The trend of Foraminifera Benthic Assemblages for Comparing Paleo-environmental change: a Case study at Bulu and Wonosari Formation, Indonesia

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The trend of Foraminifera Benthic Assemblages for Comparing Paleo-environmental change: a Case study at Bulu and Wonosari Formation, Indonesia

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Abstract. Basically, the use of foraminifera fossils is used in the exploration of energy resources, especially in the field of petroleum, but as we know foraminifera activities can be a study in monitoring the ancient environment. This study aims to compare the ancient environment of limestone in the Wonosari Formation which is composed of layered limestones that show turbidite symptoms with Bulu Formation characterized by plotted limestones. In this study using a stratified sampling method, abundance and diversity calculation of benthonic foraminifera. From the comparison of the two formations shows the response to changes in environmental changes is seen based on the trend of changes in the diversity of benthic foraminifera.

1. Introduction

Micropaleontology is generally only concentrated on the search for energy resources, especially in the field of petroleum, [8-11]**.** Some biologists and paleontologists have realized that the fossil record that shows environmental conditions can be a parameter in environmental evaluation. Paleontological studies will consider natural disturbances that may be missed by short-term ecological studies. Therefore, the researchers wanted to compare the results of the environmental analysis conducted in Wonosari, Gunungkidul, Yogyakarta, and Bulu Formation, Rembang.

2. Geological Setting

Surono et al (1992), Oyo - Wonosari Formation above the Sambipitu Formation. This formation is generally composed of limestone and marl. The spread extends to almost half of the Southern Mountains extending to the east, turning north next to the Stage Hills to reach the western part of the depressed Wonogiri - Baturetno area. The lowest part of the Oyo-Wonosari Formation is composed of layered limestones that show turbidite symptoms deposited in deeper sea conditions.

This Bulu formation limestone forms several Lithological facies, namely reef limestone facies, fossilized limestone facies, and Layered Limestones or plates. In this study will discuss the morphology and characteristics of limestone from the results of sampling in the study area **(IAGI, 2013)**. Both formations show the presence of limestones with different rock associations which will later show a different response to environmental changes.

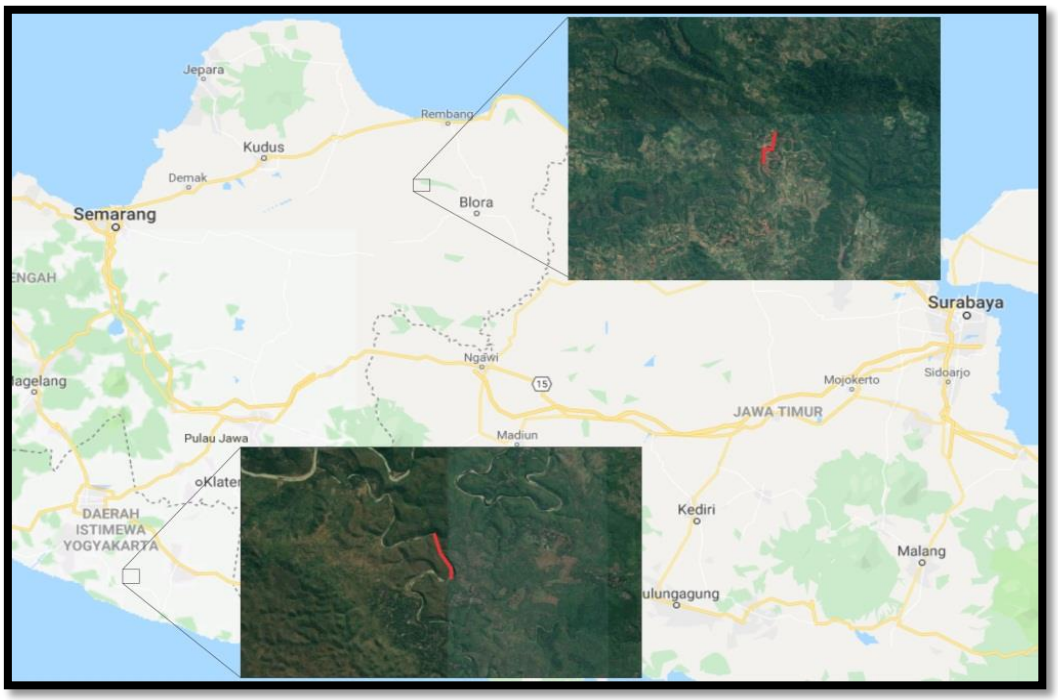

Fig.1. The sampling location of the study area in two formations, the northern part of the Bulu Formation, the south is the Wonosari Formation

