

## Coastal Characteristics of South Singkep Area, Riau Islands Province

### *Karakteristik Pantai Singkep Selatan, Propinsi Kepulauan Riau*

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**ABSTRACT:** Observations of coastal characteristics, such as coastal constituent lithology, oceanographic processes and the influence of human activities along the coastal area, are the factors that affect the coastal typology. The typology of coastal area can be divided into 3 types namely: (1) Sandy beaches, dominated by medium size quartz sand, gravelly sand and silt of alluvium deposits; (2) Rocky beaches that belong to the Tanjung Buku Granite lithologic units and Persing metamorphic complex, its beach slope between 5° and 15°, and a fault structure encountered. The steep beach slopes (45°-50°) trends to offshore with the maximum depth of 28 meters below the sea level at the distance of 3.5 km from the its shore line. At the depth of 20 m, there are a foot slope of 1.5 km width interpreted as the fault plane; (3) Muddy beaches is characterized by mangroves, gentle beach slopes until flats. Those sandy and muddy beaches are alluvial deposits of Quaternary sediments.

**Keywords:** Coastal characteristics, relief, oceanographic processes and South Singkep

**ABSTRAK:** Pengamatan karakteristik pantai, seperti litologi penyusun tubuh pantai, proses-proses oseanografi serta pengaruh aktivitas manusia di sepanjang pantai merupakan faktor-faktor yang mempengaruhi tipologi pantai. Tipe pantai di daerah penelitian, dapat dibagi menjadi 3 jenis pantai, yaitu: (1) Pantai berpasir, disusun oleh dominasi pasir kuarsa, berukuran menengah, pasir kerikil dan lanau dari alluvium, serta kemiringan pantai rendah; (2) Pantai berbatu merupakan bagian dari satuan batuan Granit Tanjung Buku dan Kompleks metamorfik Persing, kemiringan pantai antara 5° hingga 15° serta dijumpai sesar. Kearah laut kemiringan lerengnya makin besar (45°-50°) dengan bagian terdalam mencapai 28 meter pada jarak 3,5 km dari garis pantai. Pada kedalaman laut 20 m, terdapat kaki lereng (foot of slope) dengan lebar 1,5 km yang diperkirakan sebagai bidang sesar; (3) Pantai berlumpur yang dicirikan oleh tanaman bakau memiliki kemiringan pantai yang relatif datar. Pantai berpasir dan pantai berlumpur merupakan endapan aluvium yang berumur Kuartar.

**Kata kunci:** Karakteristik pantai, relief, proses oseanografi dan Singkep Selatan

## INTRODUCTION

Singkep is the island belongs to the Lingga Archipelago of Indonesia. The area of this island is 757 square kilometres (292 sq mi). The Singkep island has two ports, Dabo near Dabo Singkep and Jago near to the Sungaibuluh. The Island is the southernmost island of the Riau Islands centered on Dabo Singkep (Bappeda Kepri, 2012). The islands in the Riau Islands Province is generally a remnant erosion of Pra-Tersier land, that extends from the Malay Peninsula to the Bangka and Belitung islands. The islands forming hilly and gently topography on the beach, with an average height of 2-5 meters above sea level.

Administratively, the study area belongs to the District of West and South Singkep, Lingga District, Riau Islands Province. The study area is bordered at the north with the Municipality Singkep and Posik Island.

At the west by the Berhala Strait separated from the east coast of Sumatra, to the East by the Malacca Strait and to the South by Lalang Island. Geographically, the location of the study are within 104°14'45"E - 104°34'45"E dan 0°30'00"S - 0°45'00"S (Figure 1). Achievement to the location of the Jago ferry ports, takes approximately 3 hours by road which its conditions is relatively good.

In general, the topography of the study area is inseparable from the topography of the Riau Islands Province, specifically in the form of Lingga Islands that form a path in the direction of the main geological structures in Singkep Islands where northwest-southeast trending. This island chain is the remnant of the old morphological with appearance of hills and mountains topography (Gupta, A., 2012).

