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# BULLETIN OF THE MARINE GEOLOGY

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Cover Figure : Crystalline limestone outcrops around of Baginda Cape, Tuboali Coast, Bangka Belitung Province
(By: Noor CD Aryanto)

# PREFACE

Marine Geological Institute of Indonesia (MGI's) responsibilities are to provide marine geoscientific map, research and information to support sustainable development of Indonesian's mineral and petroleum industries, mapping of Indonesian Coastal and Ocean Territory, identification of marine and coastal geological hazards, and to provide marine and coastal geological and geophysical data base for marine and coastal landscape.

In this first edition of year 2016, the number of important information are highlighted involving: Concentration and Distribution of Polycyclic Aromatic Hidrocarbons (PAHS) During Bioremediation Processes of Oil-contaminated Beach Sediments in Karang Song Beach, Indramayu; Shallow Gas Features Based on Interpretation of Bottom Profilling Records at Topang Delta, Meranti Regency, Riau Province; The Mechanism of Sediment Depositional Environment of Core Drilling of Gilimanuk Coast, Bali and Ketapang, East Java, Based on Sediment Textures; Interpretation of Paleo-Channel Based on Shallow Seismic Reflection Record in Banten Bay, Banten Province; The Content of Placer Heavy Mineral and Characteristics of REE at Toboali Coast and Its Surrounding Area, Bangka Belitung Province. From the desk of editors, thank to the authors who contribute their valuable papers for the readers.

Editors

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# BULLETIN OF THE MARINE GEOLOGY

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## CONTENTS

# Interpretation of Paleo-Channel Based on Shallow Seismic Reflection Record in Banten Bay, Banten Province

## *Penafsiran Alur Purba Berdasarkan Rekaman Seismik Pantul Dangkal di Teluk Banten, Provinsi Banten*

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**ABSTRACT:** The objective of this study is to find out the pattern of paleo channel which was formed in Banten Bay and its surrounding. The aims are to find out the paleo-channel pattern at study area. The study methods are including vessel positioning, and shallow seismic reflection work. Vessel positioning method is to locate the exact position of seismic work when recording the data from single channel of shallow seismic reflection. Seismic line orientations are determined by regional geological setting of the area. Trend of seismic lines are dominantly north – south. In order to get the seismic data which could give geological setting configuration, seismic lines should be perpendicular to the strikes of the sediments.

Based on the calculation of velocity of seismic refraction in sea water 1,500 meters/second, while within sediment 1,600 meters/second, it could be concluded that the paleo chanels were more or less in 32 meters below sea floor depth.

This layer was the system that occur during the process of an interglacial on the Sunda Shelf when it was still a part of land that connects the Java, Sumatra and Kalimantan Islands. Paleo-channel deposits are characterized by subparalel - chaotic reflection character with a thickness between 5-35 meters.

**Keywords:** Paleo-channels, seismic records and Banten Bay

***ABSTRAK:*** *Maksud dari penelitian ini adalah untuk mengetahui pola sungai purba yang terdapat di Teluk Banten dan sekitarnya, yang tujuannya adalah untuk mengetahui pola penyebaran alur sungai purba di daerah penelitian. Metode penelitian terdiri dari penentuan posisi kapal dan penelitian seismik pantul dangkal. Penentuan posisi kapal berguna untuk menemukan posisi yang tepat saat merekam data oleh perlatan seismik saluran tunggal dangkal. Lokasi lintasan seismik disesuaikan dengan kondisi geologi daerah penelitian. Arah lintasan seismik pada umumnya berarah utara – selatan. Untuk mendapatkan data seismik yang bisa memberikan konfigurasi kondisi geologi, lintasan seismik harus tegak lurus terhadap kedudukan lapisan batuan.*

*Berdasarkan cepat rambat gelombang seismik di air laut 1.500 meter/detik, dan sedimen 1.600 meter/ detik, dapat disimpulkan bahwa alur purba kurang lebih berada pada kedalaman 32 meter di bawah dasar laut.*

*Lapisan ini merupakan sistem pengendapan yang terjadi selama proses interglasial di Paparan Sunda yang pada saat itu masih merupakan bagian dari daratan yang menghubungkan P. Jawa, Sumatera dan P. Kalimantan. Endapan alur purba dicirikan dengan pola refleksi subparalel sampai tidak beraturan dengan ketebalan antara 5-35 meter.*

***Kata kunci:*** *Alur purba, rekaman seismik dan teluk Banten*

## INTRODUCTION

The objective of this study is to find out of Paleo-Channel which were formed in Teluk Banten Waters. The aims are to conclude the development of Paleo Channel, hopefully the result of this study would be useful as a database for various needs such as for study and other development in the future.

Administratively, Banten Bay is part of Serang Regency, Banten Province, and geographically is situated at 106°00’–106°25’ E and 05°45’ – 06°05’ S. The study area is about 1,700 Km$^2$ (Figure 1).