3. Materials And Methods

3.1. Sampling Methodology

In sampling when comparisons are made of more than two parameters or between different sampling times, special treatment must be carried out **(Schroder et al., 1987)**. In this study, sampling was carried out by a stratified sampling method. Then the sample weight used is 10 grams of the sample after being prepared using peroxide.

3.2. Data Analysis Method

In this study, the analysis of abundance and diversity of foraminifera was considered as an univariate parameter (where the data for all samples were expressed as a single figure such as species diversity). It is important to note that while stability or changes in univariate size in one area may have ecological significance. For example, two regions may have exactly the same diversity of species or plants but do not have the same species.

4. Paleontology Analysis

Micropaleontology is the systematic study of microfossils, their morphology, classification, and environmental and stratigraphic significance. For practical purposes, a microfossil is any fossil, usually small, whose distinguishing characteristics are best studied by means of a microscope. It includes a heterogeneous group of fossils of organisms that are generally of microscopic size. In this study, we using foraminifera benthic and planktic to analysis paleontology **(Saraswati,2015)**. The following are some of the fossils present in the sample that we analyzed based on the appearance directly on a binocular microscope

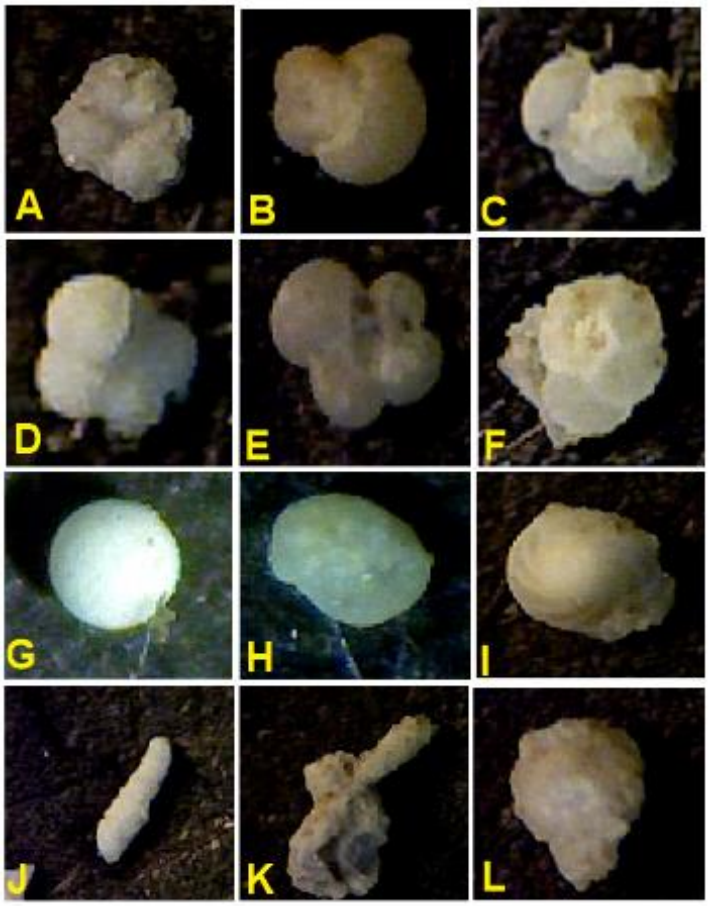

Figure 2.
A.Globigerinoidesruber,
B. Globigerinoidestrilobus,
C. Globoquadrinadehiscens,
D. Globoquafrinamayerii,
E. Globorotaliaobesa,
F. Globorotaliatumida,
G. Orbilinauniversa,
H. Robulusatlantiqus,
I. Robulusthalmanni,
J & K. Bathysiphonfiliformis,
L. Lagena sp.

