

# Quaternary – Recent Reef Facies Model in Seribu Islands – Jakarta Bay, DKI Jakarta

M. Ali Jambak<sup>1</sup>, Dewi Syavitri<sup>1</sup>, Himmes Fitra Yuda<sup>1\*</sup>, Ovinda<sup>1</sup>, Surya Darma Hafiz<sup>1</sup>, Rendy<sup>1</sup>, Fachry Muhammad<sup>1</sup>

<sup>1</sup>Department of Geological Engineering, Universitas Trisakti  
 Jl. Kyai Tapa No.1, Grogol Petamburan, Daerah Khusus Ibukota Jakarta 11440

\*Email address: himes.fy@trisakti.ac.id

**Abstract**— The research area is located on the Seribu Island in North Jakarta, DKI Jakarta Province, Indonesia. The Seribu Islands are a unique area of carbonate system that makes the presence of small islands which separate from one another in the research area. The necessary to study the history of formation and the processes that occurred thus we could understand the geometry of the reef system in the Seribu Islands. The purpose of the research is that the authors aim to know the changes in the development of the Quaternary-Recent reef model as a facies model or comparison for older reefs or ancient reefs and identify tectonic processes that affect carbonate rocks which grow in the Seribu Islands. The research methodology was by conducting field observations through underwater observation by photos of reef biodiversity and soft sediment sample on four islands including Harapan Island, Tidung Island, Pramuka Island, and Putri Island. From the observations under seawater, the biota on the four islands consists of branching coral, globular coral, massive coral, platy coral, and encrusting coral. Based on the presence of the coral biota and supported by lands at imagery on Harapan Island, Tidung Island, and Pramuka Island, the facies are coralgal sand, lagoon, reef flat, reef crest dan front reef. Meanwhile, Putri Island does not have a lagoon facies. The soft sediment sample shows that there are foraminifera organisms that support the facies interpretation in the study area. The tectonic factor of the structure that highly affects the height of the Seribu Island is the existence of a Seribu Island fault so that carbonate rocks can grow. Therefore, the Seribu Islands could be categorize as isolated reefs due to the reef that grows with a patch reef geometry on the Seribu platform.

**Keywords**— Coral, Facies, Isolated reefs, Seribu islands, Seribu island fault.

## I. INTRODUCTION

Carbonate reservoir is one of the reservoirs that has a significant amount as a producer of hydrocarbons. It can be found in various limestone and dolomite reservoirs in the form of reefs, shoals, carbonate platforms, recrystallized dolomite, and fractures. To understand the geometry of the carbonate reservoir, it is necessary to study the formation history and processes that occur in an area which is Quaternary – Recent reef to become a reference for the older reefs. By identifying the facies of the reef system and identifying the tectonic processes for the emergence of Seribu Islands, it is possible to know the development of the facies reef system model in this area. This research takes place in the Seribu Islands, North Jakarta, DKI Jakarta Province. Coral reef ecosystems consist of coral reefs which are the basic structure in the sea in the form of calcium carbonate deposits produced by coral animals.

Seribu Islands are an archipelago of about 200 reef platforms and 14 reef complexes on the East – West of Seribu Island. The platform consists of a single reef structure built by accumulated sediments from coral reefs (Scrutton,1978). One of the geological theories, 'The present is the key to the past', states that the current situation is a picture of events that occurred in the past. Hence, it is necessary to study the history of formation and the processes that occur in the Thousand Islands and its surroundings, which are Quaternary-Recent reefs to be a reference for reefs that have an older age. (Figure 1).