In the land area are usually intermontane basin rivers flowing in the valleys of these rivers. The rivers to supply of sediment so that it is possible to sedimentation in these valleys. In addition to the supply of sediment from the rivers that time, sedimentation occurs when the sea level rises relatively quickly over a period of 18,000 years sea levels rose about 140 meters high, the valleys will first be inundated and also

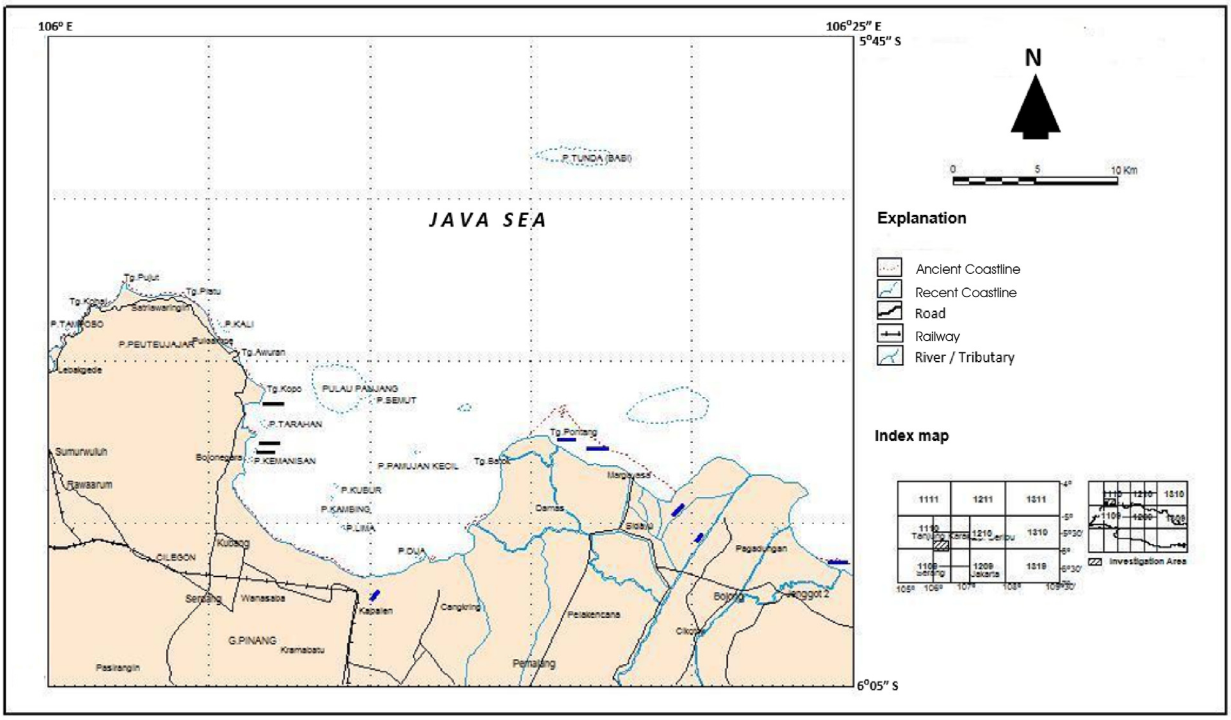


Figure 1. Study area location

experienced sedimentation. It can be seen on a map the thickness of sediment that is the areas that have a large sediment thickness (WU Chen., 1991).

To determine the sub surface configuration form of Paleo-channel is required seismic methods to explore the ancient morphological. The seismic reflection is one method of exploration which based on the measurement of the response sound wave propagates in a layer boundary and then reflected and refracted from all the difference sedimentary rocks.

Needs of marine geophysical data shows an increasing trend due to the more widespread exploration of mineral resources and energy in the ocean. One method that is powerful enough to meet the needs is seismic reflection. This method has a high accuracy to know the characteristics of the sub-marine, such as the thickness and volume of sediment deposition, sea level, the structure of the seabed, and the depth of the waters (Susilawati, 2004). Basic skills in presentation of high-resolution information with a relatively simple operation, so that this method is often used in geological study.

Based on Santosa, et al (1982), the general geological condition of study area consist of Marikangan Volcanic Rock, Product of Gede Volcano, Banten Tuff, Gede Volcanic Rock, Pinang Mt. Basalt and Alluvium Deposits (Figure 2).

Concerning to the location of seismic reflection survey, the rock unit that will influent the result of seismic survey are Banten Tuff and Alluvium Deposits.

Banten Tuff is divided into lower Banten Tuff and upper Banten Tuff. Lower Banten Tuff consist of tuff breccias, agglomerate, pumiceous tuff, lapilli tuff and sandy tuff.

Tuff breccias, is composed by the clasts are maked up of sand to bomb size, subangular to subrounded; composed of basalt, andesite, pumice, obsidian with very fine pyroclastic groundmass, thickness is several meters. The bomb clasts are scattered and at limited numbers (Santosa, et al, 1982).

Agglomerate, clast are maked up of lapilli to bomb size, well rounded to subrounded; composed of basalt, andesite, pumice with sandy or fine clastic tuff matrix; as small intercalations in the volcanic breccias, the thickness is about several meters. The exposes are found at the upper course of the Anyer River and on the northeastern escarpment of Danau Caldera (Santosa, et al, 1982)

Pumiceous tuff, dirty white to gray, clasts make up gravel to sand size, sub rounded; composes of dominantly pumice, basalt, andesite and obsidian; loose and weathered; the thickness of the layer is about several centimeters.