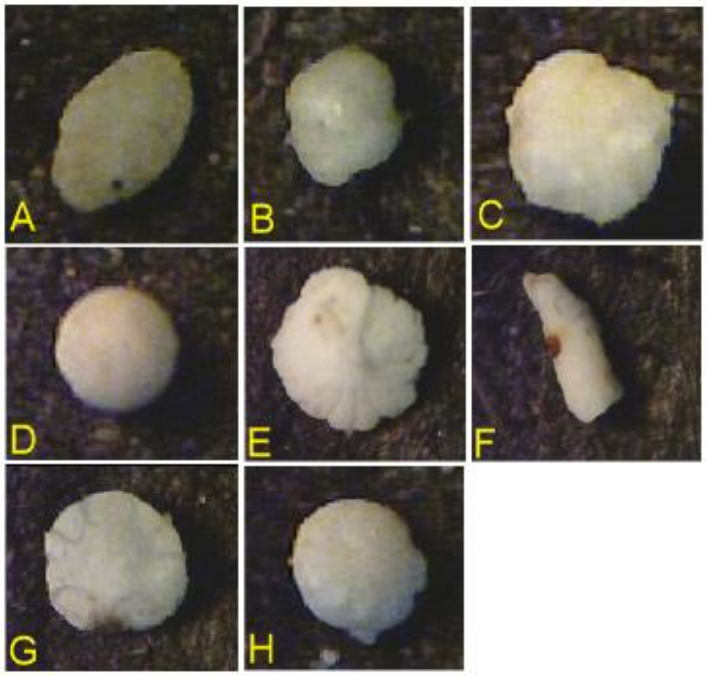

Figure 3.
A.Globorotaliafohsi,
B. Globorotaliaobesa,
C. Globorotaliaopima,
D. Orbulinauniversa,
E. Amphisteginagibbosa,
F. Bathysiphonfiliformis,
G. Eponidesrepandus,
H. Eponidesumbonatu.

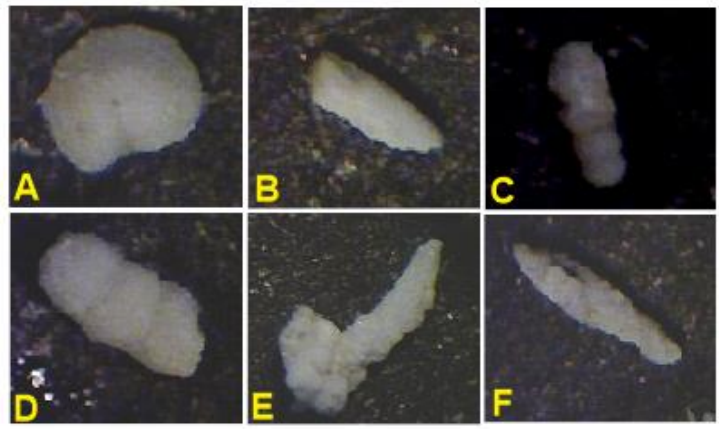

Figure 4.
A.Cibicidoidesmundulus,
B. Gaudryinaatlantica,
C.Hormosinamonile,
D. Hormosinamonile,
E. Hyperamminafriabilis,
F. Marsippelaelongata.