### Regional Geology

Geomorphology Lingga Island consists of hilly with Lingga's mountain peak that extends with the northwest-southeast. The drainage pattern of plain foot is trellis to parallel. As well as Sebangka and Selayar Island that controlled by geological structure with a folds of longitudinal axis northwest-southeast. While the north-south trending fault, in other words morphology is a function of structure, process and time in a balance (or equilibrium) which here favours one and there another but never allows two of them to be ignored. Whereas it is probably rock that has been deformed in subaerial landforms at the expense of process, climate has certainly been understressed in the study of coasts, apart from such obvious facts that creatures such as corals and mangroves do have climatic controls (Davies, J.L., 1972).

Based on the Geological Map of the Dabo Quadrangle (Sutisna, K., et al., 1994), the study area is composed of several formations of the old to the young

age (Figure. 1), are as follows: (1) Granite and diorite rocks consisting of granite Muncung - Triassic age (TRgm) and Tanjungbuku – Jurassic age (Jgt), grayish, rough texture, coarse grained generally formed as batholiths, volcanic breccia, lava, tuff resulting from Tertiary volcanic activity. This granite is apart on the Singkep island, the presence of granite are also found on the Selayar and Bintan Island and surrounding island; (2) Bukit Duabelas quartzite (PCmpk), Permo Carbon age, the distribution on Singkep Island is locally, consisting of quartzite with intercalation of phyllite and slate; (3) Persing Metamorphic Complex (PCmp), Permo-Carbon age, is a complex rock that has distribution of most widely in Singkep Island, also exposed in the eastern part of Selayar Island. Composed of: alternation of phyllite, slate and graphic schist with quartz vein which interfingering relation with Bukit Duabelas quartzite; (4) Swamp deposits (Qs), located at the northern of Singkep coast around Raya bay (Kuala Raya) that consisting of mud, clay and peat; and (5)