## METHODS

The methods are including vessel positioning, sounding and shallow seismic reflection. Trackline positioning method is to locate the exact position of the survey vessel when recording the data from single

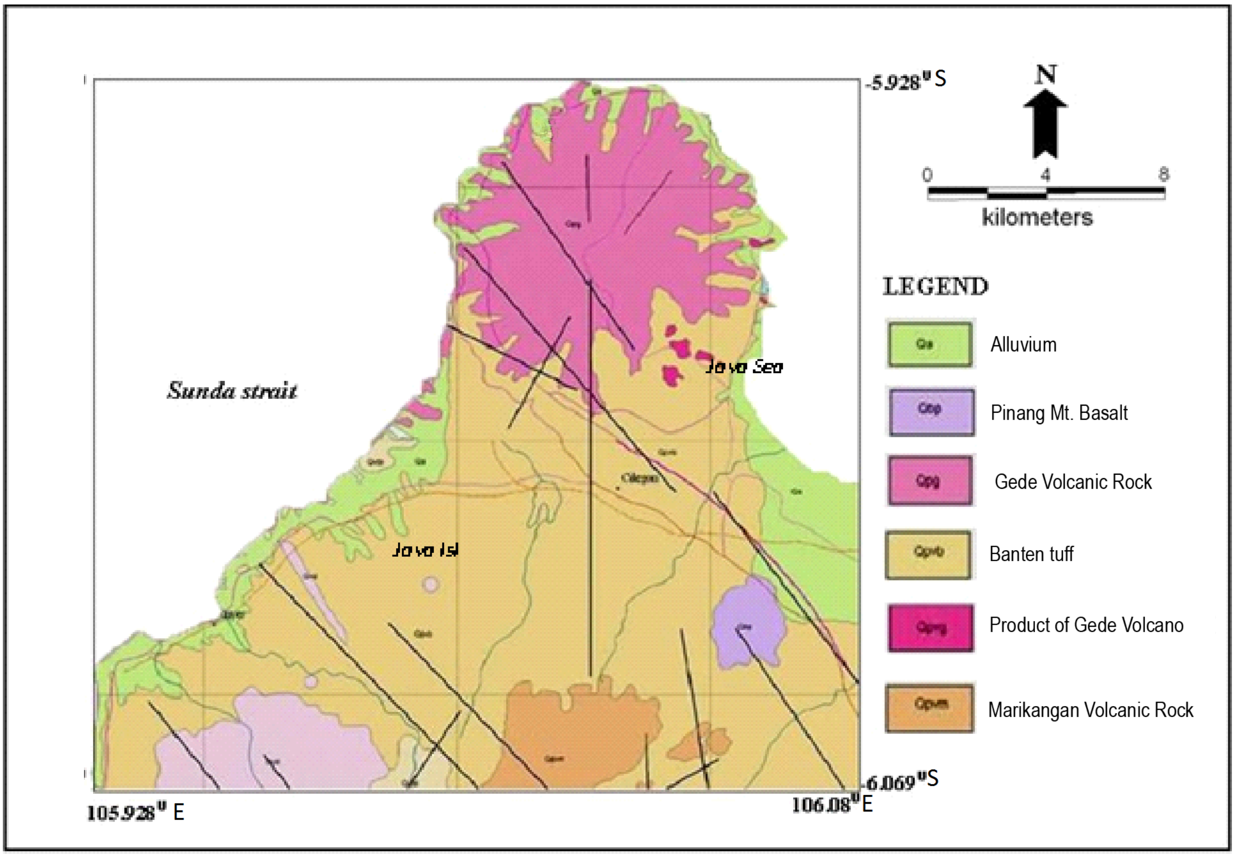


Figure 2. The geological map of Anyer Quadrangle ( modified from Santosa et all, 1982)

channel of shallow seismic reflection by using GPS (Global Positioning System) devices.

In practice however, the reflection seismic technique is mostly - complex because the echoes (reflected energy or seismic events) of interest are noised by both coherent and random. To compensate, sophisticated acquisition and processing methods have been developed to enhance the relative amplitudes of the reflected seismic events of interest. Many of these methodologies are site and target dependent. The interpretation of reflection seismic data is also complex, and as much an art as a science. Interpreted velocity/ depth models can be unreliable because of either inaccurate velocity control or incorrect seismic event identification. Similarly, seismic amplitudes can be misinterpreted because of attenuation and improperly applied gain control. (Anderson N and Akingbade A, 1995)

The success of continuous marine seismic profiling methods are sitedependent but have the potential to produce high resolutionrecords in shallow water (Haeni, 1986, 1988)

The interpretation is based on the seismic stratigraphy interpretation (Mitchum et al, 1977 a and 1977b). Its objective is to define the genetic reflection packages by the surfaces that envelope seismic sequence and system tracts. These bounding discontinuities are identified on the basis of reflection termination patterns and their continuity.

Boundaries are defined on a seismic line by identifying the termination of seismic reflectors at the discontinuity surfaces.

Seismic lines and location is determined by regional geological setting of the area. Trend of seismic lines are dominantly north – south. In order to get the seismic data which could give geological setting configuration, sismic lines should be perpendicular to the strikes of the sediments (Figure 3).

The drawing of seismic horizon was based on the criteria proposed by Ringis (1986). The assumption wave velocity has proposed that all horizons of seismic is 1,500 meters / seconds.

