size so that they cannot be seen with the naked eye. microfossils can only be seen with a microscope [1]. In the marine environment, there is a type of Protista called foraminifera which is divided into 2 (two) namely planktonic and benthonic foraminifera, where planktonic foraminifera live by floating while benthonic foraminifera live by tethered in mud or sediment. In analyzing the environment based on fossil content in the study area

using several ancient environmental parameters, namely: the number of planktonic and benthonic individuals, the total number of benthonic foraminifera species, the percentage of planktonic and benthonic foraminifera [2]. The content of calcium carbonate in seawater is a function of parameters, salinity, and pressure where the lower the pressure, and the higher the temperature and salinity, it will increase the solution of calcium carbonate. Generally, the composition of the shell wall of planktonic and benthonic foraminifera is clay [3].

2. Reserch Method

The research location was in Ako village, Pasangkayu sub-district, North Mamuju district, West Sulawesi province. Geographically, the research area is located at $119^{\circ}23'00''$ - $119^{\circ}25'00''$ East longitude and $1^{\circ}8'00''$ - $1^{\circ}11'00''$ South latitude [4]. The study area is about ± 34 km². The study area can be reached by using land routes from the city of Palu to Ako village using two-wheeled vehicles for ± 3 hours. (Figure 1)



Fig 1. Point Map Of Observation Location

Equipment and Materials

Tools and materials used during the research activities are a geological map of Pasangkayu sheet 1:250,000 scale published by the Center for Geological Research and Development in 1991, a topographic map 1:250,000 scale which is the result of the magnification of the map of Pasangkayu sheet 2014 1:50,000 scale. Global positioning (GPS) to know the coordinate points in the field, geological compass as a rock position measurement tool, structural measurement tool, slope angle measurement tool and cardinal direction determinant, magnifier used for $25 \times$ as a tool for megascopic mineral observation, field notebook where field data is stored, digital camera to take pictures of outcrops and geological conditions, HCL solution (0.1 m) as a tool to test carbonate content in rocks.

Tape meter, and roll meter as a tool to measure the length of layer thickness and outcrop length [5,6]. Sample bags are used as containers for storing samples, and writing utensils as a compliment to record field data, bows, and rulers as tools for outlining and measuring angles, backing boards are used as compass base aids, and field backpacks to store all equipment used in the field.

3. Results and Discussion

The outcrop in the research area is oriented N76°E with a slope of 32°. The length of the outcrop in the research area is ± 21.2 m.



Fig 2. Outcrop Appearance Of The Ako Area

The lithology found in the study area is composed of mudstone, siltstone, and sandstone [7,8,9]. Blackish gray claystone, grain size 1/256-1/16 mm. brownish gray siltstone with grain size 1/16-1/18 mm. brownish white sandstone grain size 1/8-1/12 mm.

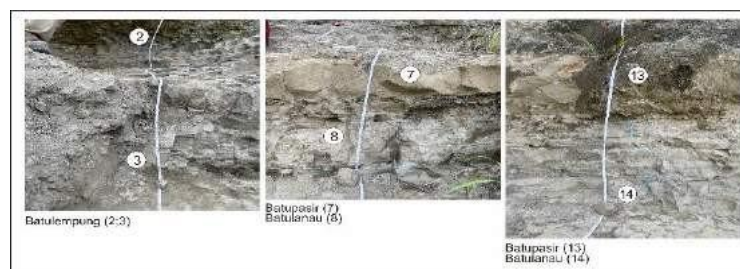


Fig 3. The Lithologic Appearance Of The Ako Area

Abundance of Planktonic and Benthonic Fossil Foraminifera

The abundance of benthonic foraminifera fossils in the study area increased with a total of (330) species with the largest abundance of all layers being *Lenticulina orbicularis* (D`ORBIGNY), while the smallest were, *Cibicidoides subhadengerii* (PARR), *Cibicidoides Incrassatus* (FICHTEL and MOLL), *Quinqueloculina lamarckiana* (D`ORBIGNY), *Hanzawaia Mantaensis* (GALLOWAY and MORREY), *Cibicides wuellerstorfi* (SCHWAGER), *Triloculina tricarinata* (D`ORBIGNY), *Triloculina trigonula* (LAMARCK), *Quinqueloculina Seminula* (LINNAEUS), *Pyrgo serrate* (BAYLEY), *Globulina myristiformis* (WILLIAMSON), *Amphicoryna Scalaris* (BATCH), *Bulimina Alazanesis* (CUSHMAN), *Dentalina extensa* (ZHENG and ZHANG), and *Nadosaria* (LAMARCK).



