THE RATE OF SEDIMENTATION ESTIMATION OF TANJUNG API-API ESTUARY SOUTH SUMATERA BY USING ^{210}Pb PROFILE

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ABSTRACT

Sedimentary processes occur intensively in Tanjung Api-Api area situated in the estuary of Musi Banyuasin river. A study on ^{210}Pb isotopes of the sediments has been done to understand the rate of sedimentation. For that purpose, the Marine Geological Institute (MGI) has also conducted bathymetry and sediment distribution mappings. Two samples represent depths of 17-30 cm and 190-210 cm below sea floor give age of 11.54 and 22.45 years. The average of sedimentation rate is 2.03 cm/years (from 0 to 0.3 m below seafloor) and 8.9 cm/years (until 2.1 m depth below seafloor). The result shows, decreasing sedimentation rate upward, that indicates the surficial sediment less influenced by wave and surface current nowadays.

Keywords : ^{210}Pb isotope, rate sedimentation, Tanjung Api-Api

SARI

Proses sedimentasi yang intensif terjadi di kawasan Tanjung Api-Api yang terletak di muara Sungai Banyuasin. Penelitian isotop sedimen ^{210}Pb untuk mengetahui kecepatan sedimentasi telah dilakukan oleh Puslitbang Geologi Kelautan, selain itu dilakukan pula pemetaan batimetri dan sebaran sedimen permukaan dasar laut. Dua buah contoh sedimen mewakili kedalaman 17-30 cm dan 190-210 cm di bawah dasar laut memeperlihatkan umur 11,54 dan 22,45 tahun. Kecepatan sedimentasi rata-rata 2,03 cm/tahun (pada kedalaman 0-0,3 meter di bawah permukaan dasar laut) dan 8,9 cm/tahun (hingga kedalaman 2,1 meter di bawah dasar laut). Hasil tersebut menunjukkan penurunan kecepatan sedimentasi ke arah atas, yang mengindikasikan bahwa pada saat ini gelombang dan arus kurang berpengaruh terhadap proses sedimentasi.

Kata kunci : isotop ^{210}Pb, kecepatan sedimentasi, Tanjung Api-Api

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INTRODUCTION

Natural radioisotope ^{210}Pb was firstly introduced by Goldberg (1963) with half life ($T_{1/2}$) 22.3 years for geochronology. The radioisotope is commonly used for interpretation of sediment age up to 100 years (Oldfield and Appleby, 1984). The radioisotope ^{210}Pb might be used as a tool for study of sedimentation process. This radionuclide in sediment is correlated with sediment genesis and sedimentation rate of fine sediment accumulated in calm water. This paper presents radioisotope ^{210}Pb data to study sedimentation rate in Tanjung Api Api area, estuary of Musi Banyuasin River.

The estuary of Musi Banyuasin River is about 100 km northeast from Palembang, South Sumatera Province. The study area covers an area of about 600 km^2 at 104°45'00"–104°58'00"E and 2°10'00"–2°40'00" S (Figure 1).

Based on Quaternary Geological Map, Sungsang Sheet, Sumatra (Rimbaman and Mulyana, 1994), the study area consists of sand bars, nearshore and shallow marine sediments, mangrove swamp sediment and small part of flood plain sediments (Figure 2). Stratigraphically, the study area is composed of quaternary deposits that are begin from Pre-Holocene (pHs) as fluviatil sediments. They consist of clay, silty sediment, sticking tenacious clay characterized by reddish brown remnant plants at the upper part. This pre-Holocene layer is bordered by hiatus of Holocene sediment interpreting as shallow marine sediments. The thickness of this layer is between less than three and more than 10 m and it composes of slightly clay with fraction of shells. The upper ward layer interpreted as shallow marine sediment that consists of brittle clay interrelated by silty layer or fine sand with reef fragments. It is then covered by mangrove swamp sediment with thickness between 1 m and 3 m. It mostly consists of silty clay and slightly peat and humus found locally. The third horizon is covered by flood plain sediment consisting of sandy clay or slightly into soft silt with approximately thickness of 1 m. It represents fluviatil sediment or land process.