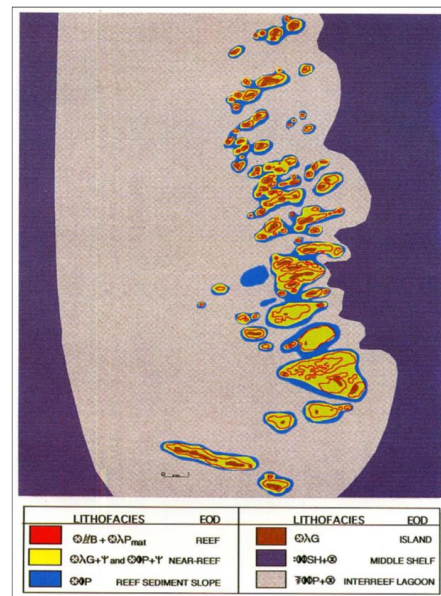


Fig. 1. Facies map in Seribu Island based on Jordan (1998)

## II. METHODOLOGY

The method used in this research started with a literature study from previous research related to the reefs in the Seribu Islands and collecting data from direct observation in the research area, that is primary data from the acquisition of new data obtained from underwater photos according to the measured water depth that will show marine biota on each island and samples in the form of soft sediments on the island, based on tectonic settings and patterns of the presence or distribution of reef systems in the study area. In addition, the current system and seawater turbidity are factors in selecting

the locations of observation and sampling. Another form of primary data used in this research is a sketch of the morphology of the island stiles from the natural formations of sedimentological and erosion processes observed on the selected islands, which located on 4 islands that is Harapan Island, Pramuka Island, Tidung Island, and Putri Island.

### III. RESULT AND DISCUSSION

#### Facies Model of Harapan Island

The location for taking photos of reefs on Harapan Island is in the north of Kelapa Island. Then sand samples were taken around Harapan Island. (Figure 2).

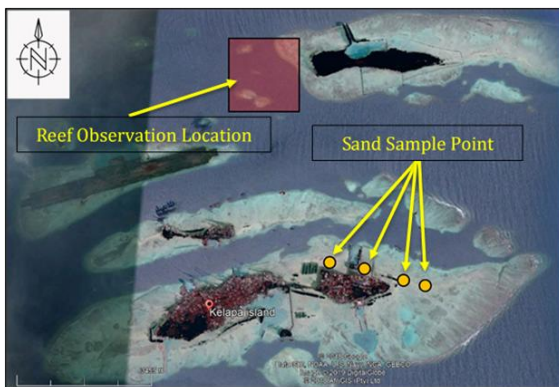


Fig. 2. Location and photo data of reefs and sand samples in Harapan Island

The type of coral in Harapan Island consists of several forms consisting of branching coral, globular coral, massive coral, and platy coral. The branching coral species that live in this area are *Acropora* sp, *Acropora Hyachintus*, *Acropora palifera*, *Acropora nobolis* and *Stylophora*.

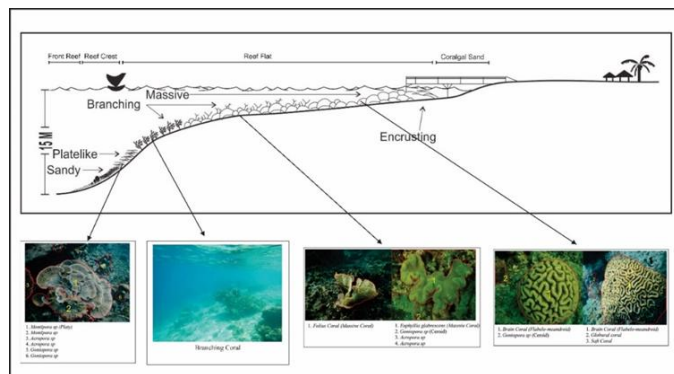


Fig. 3. Sketch and reefs diversity of Harapan Island

This association shows that there is a transition from the reef flat to the reef crest. Then the form of Globular corals consists of *Brain Coral* sp, *Goniopora* sp and *Favites abdita*. Most of this association shows that many are on reef flat. Furthermore, massive coral consists of *Folius coral*, *Pachyseris rugose* and *Euphyllia glabrescens*. From this association, it shows that they are in transition from coralgal sand to reef flat and the last is Platy coral consisting of *Montipora* sp. This association shows that it is in a transition from the reef flat to reef front (Figure 3). The reef facies that developed based on direct observations and referring to the

theory of Walker and James 1992 consisted of lagoons, coralgal sand, reef flat, reef crest, and front reef. Harapan Island and Kelapa Island are interconnected, which means have one reef coral body, while the Kelapa Dua islands and Panjang islands are interpreted as saddle reef islands because the islands are separated and there are channels between the islands. The coral biota found on this island of hope includes pelecypods, gastropods and coelenterate. The foraminifera fossil content consists of *Nonionella*, *Ammonia*, and *Amphistegina*.