Data from the seafloor depth measurements of analog data, namely tide correction to get the value of the actual sea depth. Contouring process bathymetric data is done using Surfer software version 8.0 which then produce bathymetric contours. Furthermore, bathymetric map-making is done by using the Mapinfo program. While data analog recording is used to look at the cross section of seabed morphology more clearly, a

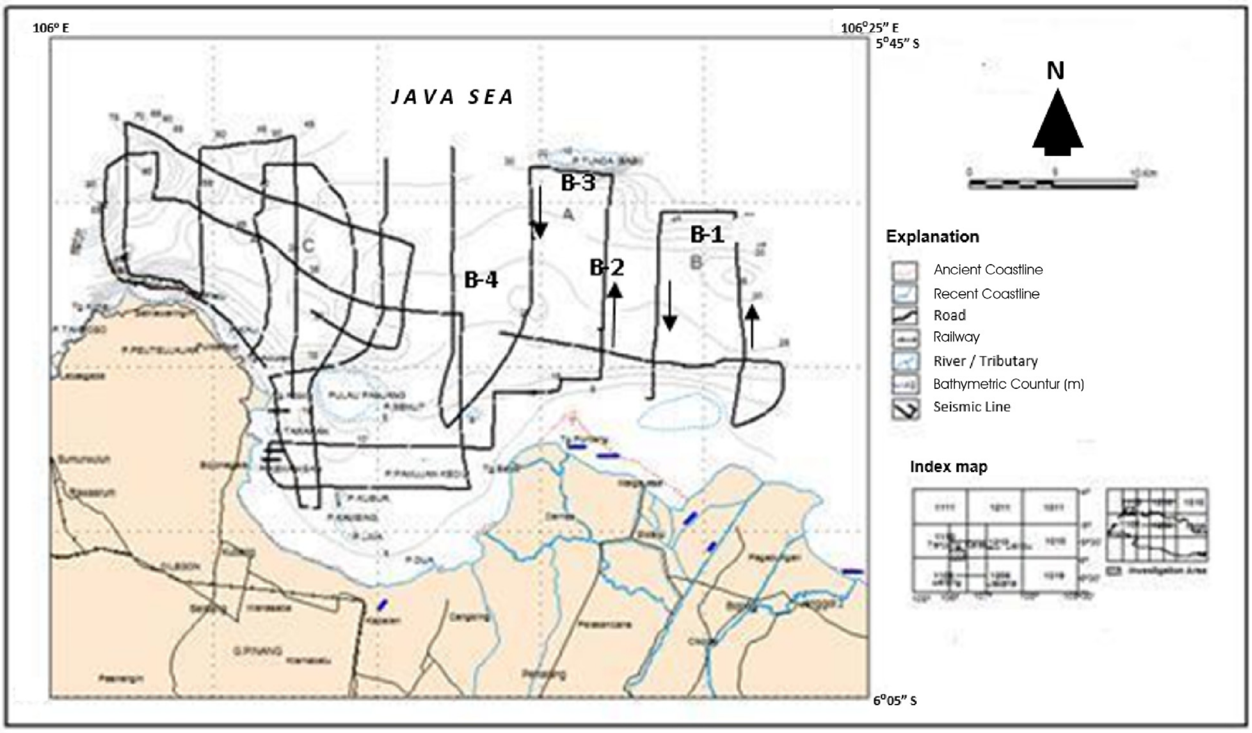


Figure 3. The location of seismic line ( modified from Hadikusumo, S et.al, 1988)

good cross section perpendicular to the shoreline as well as a cross section parallel to the shoreline.

## RESULTS

More than 200 km seismic reflection line was carried out and based on the analog recording data, the sub-surface geological condition of study area can be explained as follows:

Sequence A is the most upper layer which is characterized by strong reflector, parallel to sub parallel, high amplitude and continuous. This sequence can be seen at depth about 20 – 70 m below sea level (Figure 4, 5, 6 and 7). Based on the reflector character, the upper most layers can be interpreted as a fine grained sediment (clay, silt and mud) which was deposited as a near shore deposit. The morphology where this unit was deposited is characterized by flat to submarine hill undulation. Below sequence A is sequence B which were dominated by concave bedding form which is characterized by wavy sub-parallel to parallel and most of them have tranparent reflector, low amplitude, weak and uncontinuous reflector. Based on the characteristic of reflector, this unit probably is characterized by undifferentiated sediments and interpreted as sub-marine paleo-river environment. The biggest channel which can be found in this area is about 4 – 5 km (Figure 4, 5, 6 and 7). Below sequence B is sequence B1. This sub sequence is characterized by medium to strong reflector, high amplitude, sub parallel – parallel and wavy reflector. This sequence shows as a bottom part of a big submarine channel and probably have a differences lithology character with the upper part channel. Sequence C is overlain by sequence A and B1. This sequence is dominated by strong reflector, high amplitude, sub parallel – parallel and wavy. Based on the regional geology condition, this sequence is assumed as coastal or fluatile deposit. With the ages about Upper Plistocene to Holocene. The lower most sequence is sequence D (seismic basement) which is characterized by strong reflector, high amplitude, subparallel – parallel, wavy and continuous. The upper boundary of this sequence is dominated by wavy undulated morphology and is catagoried as erosional truncation.

Based on the regional geological condition of the study area, sequence D can be classified as Plistocene volcanic product.