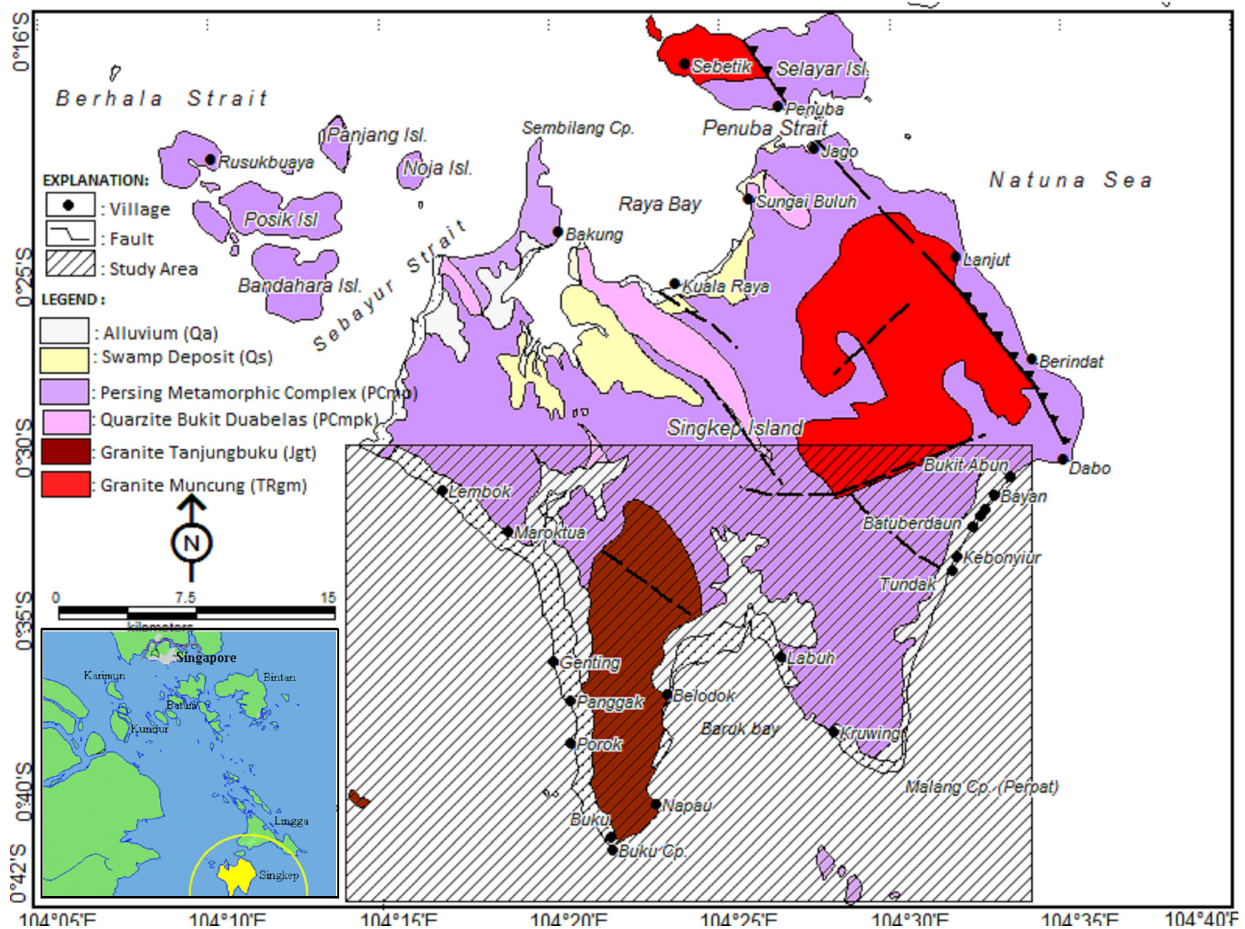


Figure 1. Geological and location map of study area

Alluvium deposits (Qa), consisting of pebble, sand, clay and mud.

Geology structures that devolved on study area, namely: normal fault, strike-slip fault and thrust fault. The structure is generally relatively directed northwest-southeast. Thrust fault found on the west side of the Singkep Island, precisely on the west side of Muncung granite that once the boundary formations between granite Muncung with metamorphic complex Persing, where found from around Dabo continues towards the northwest up to Selayar Island.

## METHODS

Coastal characteristics observations, not only to observe the coast formed due to oceanographic processes, but more important is how the relationship of coast formed to coast constituent lithology, including observing all the geological processes that occur, or in other words the observation characteristics of coast is part of the surface geological mapping consider oceanography aspects at the coastal and surrounding area using direct visual observation in the field (Aryanto, N.C.D., 2014). According to Strahler (1979), coastal definition is a zone in which coastal processes operate or have a strong influence. Coastal characteristic mapping is aimed to find out the coasts character and physics feature, both of genetically and change that influenced by human activity at coastal zone. Classification of coast type character refers to Dolan classification (1975) that considers to: geology aspect (such as: lithology, morphology, geology structure, etc.), topography, oceanography, vegetation, physical characteristics and changes due to human activities.

The data used in this study was obtained from the results of research conducted by the Marine Geological Institute of Bandung (Mustafa, M.A., et al., 2014). Observation equipment used in coastal characteristics, such as: geological hammer and compass, loupe, measuring rope, camera, grains comparator, stationery and basic map.

## RESULTS

Based on 18 location of the observation (Figure 2), Coastal of South Singkep which is an area of research, the characteristics of the coast can be divided into 3 types, namely: (1) Sandy beach; (2) Rocky beach and (3) Muddy beach (Figure 3).

### Type (I) of Sandy beach

The sandy beach is the most dominant type of beach, occupying  $\pm 80\%$  of the beaches in the study area. Located on the west side of the Buku Cape and the east side of the Perpat Cape, in eastern Perpat Cape - from the Mount Abun in the northern village of Bayan

(near SK-14) to the Cape Perpat and west side of the Buku Cape from Lebok village and its surrounding to Buku village.