Foraminifera biota data shows that the depositional environment in this area is marginal marine to middle neritic. (Figure 4).

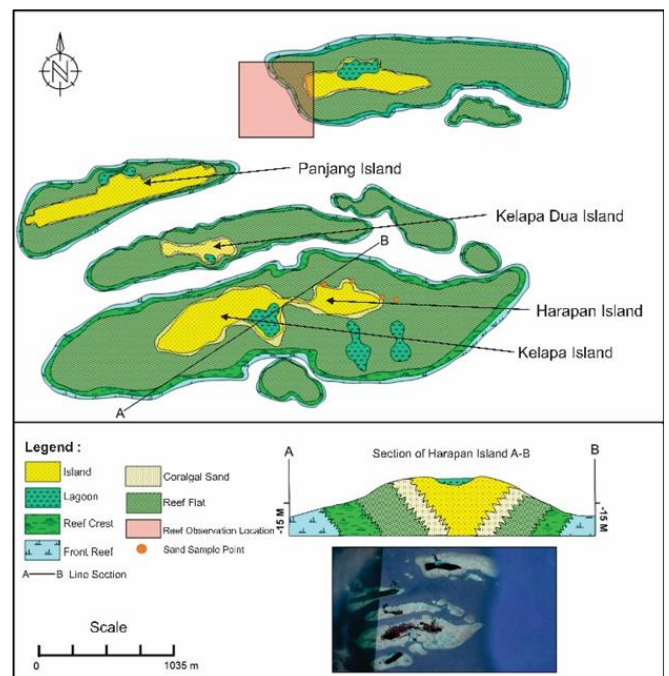


Fig. 4. Facies model of Harapan Island

#### Facies Model of Tidung Island

The location for taking photos of reefs in the Tidung Island area is in the northeast of Payung Besar Island. Then sand samples were taken around the Tidung Island. (Figure 5).

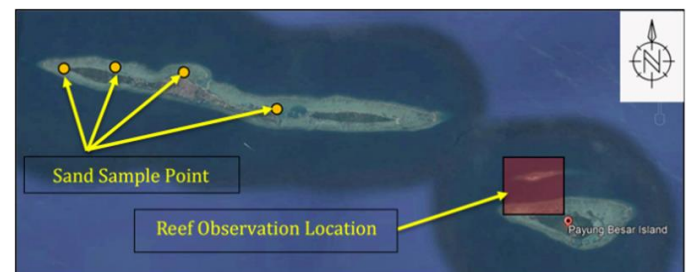


Fig. 5. Location and photo data of reefs and sand samples in Tidung Island

The type of coral on Tidung Island consists of several forms of globular coral, branching coral, massive coral, and encrusting coral. Globular coral species that live in this area are *Brain coral*, *Goniopora* sp, and *Favites abdita*. This association shows that there is a transition from reef flat. His



association shows that there is a transition from reef flat. Then form branching corals consisting of *Acropora* sp, *Acropora* *Hyachintus*, *Acropora humilis*, *Acropora* cf. *A. Diversa*. This association shows that many are in the transition from the reef flat to reef crest. Furthermore, Massive coral consists of *Porites lutea* and *Gardineroseris planulata*. From this association, it shows that they are in transition from coral galsand to reef flat and the last is Encrusting coral consisting of *Galaxea fascicularis*. This association shows that it is in a transition from land to the reef flat. (Figure 6).