## DISCUSSIONS

The seismic sections clearly show the characteristic curved geometries of classic cut-and-fill or channel features (Figure 4). From the morphology feature can be identified at least two channel features, each approximately 2 to 4 km wide with one slightly offset yet superimposed on part of the other. According to seismic interpretation shows that the paleochannel geomorphology with respect to interbed sequences and its characteristic variability.

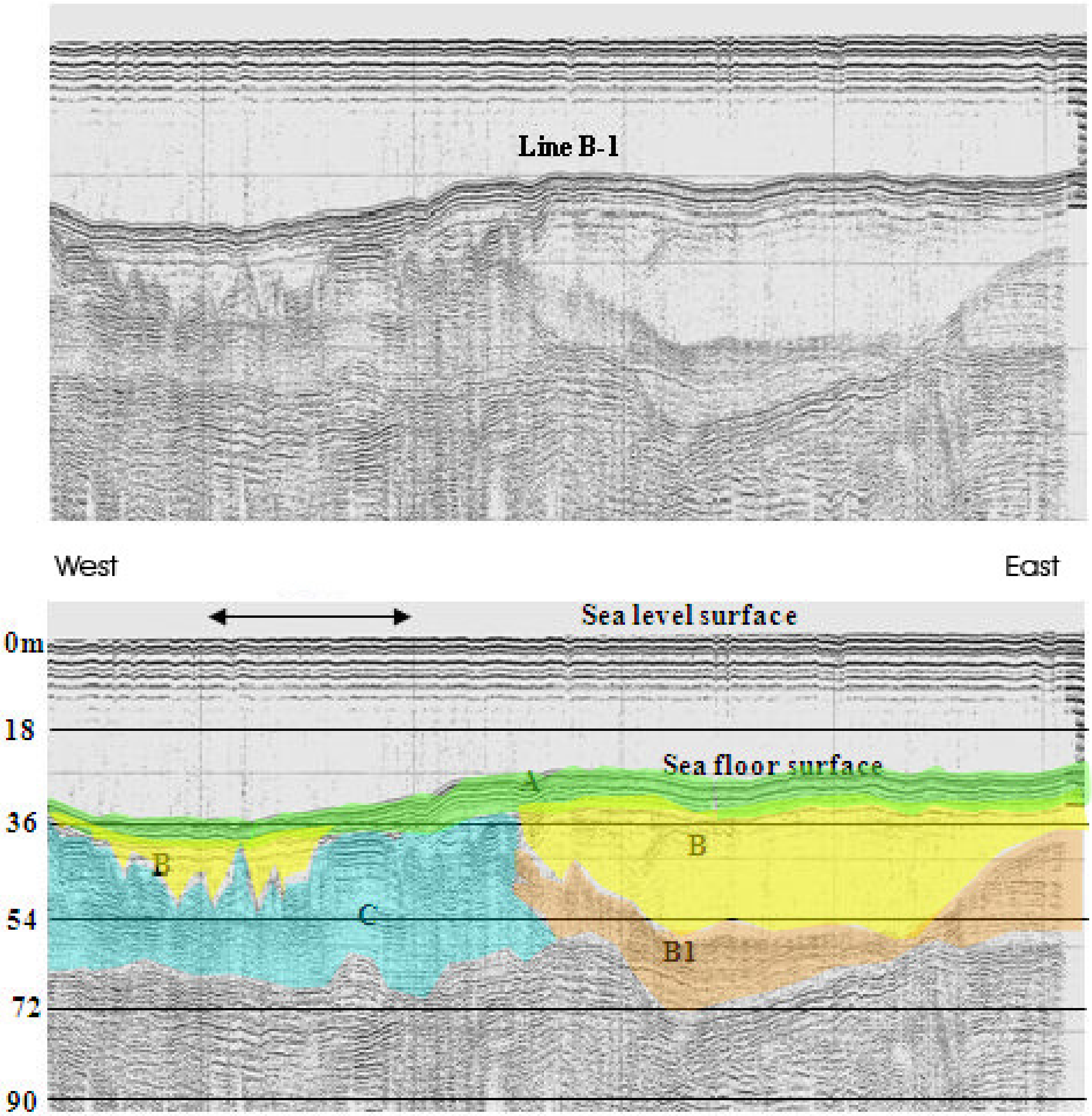


Figure 4. Original and interpretation of seismic reflection record of line B-1

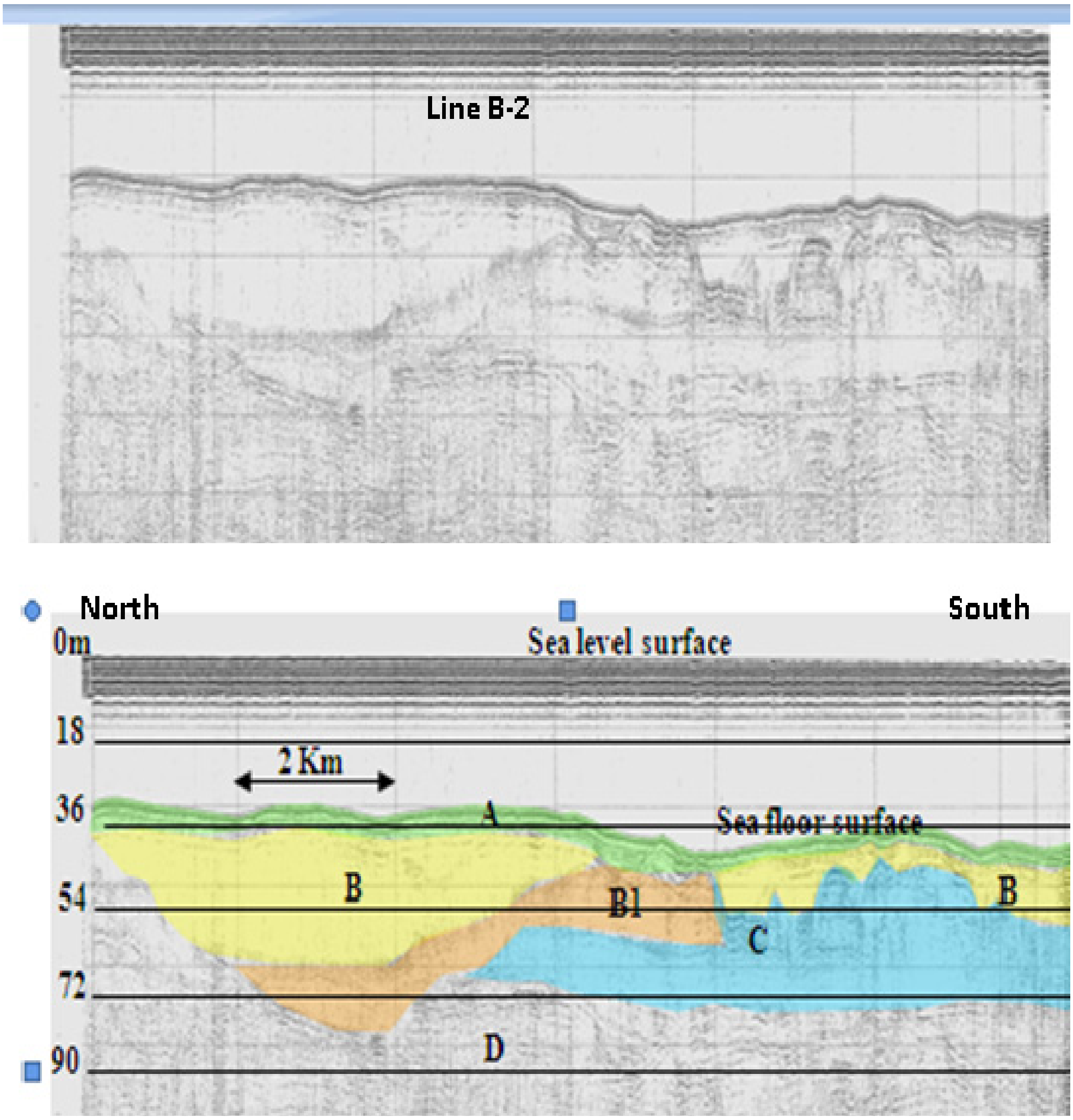


Figure 5. Original and interpretation of seismic reflection record of line B-2 (Upper original and bellow interpreted record)

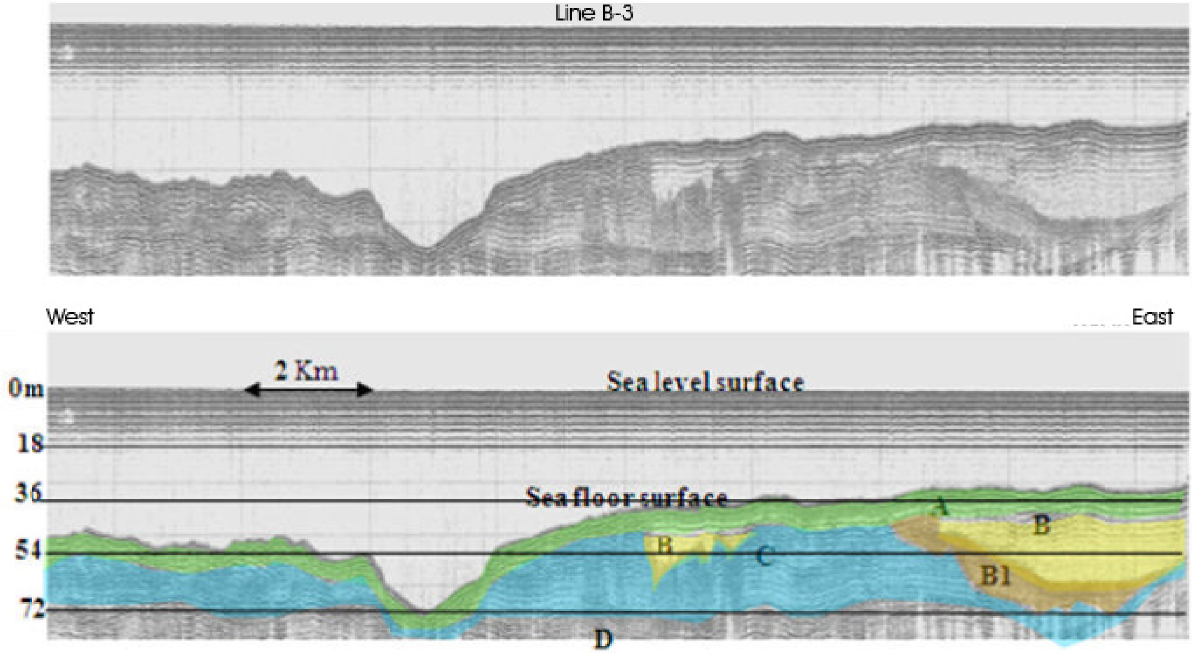


Figure 6. Original and interpretation of seismic reflection record of line B-3.

