SMALL BENTHIC FORAMINIFERA AS AN INDICATOR OF PALEOTSUNAMI IN UJUNGKULON, BANTEN PROVINCE, INDONESIA

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ABSTRACT

Research area is located at 105^0 27" 6,99" E and 6^0 50' 1,29" S. The purpose of this research is to know the diversity of small benthic foraminifera on "X" core, Ujung Kulon, Banten Province, Indonesia. Sixteen sediment samples (paleotsunami deposits) from research area were analyzed to collect small benthic foraminifera. Sediment samples are coastal sediment that were taken from one drill point by using shallow drill to a depth 240cm from the ground. Sampling for analyses small benthic foram was conducted in each layer sediment. At this stage, sequence of layers and the thickness of sediment were observed. In order to separate the sediments and the foraminifera, sediment samples were threated using Hydrogen Peroxide method. Small benthic foraminifera data is collected by using quantitative method. The number of species and individuals were counted in every 1 gram dry sample. Analyses of small benthic foraminifera shows there are 55 species small benthic foraminifera and 43.866 specimen. The dominance species is *Planulina wuellerstorfi* which is a deep marine species. Furthermore, The Sannon-Wiever diversity index of all sample are low. It can be concluded that was a paleotsunami.

Keyword: Ujung Kulon, paleotsunami deposit, small benthic foraminifera, diversity index

INTRODUCTION

The study area is located on the Laban Isthmus, Ujung Kulon peninsula, Java Island. Geographically, it laid down between 6 50' 15,60" S and 105 27' 6,99" E. (Fig.1) Many examples of areas that has tsunami deposits as well as paleotsunami containing abundance of foraminifera, but only a little that has paleotsunami deposits from volcanic eruptions products with variations of abundance of foraminifera as produced by the mighty eruption of Krakatoa in 1883. The eruption of Mount Krakatau that occurred in 1883 throwed more than 10 km3 of pyroclastic material, either in the form of hot clouds of eruption and ash eruption. This eruption caused the deaths of more than 36,000 people died, caused by the tidal wave (tsunami) caused by the collapse of the crater wall of this volcano (sector failure) and the flow of hot clouds of eruption into the sea. The awesomeness of the tsunami waves is evidenced by a number of large limestone coral reef boulders which are throwed and fell inland.

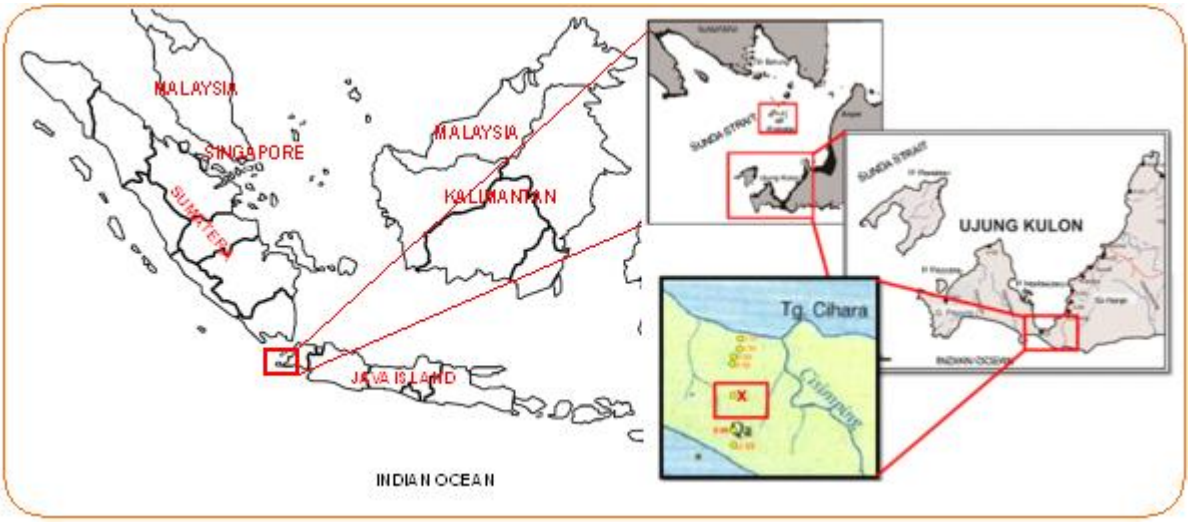

Figure 1. Map of Research Location (No Scale)

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The Sunda Strait witnessed several eruptions of Mount Krakatau, which in 1883 inflicted considerable damage in the region, which was mainly caused by the tidal waves it generated in addition to volcanic material bursts into the atmosphere and vibrations following the blast. The awesomeness of this tsunami waves, among others, is evidenced by a number of large boulders of coral limestone pieces that are thrown to lag and lie deep inland. Tsunami relics are also deposits of coral reef crumbs found far from the coastline of Anyer and in the bay area of Lampung.