Fig 4. Benthonic Foraminifera species

Table 1. Benthonic Foraminifera Fossil Abundance Tier

No	Spesies	Turus Foraminifera Bentonik Ako																Total (%)	Kelimpahan											
		2	3	5	8	11	16A	16B	16C	18A	18B	19	20	22A	22B	23	24A			24B	24C	25	28	29A	29B	31	33A	33B	35	
1	<i>Cibicides wuellerstorfi</i> (SCHWAGER)																											3,03	Cukup	
2	<i>Cibicoides incrassatus</i> (FICHEL dan MOLL)						1	2	5	1	9	12	3			9	4	2	1	1								17,27	Banyak	
3	<i>Cibicoides subhaidergii</i> (PARR)	1	2	1	2	1	3		2	1	6	7	12	1	1	7	1	1							4	3	1	2	17,88	Banyak
4	<i>Lenticulina orbicularis</i> (D'ORBIGNY)				4		8		9	8	14	11	3	2	1	8	5		9	1				2	1	7	2	6	32,12	Banyak
5	<i>Hanzawaia mantaensis</i> (GALLOWAY dan MORREY)										2	4	4			3	1											4,85	Cukup	
6	<i>Trilaculina tricarinata</i> (D'ORBIGNY)											1	1			7								1				3,03	Cukup	
7	<i>Trilaculina trigonula</i> (LAMARCK)				1						1	2			6													3,03	Cukup	
8	<i>Quinqueloculina lamarckiana</i> (D'ORBIGNY)						1				1	10	3	1	1	9	1		1	1				2	1			9,70	Banyak	
9	<i>Quinqueloculina seminula</i> (LINNAEUS)				1	2					1	1							1	1	1						1	2,73	Cukup	
10	<i>Pyrgo serrata</i> (BAILEY)									1																		0,91	Sedikit	
11	<i>Globulina myristiformis</i> (WILLIAMSON)	1	1	1																								0,91	Sedikit	
12	<i>Amphicoryna scalaris</i> (BATSCH)											1	1															0,61	Sedikit	
13	<i>Bulimina alazanensis</i> (CUSHMAN)											1	1															0,61	Sedikit	
14	<i>Dentalina extensa</i> (ZHENG DAN ZHANG)								1			3	3			1	1	1										3,03	Cukup	
15	<i>Nodosaria</i> (LAMARCK)											1																0,30	Sedikit	

The largest abundance of Planktonic Foraminifera in all layers was *Globorotalia Tumida* (BRADY). while the smallest were: *Globigerinoides immaturus* (LEROY), *Globorotalia crassaformis* (GALLOWAY and WIESLER), *Orbulina universa* (D'ORBIGNY), *Globorotalia menardi* (BOLLI), *Orbulina bilobata* (D'ORBIGNY), *Sphaerodinella subdehiscens* (BLOW), *Globorotalia dutertrei* (D'ORBIGNY), *Globigerinoides sacculiferus* (BRADY).

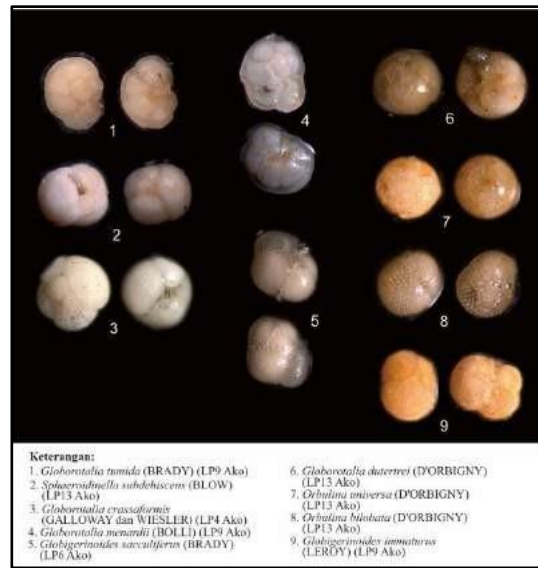


Fig.5 Species of Planktonic Foraminifera

Table 2. Tourus of Planktonic Foraminifera Fossil Abundance

		Turus Kelimpahan Foraminifera Planktonik Ako																				
No	Spesies	Lapisan																				
		5	8	16A	16B	16C	18A	18B	19	20	22A	22B	23	24A	24B	24C	25	29A	29B	31	33A	
1	<i>Globigerinoides sacculiferus</i> (BRADY)													1	1	1	1					
2	<i>Globigerinoides immaturus</i> (LEROY)				2	6	2	9	11	9			2	1	1							1
3	<i>Globorotalia tumida</i> (BRADY)	1						1	4	14	17	1	2	6	1	1	1	2	1	1		
4	<i>Globorotalia menardii</i> (BOLLI)	1		3	1	1				4	3			2	2	1						
5	<i>Globorotalia dutertrei</i> (D'ORBIGNY)								1	1	3											
6	<i>Globorotalia crassaformis</i> (GALLOWAY dan WIESLER)								2	11	6			1	1	2	2		1	1		
7	<i>Orbulina bilobata</i> (D'ORBIGNY)		1						1	1	1										1	
8	<i>Orbulina universa</i> (D'ORBIGNY)		1		1	2	1	1	3	10	1	1	1	1							1	1
9	<i>Sphaeroidinella subdehiscens</i> (BLOW)				1			1	2				1									