### Lithology

Sand constituents are composed mainly of quartz dominance, and slightly reworked of rock-forming minerals, such as pyroxene, hornblende and olivine with the generally conditions have ruptured. Beaches are generally white to dark yellow (dominated by quartz), with a relatively uniform size (medium size), separately and detrital, in some types of coastal beaches are also composed by quartzite. For beach on the east side of Perpat Cape, sandy beach is a constituent part of Alluvial Unit (Figure 4) and the Persing metamorphic complex that exposed around at Batu Ampar waterfall (Figure 5).

### Coastal morphology and topography

In general, the sandy beach face slope, ranging from 0 or flat to 5 - is part of Alluvial Unit (Figure 6), that it has a straight coast, and is a stable beach.

Especially for areas where located in the headlands as at Napau Cape and Buku Cape and its surrounding, had a beach slope of 5 to 15 (Figure 7), due to at the bottom of the sandy beaches, there are outcrops of granite, which is part of the Buku Cape Granite Unit which coastal beach form is a pocket beach and showed indications of abrasion. Besides the two forms of the beach, the spit morphology found also as a sedimentation process result, as seen in the Belodok Beach and its vicinity (SK-12) with sandbar at the rear and front of the beach (Figure 8).

Towards the sea by the crossline profile A-B (Figure 9 and 10a) ranges slope from 30-35 at a distance of 6 km reach different depths of 10 meters, which the surface of the surficial seafloor sediments range from *silty sand* to *coarse sand* (Kamiludin, U., et al., 2014).

Wave character when measurements were performed (April) relative calm, a wave height ranging from 15-20 cm with 6-8 second period and wave direction N 140 E (southeast relatively).

### Type (II) Rocky beach

Distribution of rocky beach type in study area is scattered and locally. This beach, is generally present in the cape area, such as: Perpat Cape, Napau Cape (SK-17) and Buku Cape (SK-16) and found also at flanking side of pocket beach form (Figure 11), as seen in Porok Beach, Panggak (SK-19), and Kruwing Beach.

### Lithology

The rock components generally is part of Persing metamorphic complex (on the east side) and Granite