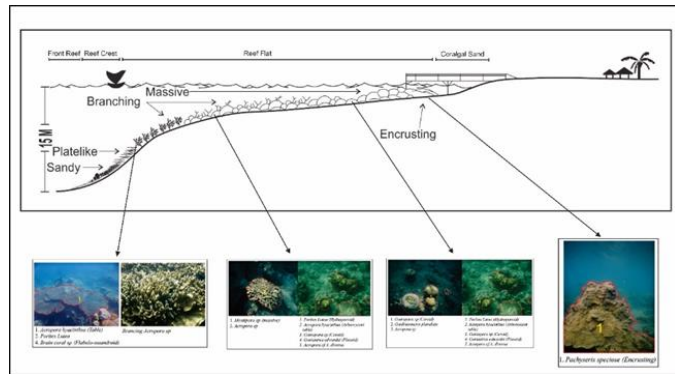


Fig. 6. Sketch and reefs diversity of Tidung Island

The reef facies that developed based on direct observations and based on Walker and James, 1992 theory consisted of: lagoon, coralgal sand, reef flat, reef crest and front reef. Tidung Besar Island and Tidung Kecil Island are interconnected, which means they have one reef coral body, while Payung Island is interpreted as a saddle reef island because the islands are separated and there are channels between the islands.

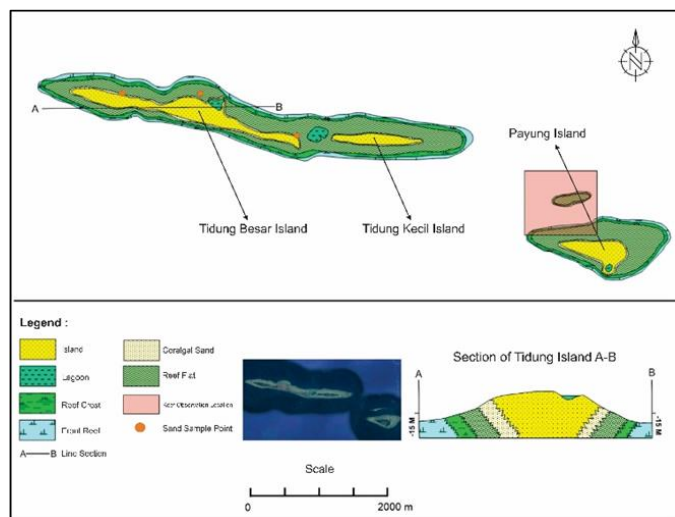


Fig. 7. Facies model of Tidung Island

Then the coral biota found on Tidung Island includes pelecypods and gastropods. Then the content of foraminifera fossils consists of *Ammonia* and *Cibicides*. From the foraminifera biota data, it shows indications of the depositional environment in this area, that is marginal marine to outer neritic. (Figure 7).

Facies Model of Pramuka Island

The location for taking photos of reefs in Pramuka Island is in the southeast of Semak Daun Island. Then sand samples were taken around Pramuka Island. (Figure 8).

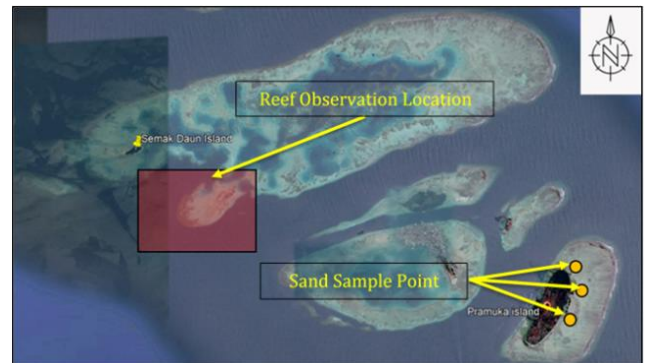


Fig. 8. Location data for photos of reefs and sand samples in Pramuka Island

The group of coral types on Pramuka Island is massive coral consisting of *Porites lutea* and *Goniopora* sp, from this association shows that they are in transition from coral galsand to reef flat. The next form of coral consists of encrusting coral consisting of *Halimeda* sp.

This association shows that it is in a transition from land to the reef flat. The last group of coral types is branching corals consisting of *Acropora* sp, from this association shows that there is a transition from the reef flat to reef crest. (Figure 9).