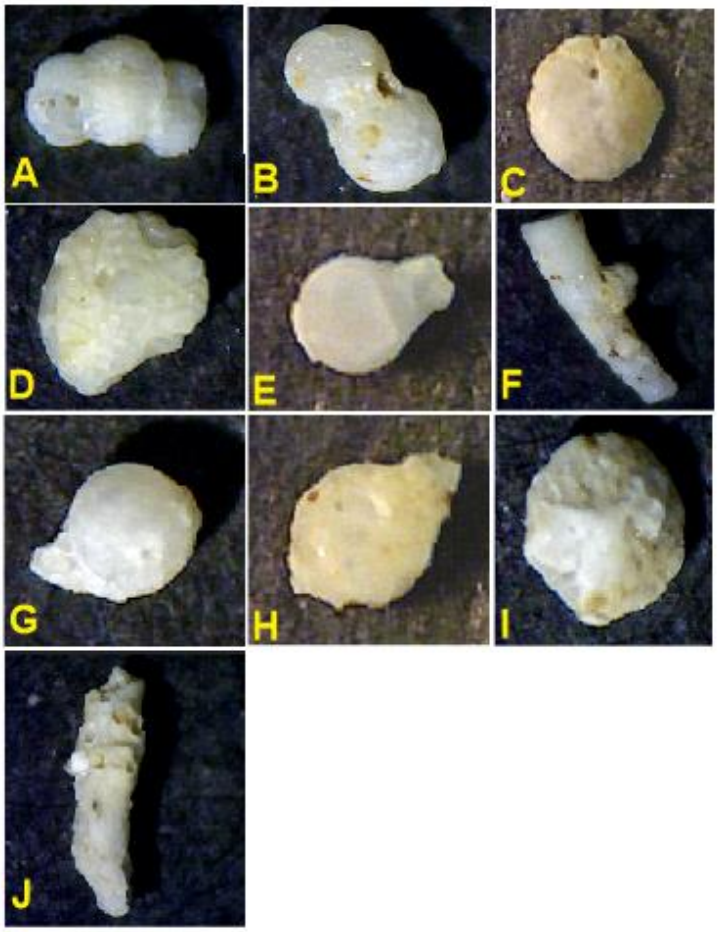

Figure 5.
A.Globigerinoidesprimordius,
B. Globigerinoideesruber,
C. Globorotaliakugleri,
D. Globorotaliapraemenardii,
E. Lagenagibbera,
F. Marsipellaelongata,
G. Orbulinauniversa,
H. Rectoglandulinarolundata,
H. Robulusthalmanni,
I. Aschemonellacalenata

Figure 6.
A.Eponidesbradyi,
B. Eponidestumidulus,
C. Hormosinacarpenleri.

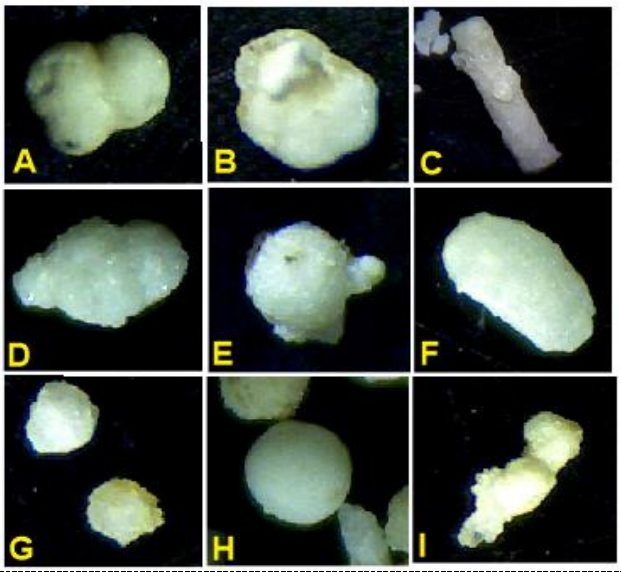

Figure 7.
A.Globigerinoidesimmaturus,
B. Globorotaliamayerii,
C. Bathysiphonfiliformis,
D. Dorothiascabra,
E. Lagena sp.
F. Lagenatruncata,
G. Lenticulinaconvergens,
H. Orbulinauniversa,
I. Stilostomellaabyssoru.

5. Geology Of Research Areas

In the two study areas consisted of limestone lithology with different conditions. The Wonosari Formation is characterized by layered limestones and coral reefs in Figure 2. While the rock associations in the Bulu Formation consist of layered limestone, massive limestone and plastered limestones shown in Figure 3. Based on the history of the formation of the Wonosari Formation in the south shows shallow calcareous marine environment with fine-grained rock associations and carbonates, while in the formation Bulu which is the same environment is a chalky shallow sea resulting from gradual changes which show the transgression of the Ngrayong Formation which characterizes the transition environment.