METHODS

Seven core sediment samples has been collected by using hand and machine drillings in coastal and estuary areas (Figure 1) for ^{210}Pb analyses at laboratory of BATAN-Yogyakarta. Material and equipment used in laboratory are sieve 100 mesh, Spectrometer gamma Ge (Li), SRM IAEA-315 and weights (Sumining, et.al,1999). The sediment is pushed out and cut into 2 cm each by flexyglass the outer part was kept away and the middle part dried, pounded and sieved (100 mesh), homogeneous and then inserted in a container gamma spectrometer for ^{210}Pb.

Aged estimation using an equation Goldberg (1963) :

$$C_o/C_s = e^{-\lambda t}$$

C_o = ^{210}Pb unsupported content (^{210}Pb total – ^{210}Pb supported) at undisturbed sediment surface.

C_s = ^{210}Pb unsupported content (^{210}Pb total – ^{210}Pb supported) at a certain sediment depth

λ = constant (0.693/half life ^{210}Pb = 0.693/22.26)

t = sediment age (year)

If ^{210}Pb supported > ^{210} Pb total its mean this age > 150 years

Rate of sedimentation was calculated from sediment thickness is divided by age sediment Goldberg (1963). The bathymetry data is used

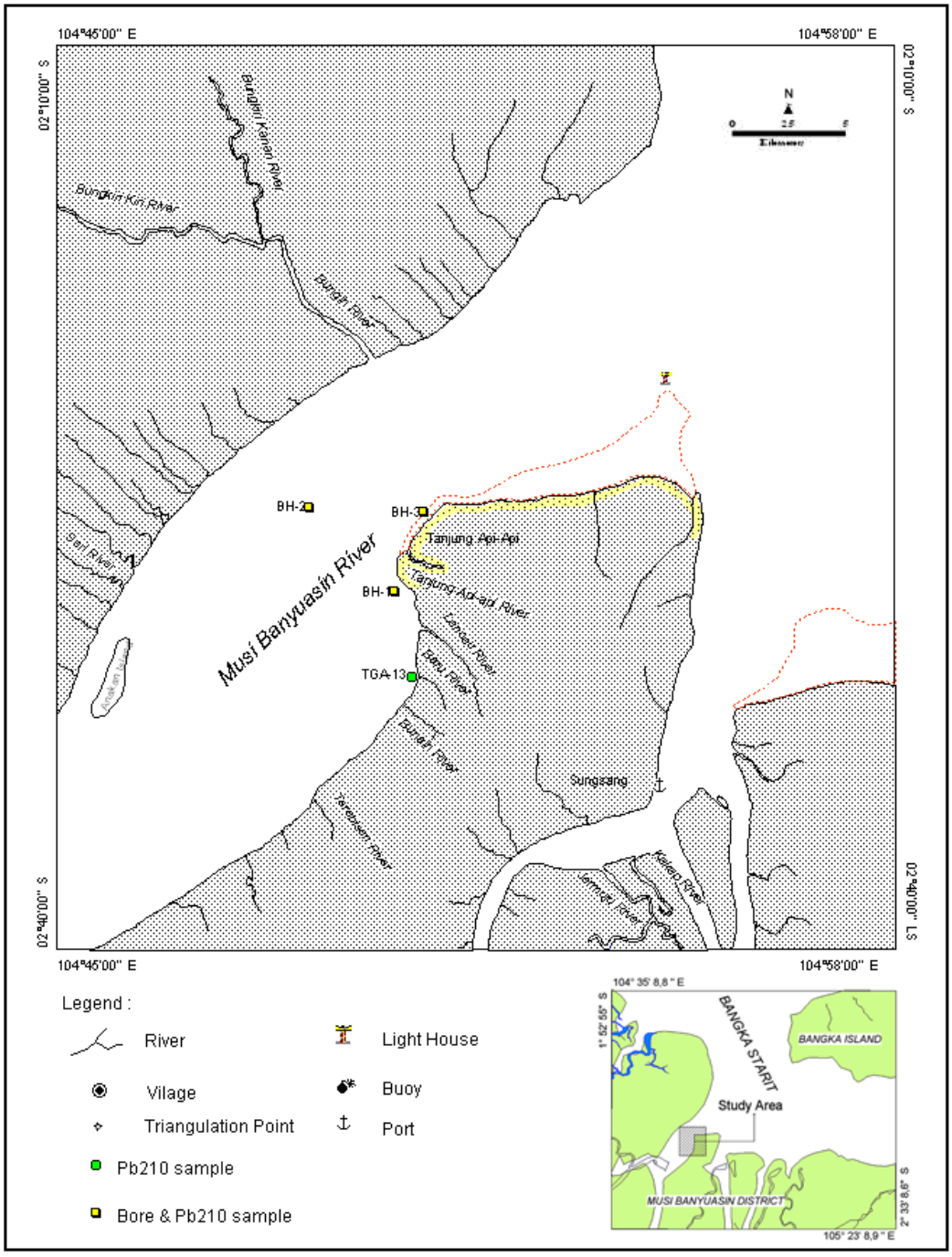

Figure 1. Study area

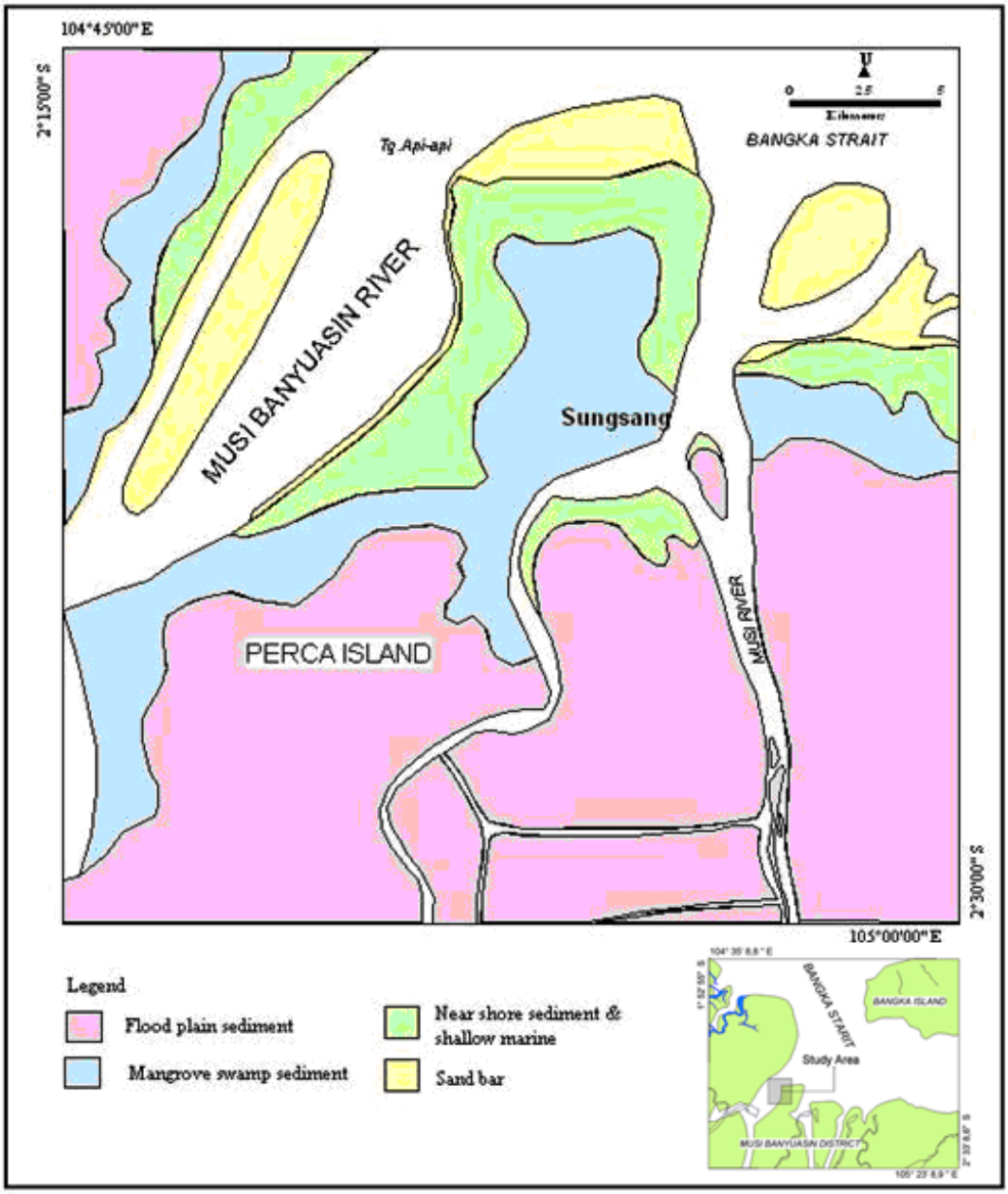

Figure 2. Quaternary geological map of Sungsang sheet, South Sumatra (after Rimbaman and Mulyana, 1994)

to indicate depth of sea floor in which bore hole is located (Figure 3). The distribution of sea floor surficial sediment is important as a guidance to find out the fine sediment within the bore hole succession.