The tsunami sand deposits have distinctive features that can be distinguished from other sand deposits. These deposits are often found covering the primordial soil layer. Generally the tsunami sand deposits show the appearance of the fining upward grain size structure. In tsunami deposit, this structure can be seen more than one. This structure is Foraminifera is one of the organisms that can be used in the determination of depositional facies and it is an organism that has a single cell that lives in the sea, which can live on a float (planktonic) or in the seabed (benthonic). Foraminifera can only have one room or many rooms that separated from each other by the septum which is penetrated by many fine holes (foramen).

a clue to the number of waves that hit when a tsunami occurred. Inside the sand is often found shells of small animals that come from the depths of the sea. Ground boulder are also often present in the tsunami sands as a result of a tsunami wave. This brings significant changes in the environment, such as mangroves and the destruction of sponges by a tsunami event, will affect the population's ability to survive and force it to adapt to its environment (Yulianto, 2007).

Tsunami deposits not only have distinctive features of sediment deposits but also have foraminiferals abundances. Foraminifera in this deposit can be small benthic foraminifera that redeposited on the land (reworked fossils) by the role of tsunami waves as it undermines the sea floor on its way to the shore.

Small benthic foraminifera can be found in abundant amounts in sediment deposits. Their lives affected by their environment. There are two kind of small benthic foraminifera based on the way of their life, which are vagile (moving) and sesile (attach). (Pringgoprawiro, Kapid and Barmawidjaja, 1994). Therefore, the aim of this research is to know the diversity of small bentonic foraminifera in order to determine paleotsunami.

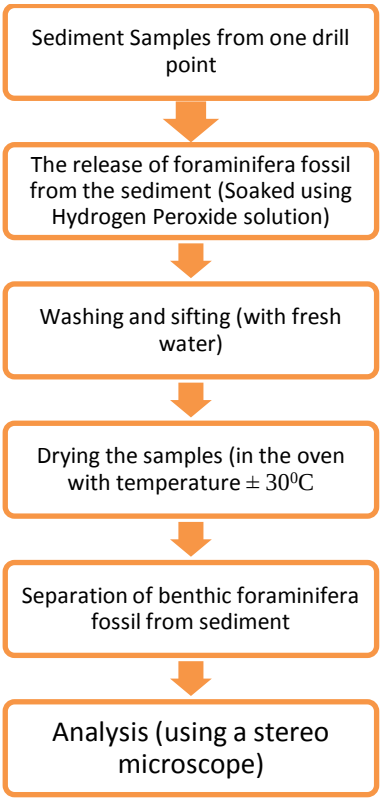

Figure 2. Foraminifera Preparation Stages

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RESEARCH METHOD

Sixteen sediment samples were taken from every sequence layers (Fig. 3). Stages of Foraminifera preparation were performed in Figure 2. Separation of sediment and benthic foraminifera was conducted by using Hydrogen Peroxide method.

Collection of Foraminifera data was done in every 1 gram dry sample sediment. Determination of foraminifera by observing structure and composition of shell wall, number and arrangement of chambers, aperture and ornamentation was reffered to Barker (1960).

After the determination process, the number of species and individu were calculated. Diversity Index (Shannon-Wiever, 1949) is used to know the Diversity Index of study area.

can be calculated using the following formula:

$H' = - \sum Pi \log Pi$

Information:

H' = Divesity Index

Pi = ni/N

Ni= The number of individual types of i

N = Total of individual

With the result;

If H' <1, so it shows low diversity

If 1< H' < 3, so it shows medium diversity

If H' >3, so it shows high diversity

The method for calculating the percentage of dominance species is by calculating the number of individuals then divided the total number of individuals multiplied by 100%. The highest percentage of species is the dominant species.