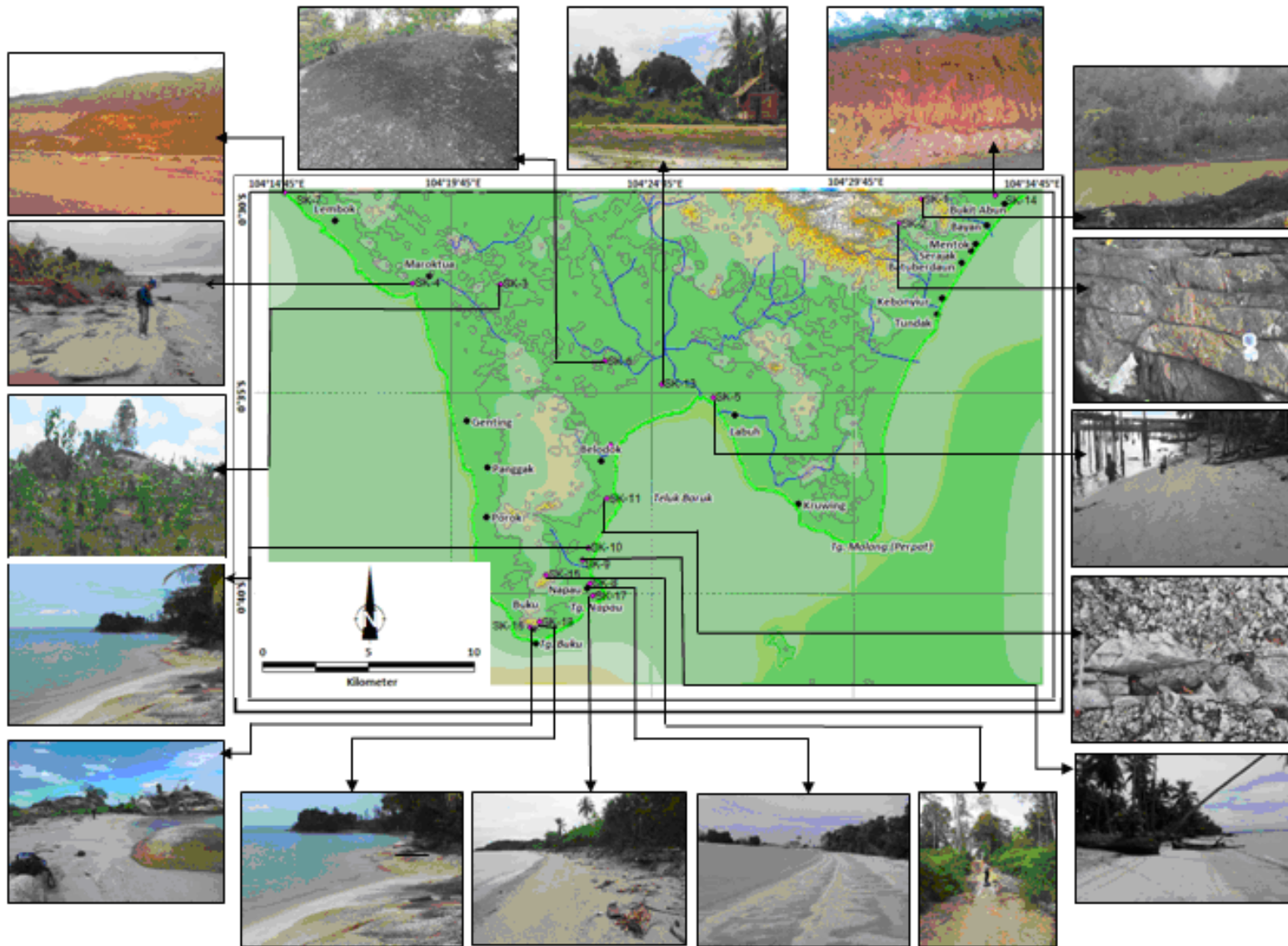


Figure 2. Location map of coastal characteristics observation

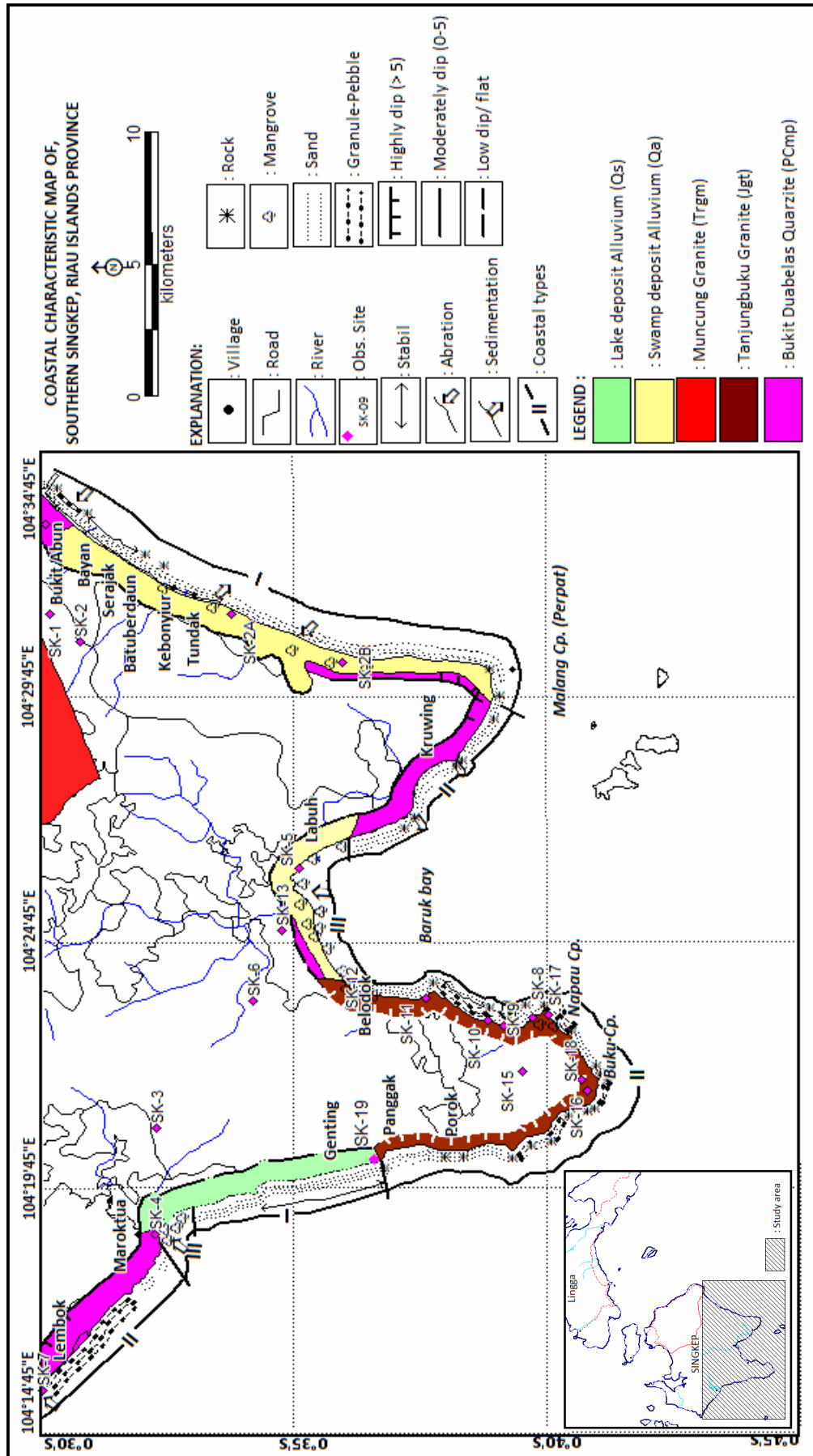


Figure 3. Coastal characteristic map of study area



Figure 4. Sand, silty sand and gravelly sand is part of Alluvial Unit at Napau Beach (SK-9); lithologies unit is one of the constituent beach type-1



Figure 5. Phyllite outcrops of Persing metamorphic Complex, showed many fractures and a slightly altered



Figure 6. Sandy beach, beachface slope is  $<5$  at Napau beach and its surrounding (SK-8).



Figure 7. Sandy beach, beachface slope is  $>5$  at Buku Cp. and its surrounding (SK-16)



Figure 8. Sandy beach and spit morphology at Belodok beach (SK-12).