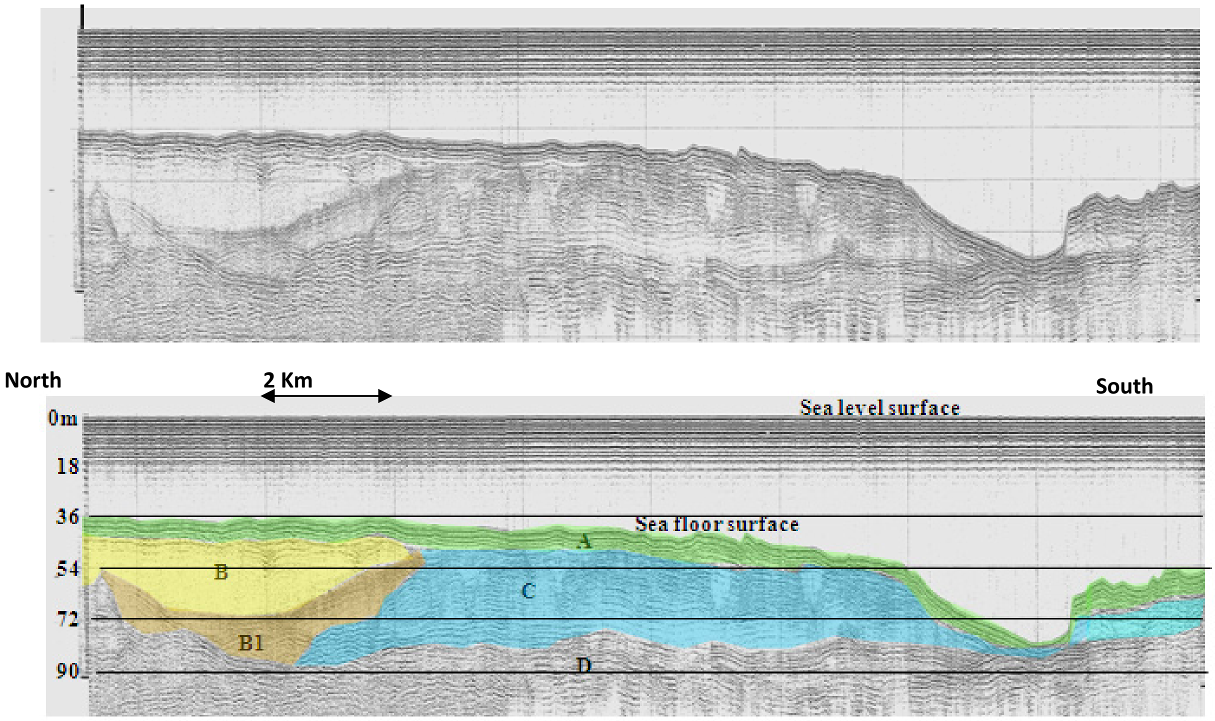


Figure 7. Original and interpretation of seismic reflection record of line B-4

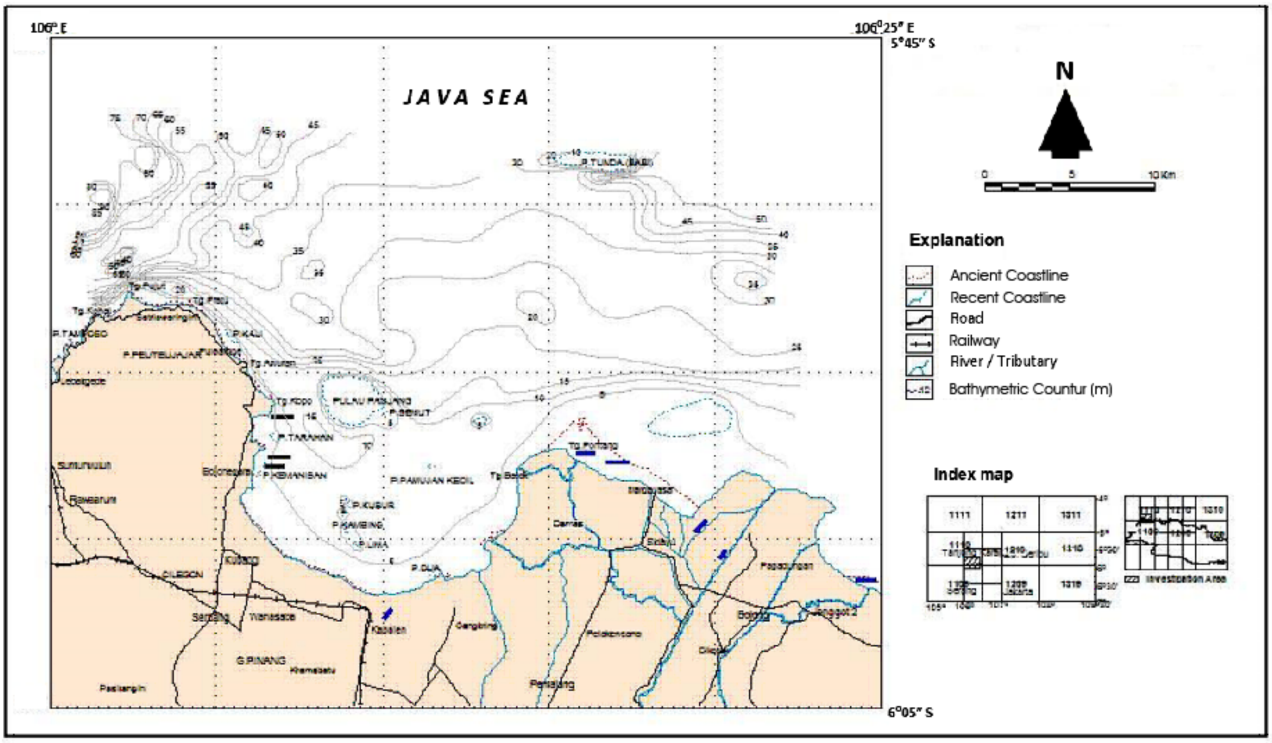


Figure 8. Bathymetric map of study area.

From the bathymetric mapping survey results, shows the seabed relatively flat with an average a depth of 20 m, where also found the shape of the sea floor that resembles with some valleys groove formed (closures) and forming a lineament trending northeast - southwest. The valleys as a small notches constitute grooves strait within Kopo Cp. and Porong Cp. The layout of this valley groove near the mouth of the river towards Porong Cp. that assumed, flow channel river valley which has been inundated by sea level rises (Figure 8).

Based on the interpretation of shallow seismic reflection which is taken in the North Serang waters, that found a layer of sea sand deposited in paleo channel morphology. This layer is the system that occur during the an interglacial process on the Sunda Shelf is still a part of land that connecting among the Java, Sumatra and Kalimantan Islands. Paleo-channel deposits are characterized by reflection character subparalel - chaotic with a thickness of between 5-35 meters.