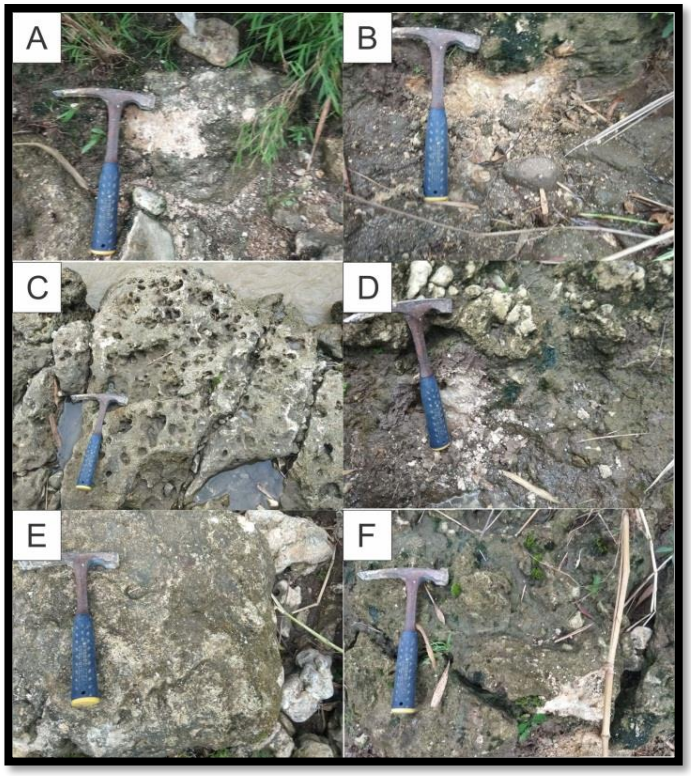

Figure 8. The sampling location of the study area in the Wonosari Formation: A, B, D, E, F, layered limestone, C, coral reefs.

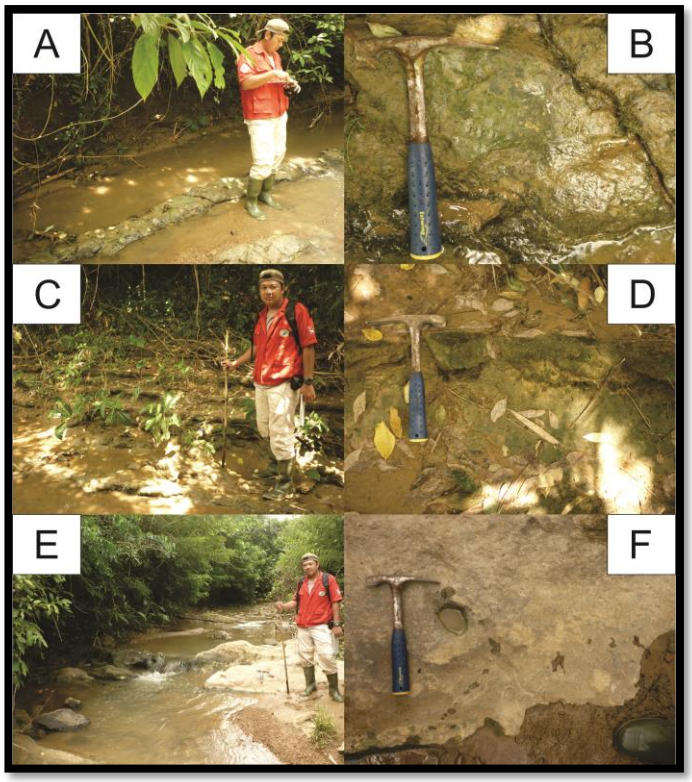

Figure.9. The sampling location of the research area on Bulu Formation: A, layered limestone, B, photo parameters of layered limestone, C, plastered limestone, D, photo parameters of plotted limestone, E, massif limestone, F, massive limestone.