RESULTS

Result of bathymetry and sedement distribution mapping show that the study area consist of silt (Z), sandy silt (sZ), sand (S) and silty sand (zS) as seen in Figure 4. Sampling were carry out at sediment type of silt and sandy silt due to this sediment type more realable for ^{210}Pb analysis.

Based on Folk (1980) classification, the distribution of silt sediment about 20% of study area that covers an area close to the river mouth both in north and southern part of the study area: Bungin, Terabisan, Bunain, Baru, Lancau and Tanjung Api-Api Rivers. It is distributed parallel to the costline in the Musi Banyuasin River but it does not occur in the estern part of the study area or north of Musi River. The characteristic of silt sediment is soft greenish gray, homogeneous, containing mafic mineral or organic materials.

Sandy silt predominate almost 50% cover the study area that is distribute in the middle of Musi banyuasin River into the strait of Bangka. The silt sediment is characterized by greenish gray, soft, homogeneous, and contain of black mineral. The soft send sediment composed of quartz and feldspar (50 %), 15 % of mafic mineral, and 5 % of shell. The grain shape is roundness to middle roundness.

Seven sub-samples have been analyzed for ^{210} Pb and only two can be used (TGA 13 at 17-30 cm and TGA 13 at 190-210 cm, Figure 1). The sample TGA-13 lies on indentation area that sedimentary type is soft sediment such as silt and sandy silt at water depth of 2-12 meteres. The result shows that the age of core at depth 23.5 cm below the seafloor is 11.54 years and at depth 200 cm is 22.45 years (Table 1). The average of sedimentation rate on surface sediment in river bed from 0 to 23.5 cm below the seafloor is between 23.5 cm/11.54 year or 2.03 cm/years and 200 cm/22.45 year or 8.9 cm/year. The other result, sample at 5 m below seafloor BH 1 (500-1015 cm) and BH 2 (500-1015 cm) indicates age of sediments is more than 150 years. It can not represent the real age.

DISCUSSIONS

The shallowest water depth is affected by sediments that accumulate as sandbar morphology *(spit)* upon ebbing. It can be

Table 1. Age of sediments based on ^{210}Pb concentration

No	No. of sediment samples (depth below the seafloor)	Co	Cs	Age (year)
1	TGA-13 (0-17 cm)	3.488 Bq/kg	-	-
2	TGA-13 (17-30 cm)	-	2.4076 Bq/kg	11.54
3	TGA-13 (190-210 cm)	-	1.7140 Bq/kg	22.45
4	BH 1 (500-515 cm)	-	-	>150
5	BH 1 (1000-1015 cm)	-	-	>150
6	BH 2 13 (500-515 cm)	-	-	>150
7	BH 2 (1000-1015 cm)	-	-	>150