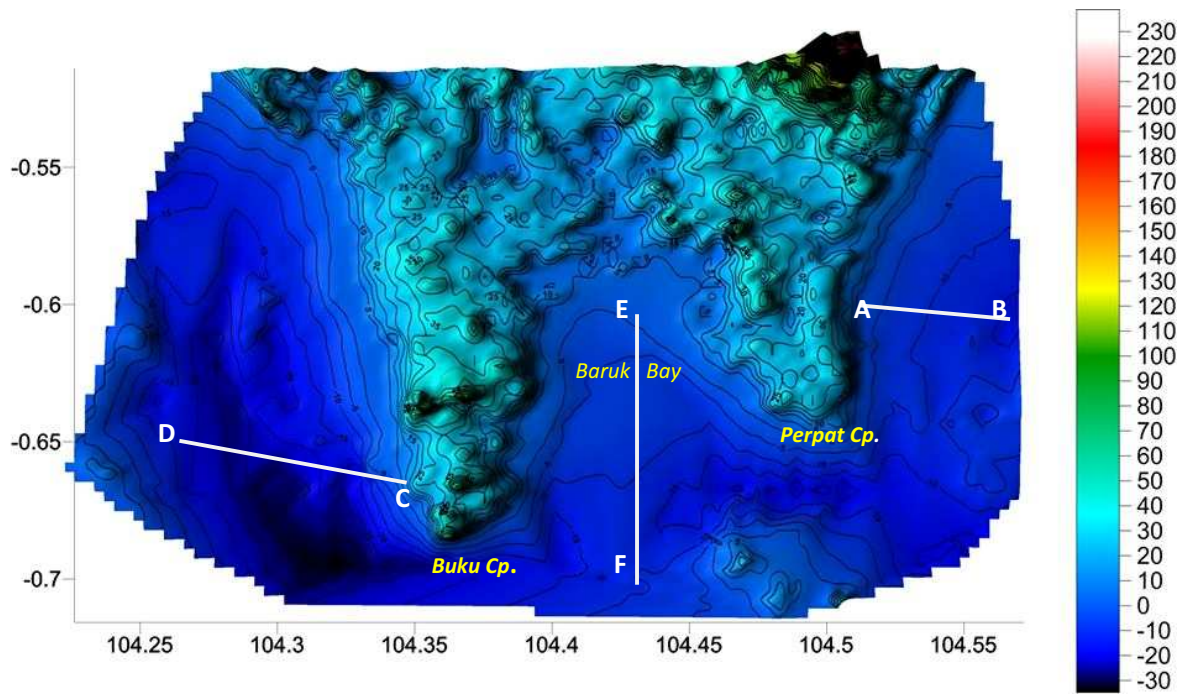


Figure 9. Coastal and seafloor morphology of study area

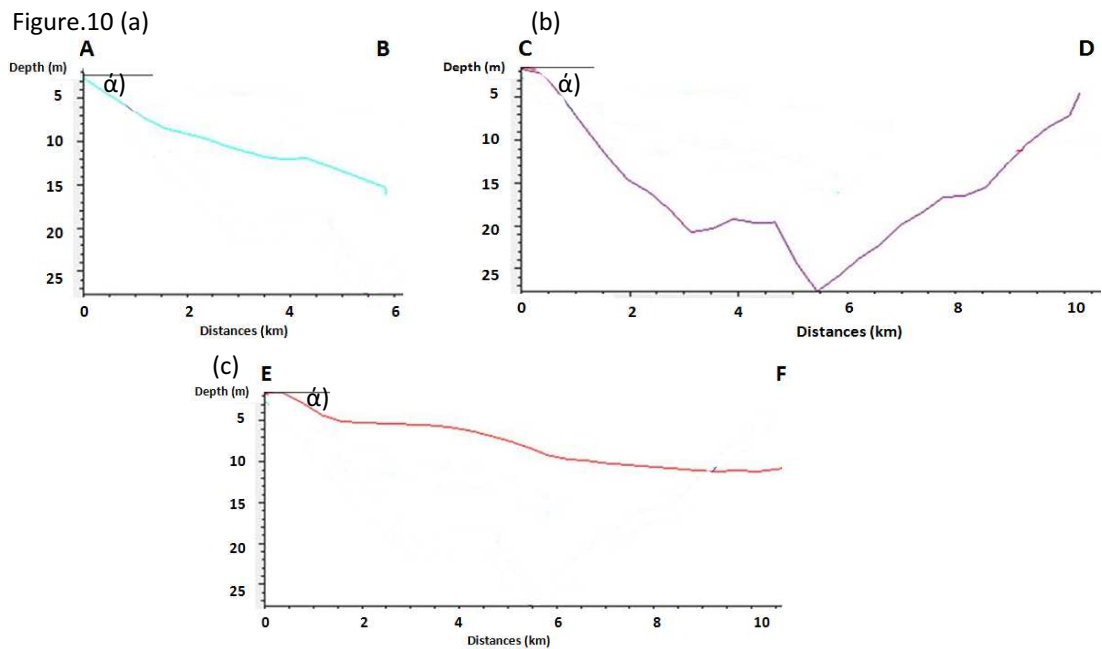


Figure 10. Cross section of coastal to seaward

Buku Cape (west side of the study area) composed of granite that altered and deformed, is marked by numerous fractures with were 14 cm width then filled by quartzite. Granite is characterized by grayish color, rough texture, crystal size of coarse grained quartz and mafic minerals are large (1 - 2.5cm), hollocrystalline texture, panidiomorphic granular (Figure 12). Quartzite, dark white to grayish, crystal size to 8 cm and amorf (Figure 13).