6. Rate Of Response From Both Formation

The response of an organism to environmental changes is influenced by factors such as periods of change and their effects on diversity. Is the change potentially "profitable" or "no". [7], in considering the response of an organism to environmental variables, several ecological factors are limiting in the sense that there is a threshold at which effects on organisms are good for inhibiting reproduction. This term is used to describe ecosystems, including the effects of all ecological factors. When an environment deteriorates, certain species that cannot survive will disappear.

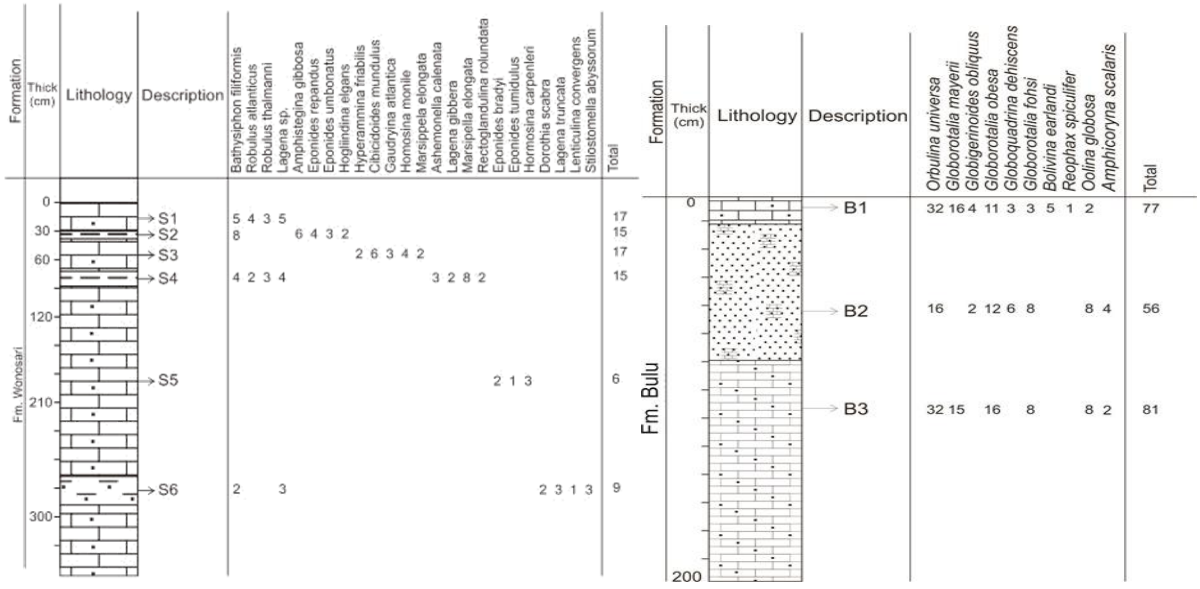

Figure 10. The abundance of foraminifera present in the study area rocks.