Paleoenvironment of the Ako Region

The living environment of foraminifera in the study area is included in the *middle* Neritic zone or (*middle shelf*) at a depth of 30-100m. Foraminifera that live at these depths have a relatively large shell shape due to sunlight that can penetrate these depths so the nutrients obtained by foraminifera at this depth are very sufficient. The oxygen needed by foraminifera is also very good. Salinity is quite varied, but still in (normal marine) which is around 30-40%. Temperature or climate at this depth is divided into 2 (two) climates, namely hot climate and warm climate. The hot climate of planktonic foraminifera encountered are *Globorotalia Tumida* (BRADY), *Globorotalia Menardii* (BOLLI), *Globigerinoides immaturus* (LEROY), and *Globigerinoides Sacculiferus* (BRADY). As for the warm climate planktonic foraminifera encountered are: *Orbulina bilobata* (D'ORBIGNY), *Globorotalia Dutertrei* (D'ORBIGNY), *Orbulina universa* (D'ORBIGNY), *Globorotalia crassaformis* and (GALLOWAY and WIESLER). Benthonic foraminifera that live at this depth are: *Cibicides Wuellerstorfi* (SCHWAGER), *Cibicidoides Incrassatus* (FICHTEL and MOLL), *Cibicidoides*

Subhaidingerii (PARR), *Lenticulina orbicularis* (D'ORBIGNY), *Hanzawaia mantaensis* (GALLOWAY and MORREY), *Triloculina tricarinata* (D'ORBIGNY), *Triloculina trigonula* (LAMARCK), *Quinqueloculina lamarckiana* (D'ORBIGNY), *Quinqueloculina seminula* (LINNAEUS), *Pyrgo serrata* (BAILEY), *Globulina myristiformis* (WILLIAMSON), *Amphicoryna scalaris* (BATSCH), *Bulimina alazanensis* (CUSHMAN), *Dentalina extensa* (ZHENG AND ZHANG), and *Nodosaria* (LAMARCK).

Changes in the marine environment in the middle Neritik or (middle shelf) at a depth of 30-100 m, where wave dynamics are quite dynamic the closer to the sea surface the dynamics of ocean waves are getting stronger. After sedimentary rocks are deposited, changes occur due to basin conditions that are controlled by fluctuations in sea level, causing a decrease in sea level (regression), and a slow rise in sea level to land (transgression) and causing the removal of sedimentary rocks to the surface.

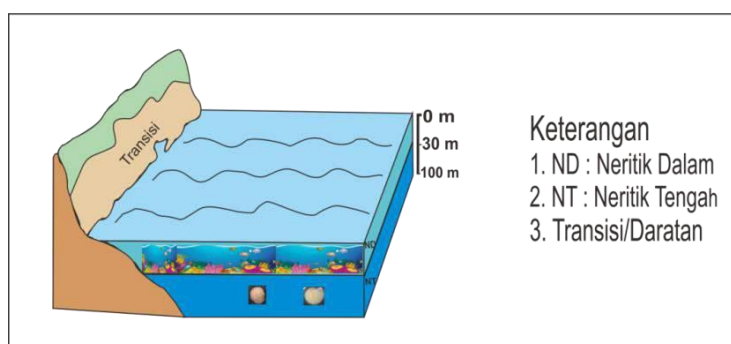


Fig 6. Marine environment

4. Conclusion

Based on the previous discussion, it can be concluded that the abundance of planktonic and benthonic foraminifera fossils in the Ako area is very diverse, ranging from 192 species of planktonic foraminifera, and 330 species of benthonic foraminifera. The characteristics of foraminifera in the study area have a relatively large shell shape because the nutrients sourced from sunlight are obtained by foraminifera very well. Paleoenvironment foraminifera research area into the Middle neritic zone or middle shelf 30-200 m. Salinity at this depth still varies but is still included in the normal marine range between 3-30%. Temperature or climate at this depth is divided into 2 climates, namely hot climate and warm climate. Changes in the marine environment in the middle Neritik are caused by basin conditions that are controlled by fluctuations in sea level, causing a decrease in sea level (regression), and the rise of sea level to land (transgression) slowly and causing the removal of sedimentary rocks to the surface.

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