**Coastal morphology and topography**

In general, the beach face slope of the rocky beach has range of 5 to 15 and even more than 15 as seen around at northern of Napau beach (SK-10) - (Figure 14). This appearance is understandable, given that the rocky beach at study area in which the composition of the plutonic rocks that are characterized by resistancy against the waves of wind and other weathering processes so that the general condition of its beaches form a stable beach. Towards its land, this granite rocks

form many isolated hills morphology, as seen at eastern of Maroktua (SK-03) – (Figure 15). Meanwhile, towards the sea by the crossline profile C-D (Figure 9 and 10b) ranges slope from 45 -50 at a distance of 10 km reach different depths of 25 meters, which the surface of the surfacial seafloor sediments range from coarse sand to gravelly sand (Kamiludin, U., et al., 2014). In cross section, the seabed slope is quite steep valley with 'V' shaped in width 10 kms. The difference between the foot slope ( $\pm 1.5$  kms width) to the deepest part of the valley at 8 metres were trending NW-SE in accordance with the general direction of the fault in its land.

**Type (III) Muddy beach**

Muddy beach is the type of beach that is not too wide be found, estimated that only about 5% of all types of beaches there, just encountered around the mouth of the Baruk bay, Maroktua estuaries (Figure 16) and Labuh estuaries.



Figure 11. Rocky beach that flanking of sandy beach at Panggak beach and its vicinity (SK-19)



Figure 12. Outcrop handspeciment of Tanjung Buku granite (SK-10A).



Figure 13. Fracture of granite (N 36 E) that filled by quartzite as apart of Buku Cape granite unit at around southern of Belodok beach (SK-11).



Figure 14. Rocky beach has high slope at northern of Napau beach (SK-10).





Figure 15. Hilly morphology is composed by granite unit at eastern of Maroktua (SK-3).

### Lithology

Constituent material of mangrove beach is generally a part of the alluvial units, such as fine sand, silt and gravelly sand with grayish white color, loose grain and detrital. Sand component consist of quartz, lithic and shell fragments. Coast resistance to the waves is very low, making it vulnerable to abrasion process.

### Coastal relief

In general, beach face incline of this coastal type showed  $<5^\circ$  with a beach face width varying from 4-12 meters perilously close to the mouth of the river, beach face width is more narrow with its relief is generally a flat area (Figure 16). Therefore, the designation of this type of coastal areas are used as residential areas and plantations. Towards the sea as shown in Figure 9 and 10c, the slope is no more than  $10^\circ$  with a sea depth of 10



Figure 16. Muddy beach at Maroktua (SK-4) with low slope and overgrown by mangrove.

meters with a distance of 10 km. Seabed sediment type is dominated by muddy.

### Coastal use

Coastal area use, not only for housing and plantation but also for tourism area, there is at Buku cape and its surrounding which white sand distribution and granite which function as a natural wave barrier. Toward its land, various of hills morphological appearance with cool air and the presence of a waterfall (Figure 17) as a result of geological events, adds to the appeal to be developed further. This potential would be optimal, if supported by the existence of adequate infrastructure, such as roads, ports, banking facilities and other supporting facilities.

### CONCLUSION

Coastal characteristics of the study area is divided into 3 coastal types such as (1) Sandy beaches, of medium quartz sand, gravelly sand and silt, and gentle slopes. (2) Rocky beaches of the Tanjung Buku Granite lithologies and Persing metamorphic complex, and (3) Muddy beaches of mangroves, and low slope until flats. Types of rocks form the coastal types in shape and seabed morphology. The coasts of harder rocks are resistant to erosion forming generally steep slope beaches.

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Figure 17. Waterfall at Batu Ampar (SK-2) as tourism land use

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