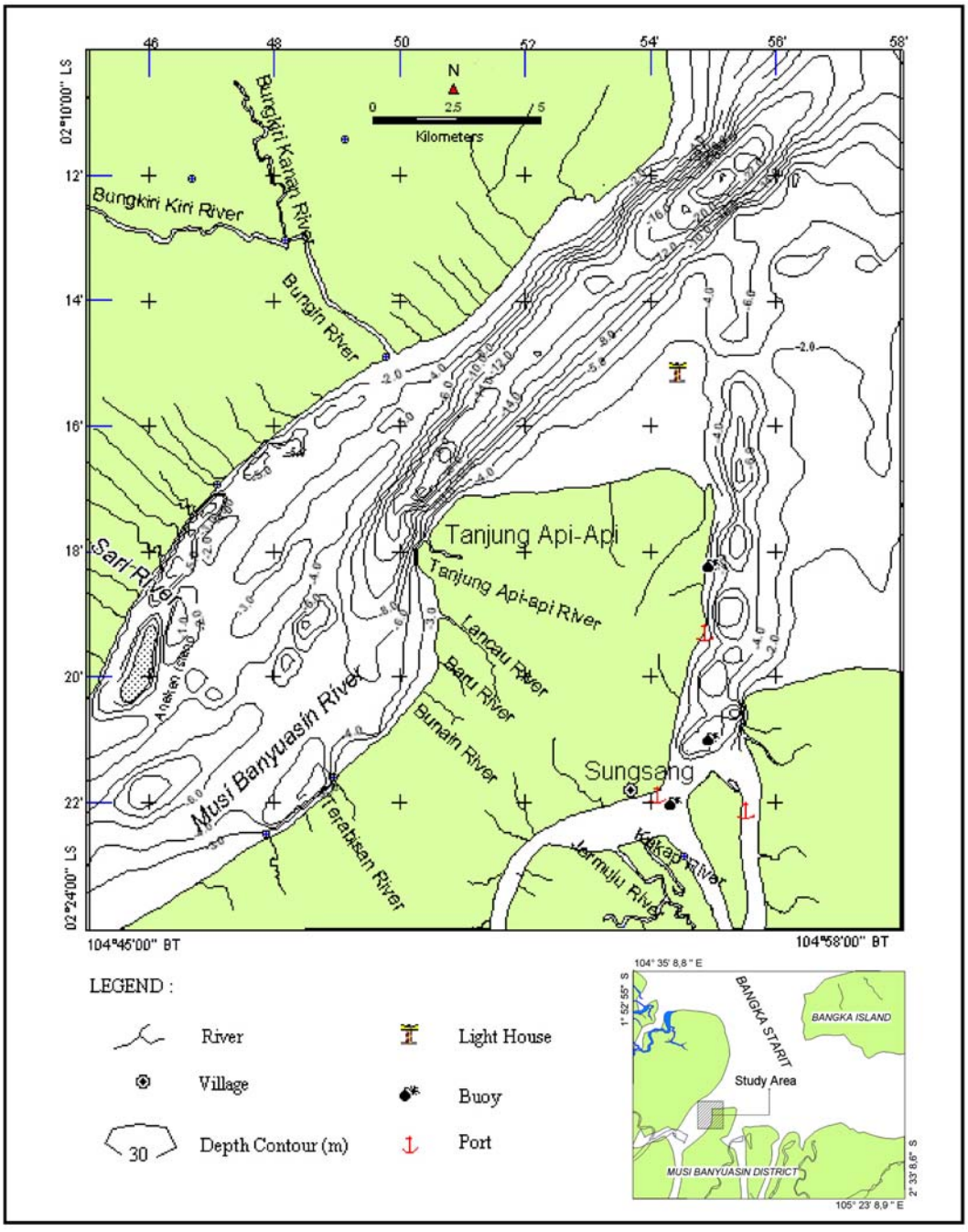

Figure 3. Bathymetric map surrounding Tanjung Api-api

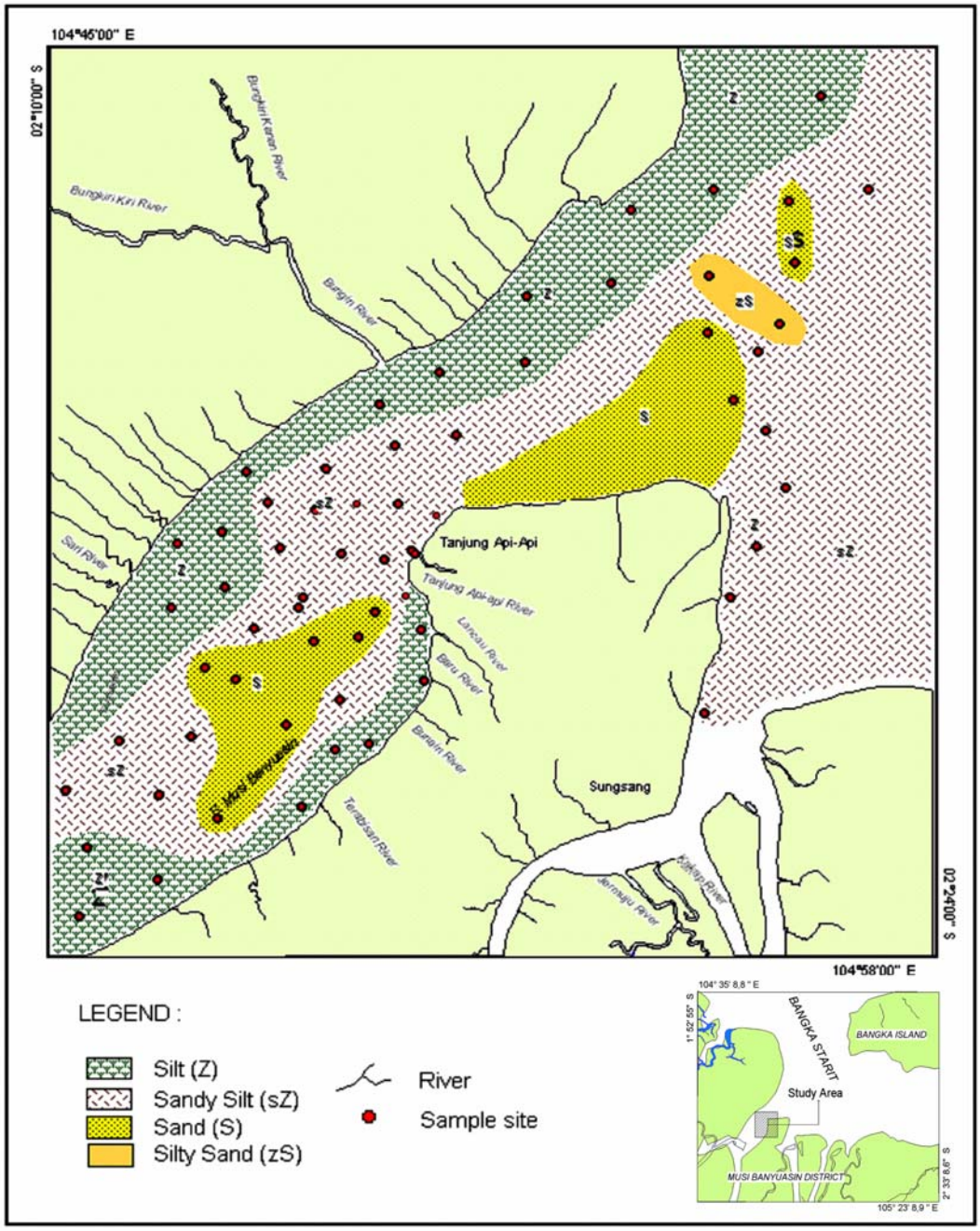

Figure 4. Distribution of surficial sediment of Tanjung Api-api

reached about 1 m until 3 m in the south-west of the study area.

The other result, sample at 5 m below seafloor (BH 1 and BH 2), indicates age of sediments is more than 150 years. It can not represent the real age. The sample TGA-13 lies on indentation area that sedimentary type is soft sediment such as silt and sandy silt at water depth of 2-12 meteres. For other sedimentation region which is same sediment type could be equal. Meanwhile, sedimentation region that have coarser grain sediment than silt or sandy silt is interpreted to have higher rate of sedimentation then 8.9 cm/ years. This condition might be caused by upstream flood of river or storm wave.

Sea bottom morphology near shore is shallow about 1 to 3 meter depth due to active sedimentation process. The deepest morphology is only in the channel of Musi Banyuasin and Musi River.

Rate of sedimentation at sea floor up to 23.5 cm is 2.03 cm/year and up to 200 cm is 8.9 cm/year. Sedimentation process decreased upward, it can be interpreted that surficial sediment influence by the wave and surface current. Another analyzed result of sediment below 5 meter depth from sea floor of more than 150 years age, it is not reliable.

CONCLUSIONS

Rate of sedimentation in Tanjung Api-Api is counted by ^{210}Pb tracer. This method is usefull at calm water environment, especially for fine grain sediment.

The lowest rate of sedimentation is occurred at 23.5 cm sediment depth of 2.03 cm/years and at 200 cm sediment depth is 8.9 cm/year. At more than 500 cm sediment depth, age of sediment could not estimated due to sediment contain coarse grain sizes such as sand and silty sand.

Bathymetry map shows that Tanjung Api-Api waters are becomes shallow due to sedimentation processes is still being active. Soft and fine sediments such as clay and silt are accumulated wide enough at Tanjung Api-Api waters. The distribution is accumulated more extensively at near shore than the coarse sediment (sands). It is estimated sediment supply from the land constitute of suspended material.

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