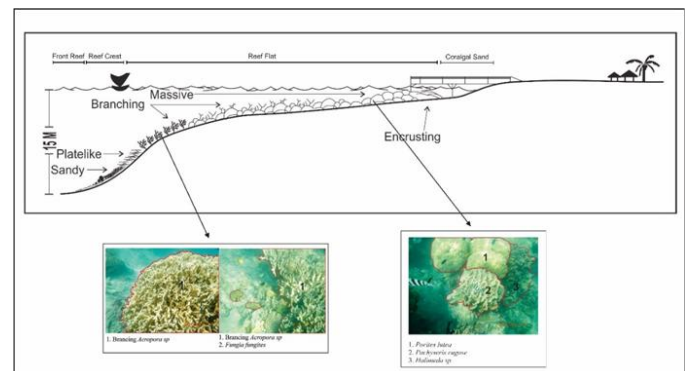


Fig. 9. Sketch and reefs diversity of Pramuka Island

The reef facies that developed based on direct observations and refers to the theory of Walker and James 1992 consisted of lagoons, coralgal sands, reef flats, reef crests and front reefs. The relationship between Pramuka Island and the Semak Daun Island is mutually exclusive which is interpreted as a saddle reef island so that there is a channel that separates the two islands. Then the coral biota found on this island of hope includes pelecypods shells, gastropods, and coral fragments. Then the content of foraminifera fossils consists of *Ammonia* and *Cibicides*. From foraminifera biota data shows there is indications of the depositional environment in this area, that is marginal marine to outer neritic. (Figure 10).

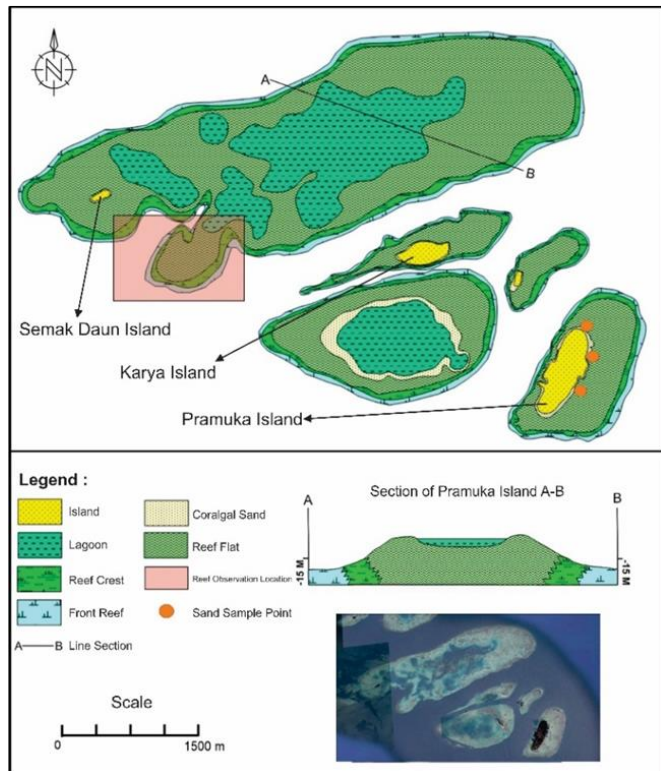


Fig. 10. Facies model of Pramuka Island-

*Facies Model of Putri Island*

The location for taking photos of reef photos in the Putri Island is in the southeast of Putri Besar Island. Then sand samples were taken around Putri Kecil Island. (Figure 11).

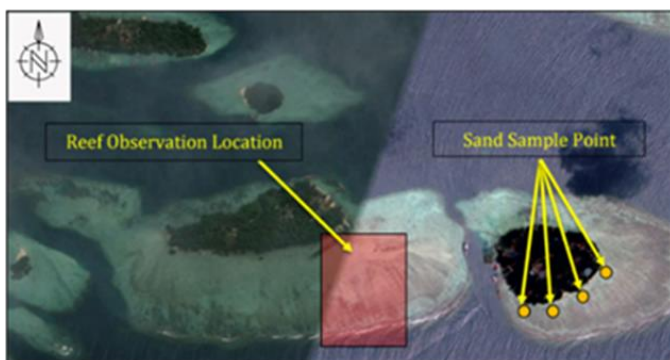


Fig. 11. Location data for photos of reefs and sand samples in Putri Island

The group of coral types in Putri Island in terms of the shape of the branching corals consists of *Acropora* sp, *Acropora*, *hyachintus*, *Acropora palifera*, *acropora nobolis* and *Stylophora*.