RESULT AND DISCUSSION

- Lithology

The sediment samples used in this study are tsunami sediments which are a combination of volcanic materials spewed in enormous quantities into the ocean and the original seabed materials crushed by the force of tsunami waves on their way to the mainland (Iskandarsyah,2016). "X" core consist of 5 type of sediment deposit, they are sandy soil, silty soil, coral boulder, gravel sand and coarse to fine sand. Generally, tsunami sediment deposit shows the appearance of the grain size structure which is fining upward. This structure is a clue to the number of waves that hit when a tsunami occurred. In this deposit is often found shells of small animals that derived from the sea, for example at the depth of 90 cm – 120 cm, 120 – 150 cm, and 210 – 240 cm. The coral boulder are also present in this tsunami sediment deposit as a result of a tsunami wave, precisely at the depth of 155 cm - 162 cm and 168 cm - 172 cm. Moreover, there is a sedimentary structure which is characteristic of tsunami sediment, that is rip up clasts structure at the depth of 172 cm – 210 cm. (Figure 3). The presence of coral boulder layers, pumice structure and the existence of rip up clast structure is an indication of tsunami caused by the eruption.

- Foraminifera

Based on the result of benthic foraminifera determination of 16 sediment samples, there are 55 species of small benthic foraminifera consisting of 43,866 individuals. The dominance species is *Planulina wuellerstorfi*. The highest percentage of *Planulina wuellerstorfi* is 66,99% which is found in the depth of 180-210 cm (figure 3).

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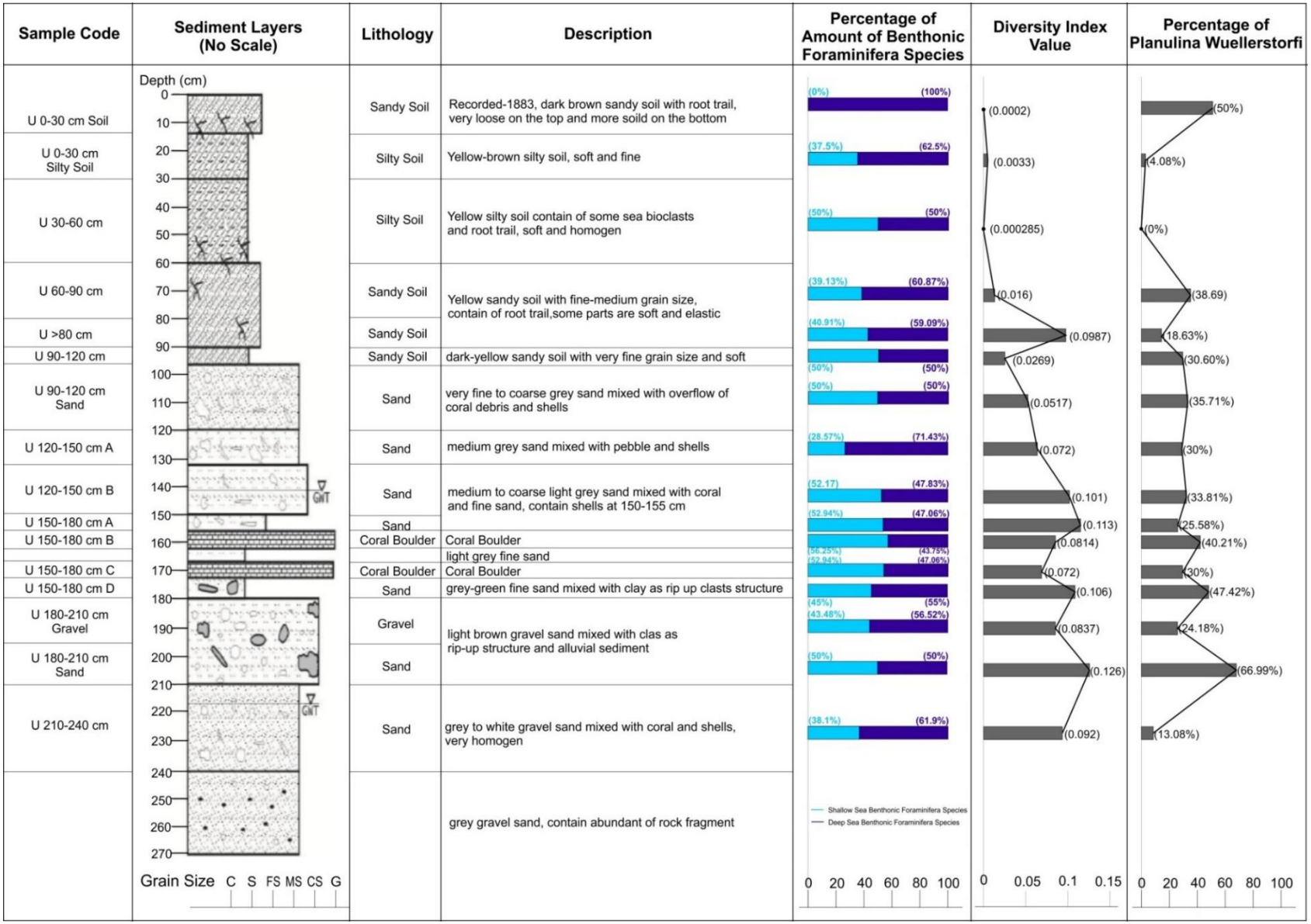