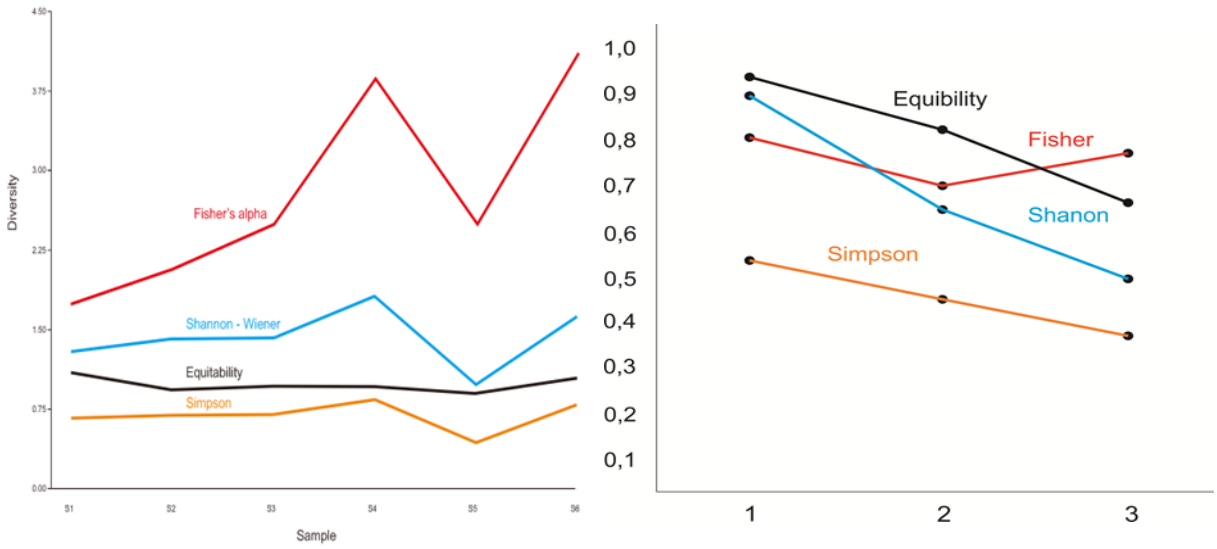

Figure 11. The diversity of benthic foraminifers present in rock samples

An important index of dominance is the Simpson index (Simpson 1949), the diversity index called Fisher's alpha (alpha) defined by the formula S = αln(1 + n / a), the Fisher index is not really meaningful, but still seems to be an index who perform well in practice. The Shannon-Wiener index value does not only depend on relative abundance, but also on the number of taxa. Then (Pielou's) equitability with the formula J = H ′ / Hmax, varies from 0 to 1.

From these data, it can be seen that the Wonosari Formation experienced a relative change with the relatively stable diversity and abundance of foraminifera, while in the Bulu Formation the presence of foraminifera decreased and the relative trend showed a decrease in the presence of foraminifera itself.

7. Comparison Of Environmental Change Trends

By using foraminifera, rapid and large changes such as volcanic eruptions or aesthetic changes can be stored properly, but to try to document slow environmental changes, it is necessary to have a detailed database of the natural variability of the environment and fauna. The sample taken must show patchiness and provide statistical accuracy.

From the data taken by the Wonosari Formation, it looks more stable than the Bulu Formation which shows a decrease in the level of ecology. This is due to changes and significant environmental differences seen from the gradations of rock changes in the layers taken. The Wonosari Formation shows insignificant changes that show a fixed rock association, while the relatively thin Bulu Formation shows significant changes in rocks or environmental changes.

8. Planktonic: Benthonic Ratio

The ratio of plankton and benthic foraminifera (P / B) is a criterion for estimating depth. The proportion of foraminifera planktic to benthic (in%) varies from the inner shelf to the upper continental slope as follows 1.) Inner shelf <20:> 80; 2.) Middle shelf 10 - 60:90 - 40; 3.) Outer shelf 40-70: 60-30; 4.) Upper continental slope> 70: <30 From the foraminifera ratio it can be seen that the abundance in the Wonosari Formation based on the ratio is in the Middle shelf - Upper continental slope region, while the Bulu Formation shows the dominance of foraminifera plankton which shows depth. Outer shelf - Upper continental slope.

9. Results And Discussion

In the Wonosari Formation, there was a relative change with the relatively stable diversity and abundance of foraminifera, while in Bulu Formation the presence of foraminifera decreased and the relative trend showed a decrease from the presence of foraminifera itself.

This is due to changes and environmental differences are seen from the gradation of rock changes in the layer taken. The Wonosari Formation shows insignificant changes that show rock associations that are relative to the same environment, while the relatively thin Bulu Formation shows significant changes in rock or environmental changes (Wonocolo Formation). The Wonosari formation is based on the ratio in the Middle shelf - Upper continental slope, while the Bulu Formation shows depth. Outer shelf - Upper continental slope.

10. Conclusions

Benthic foraminifers can identify trends in environmental changes based on depth and eustatic environmental approaches, and the presence of limestones in a formation possessing different presence or environments can be identified using benthic foraminifers.

Acknowledgment

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