This association shows that there is a transition from the reef flat to the reef crest. The next form of coral consists of massive coral consisting of *Folius* coral, *Pachyseris rugose*, and *Euphyllia glabrescens*. From this association, it shows that it is in the transition from coralgalsand to reef flat. This association shows that it is in a transition from coralgalsand to reef flat. Then the form of Globular coral consists of *Brain Coral* sp, *Goniopora* sp and *Favites abdita*. From this

association, it shows that many are on reef flats. The next form of coral from this island is composed of encrusting coral consisting of *Galaxea fascicularis*. This association shows that it is in a transition from land to the reef flat. Then the last form of Coral consists of *Platy* coral consisting of *Montipora* sp. This association shows that it is in transition from the reef flat to the front reef. (Figure 12).

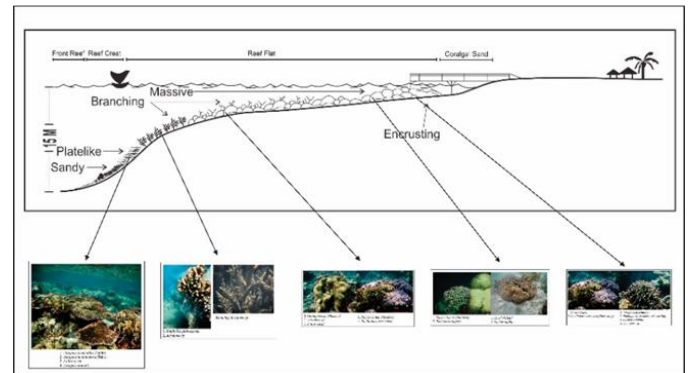


Fig. 12. Sketch and reefs diversity of Putri Island

Reef facies that developed based on direct observation and referring to the theory of Walker and James (1992), consisting of coralgalsand, reef flat, reef crest and front reef. Coral biota found on the Harapan Island include abundant gastropods, molluscs and coral fragments.

The fossil content of foraminifera consists of *Ammonia* and *Cibides*. The relationship between Putri Island and Karya Island and Semak Daun Island is mutually exclusive which is interpreted as a saddle reef island so that there is a channel that separates the two islands. Then from the foraminifera biota data, it shows indications of the depositional environment in this area, that is marginal marine to outer neritic. (Figure 13).

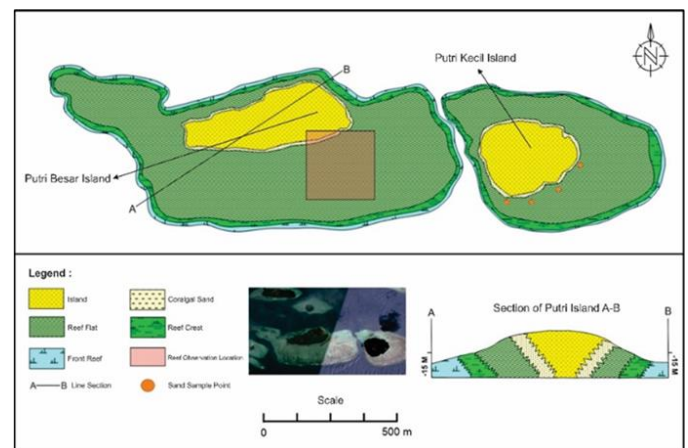


Fig. 13. Facies model of Putri Island

*Comparison with Late Miocone Fields*

Seribu Islands is an analogue of modern carbonate to ancient carbonate. This analogue could be proven by Jatinegara – Rengasdengklok area that has Parigi formation which is a patch reef that grew during the Miocene.