Based on the fence diagrame of several seismic line, shows that the direction of the channel is east–west (Figure 9).

## CONCLUSION

The water depths in study area range from 5 to 20 meters in the southern part of Tunda Island. Furthermore, to the north of the study area to Tunda Island the depths reach 50 meters.

The study area is a part of the Sunda Shelf which connecting Java, Sumatra and Kalimantan Islands that influenced by inter-glacial process. Sand deposits are characterized by reflection character subparalel - chaotic with thicknesses between 5-35 meters.

Sequence A is interpreted dominated by clay which in some areas containing lenses of fine sands, mollusc shells, and carbonate material while Sequence B is interpreted as sedimentary layers of sand. Contact between A and B sequences is erosional truncation and downlap. Distribution of paleochannel which be indicated containing sand is occurred on sequence B.


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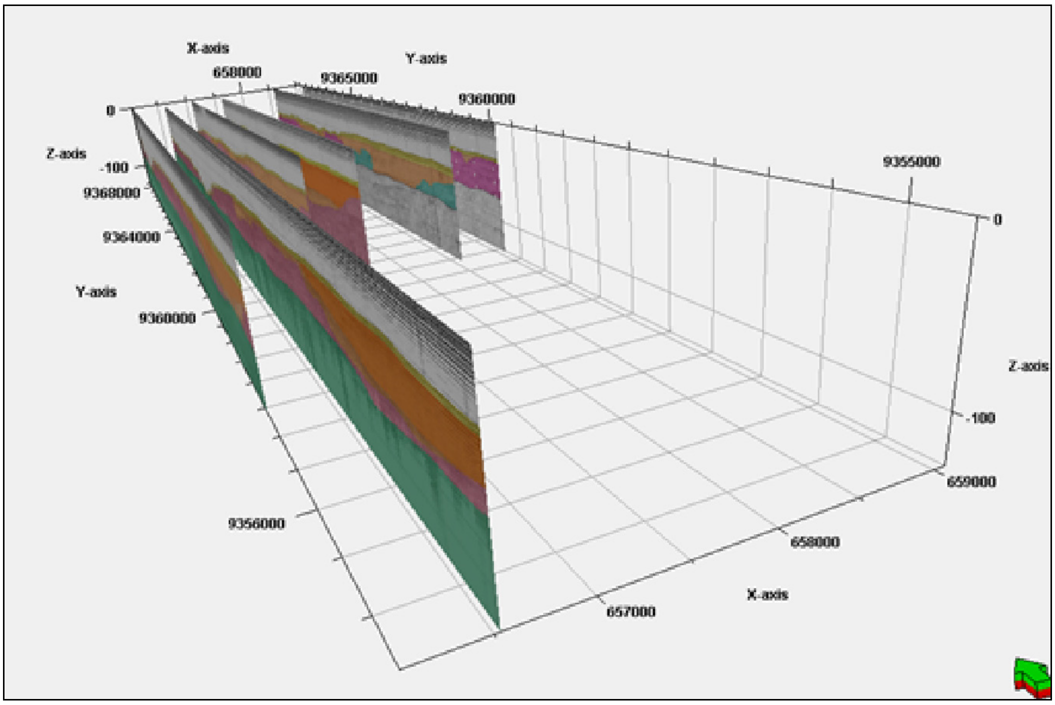


Figure 9. Fence diagrame of seismic record

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