Figure 3. Stratigraphy Profile and Species Graphic

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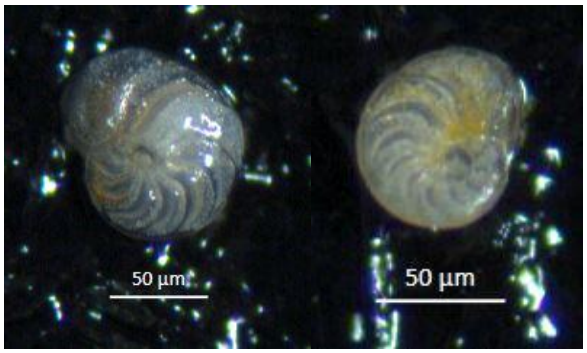

Figure 4. *Planulina wuellerstorfi* **Schwager**

The presence of *Planulina wuellerstorfi* which is a deep marine benthic foraminifera on the tsunami sediment proves that tsunami waves resulting from Krakatoa volcano eruption also hit the Ujung Kulon area from the direction of the Indian Ocean. The tsunami wave originating from the Indian Ocean is still the same tsunami wave as the tsunami wave from the Sunda Strait. Those tsunami wave were deflected (refraction) following the form of Ujung Kulon Peninsula around Pulau Panaitan and Peucang Island. This refraction occurs as a result of the unique coastal morphology of the Ujung Kulon Peninsula with its several bay shaped like a "V".

All sediment samples from "X" core has a low diversity index value of fossil small benthic foraminifera (Table 1). It can be assumed because of the influence of the situation in the past such as the eruption of Krakatoa volcano that caused the tsunami in the research area in the year 1883.

Table 1. Diversity Index

No	Sample Code	Diversity Index
1	U 07 0-30 cm Soil	0,0002 ; Low
2	U 07 0-30 cm Silty Soil	0,0033 ; Low
3	U 07 30-60 cm	0,000285 ; Low
4	U 07 60-90 cm	0,016 ; Low
5	U 07 >80 cm	0,0987 ; Low
6	U 07 90-120 cm	0,0269 ; Low
7	U 07 90-120 cm Sand	0,0517 ; Low
8	U 07 120-150 cm A	0,072 ; Low
9	U 07 120-150 cm B	0,101 ; Low
10	U 07 150-180 cm A	0,113 ; Low
11	U 07 150-180 cm B	0,0814 ; Low
12	U 07 150-180 cm C	0,072 ; Low
13	U 07 150-180 cm D	0,106 ; Low
14	U 07 180-210 cm Gravel	0,0837 ; Low
15	U 07 180-210 cm Sand	0,126 ; Low
16	U 07 210-240 cm	0,092 ; Low

The low diversity index is caused by ecological factors in an unsupport habitat. The lower the reproduction rate of foraminifera species, the less the number of foraminifera species that grow so that the foraminifera can not form a large population.

CONCLUSION

The dominance species namely *Planulina wuellerstorfi* which is a deep marine species and the low diversity value of small benthic foraminifera show that there were paleotsunami in research area.

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