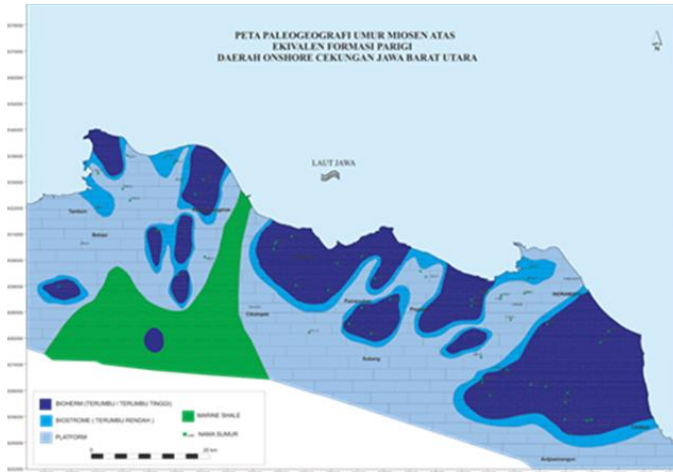


Fig. 14. Paleogeographic map of the onshore part of the North West Java Basin at the Late Miocene age of Parigi Formation

The paleographic map shows a distribution of reef limestone that grows with a patch reef geometry that stretches from there are similarities in geometry, facies and rock types. The difference between the distribution of the "x" field and the Seribu Islands is an indication of differences in tectonic control in the study area. This field is controlled by an extensional fault from previous research, that is in the NE SW and NW-SE directions. The fault makes the area in the field grow carbonate rocks in the east and west. The difference in the Seribu Islands is controlled by the Seribu island fault, which is relatively N-S and the distribution geometry is north-south.

In addition, the factor of wind moving from west to east also affects the shape of the island and the reef's geometry. The similarity of geometry on the islands in Seribu Islands is an analogue of the Miocene field. This statement is proven by the existence of subsurface data from the "x" field as a result of lithostratigraphic correlation, that is the existence of a patch reef if we make an analogy to the present day as on islands in Seribu Islands. (Figure 15).

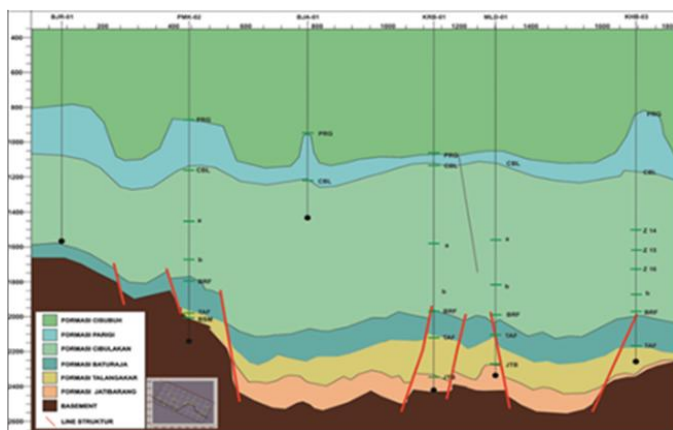


Fig. 15. Lithostratigraphic correlation of wells BJR-01, PMK-02, BJA-01, KRB-01, MLD-01 and KHB-003 showing the formation of reef facies in Parigi Formation

#### IV. CONCLUSION

The type of coral reef that grows on the Harapan island is dominated by the presence of globular coral, on Tidung Island is dominated by branching coral, Pramuka Island is dominated by massive coral, and Putri Island is dominated by the presence of branching coral. The facies that developed in the study area in the Seribu Islands are based on the analysis of the facies model which refers to the type of coral on each island in the dominant research area consisting of lagoon, coralgal sand facies, reef flat, reef crest and fore reef. These facies have different geometries on each island. Hence, the facies on one island do not work well if applied on another island. Then the structural factor that greatly influences the height of the Seribu Islands is the presence of a moving Seribu Island fault so that carbonate rocks in the Seribu Islands can grow. Modern to ancient analogue from Seribu Island can be implemented in the case of Jatinegara-Rengasdengklok area in Parigi formation as a result of all tectonic controls and facies identified that the Seribu Islands could be categorised as isolated reef located on the platform due to the presence of reefs growing with patch reef geometry on the Seribu platforms.

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