

THE IMPACT OF COASTAL LINE DEVELOPMENT OF THE JAMBI AREA DURING LATE PLEISTOCENE - RECENT TIME ON DECLINE OF THE SRIVIJAYA KINGDOM PROSPERITY

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Abstrak. Pengaruh Perkembangan Garis Pantai Kawasan Jambi Selama Kala Plestosen Akhir Hingga Kini Terhadap Menurunnya Kemakmuran Kerajaan Sriwijaya. Analisis terhadap garis pantai purba di Jawa menunjukkan kesamaan perkembangan dengan di Sumatra. Setidaknya dapat direkonstruksi lima garis pantai purba akibat kenaikan muka laut secara berkala selama fluktuasi muka laut pada kala Plestosen Akhir hingga kini. Sejumlah penelitian lapangan di Jawa dan Sumatra, yang didukung oleh analisis laboratorium, juga menunjukkan evolusi garis pantai tersebut bergeser ke arah laut masa kini, yang memperlihatkan terjadinya penurunan muka laut secara drastis di seluruh dunia pada saat yang bersamaan. Berkenaan dengan kegiatan perdagangan di Kerajaan Sriwijaya di kawasan Jambi, yang diperkirakan berlokasi di sejumlah pelabuhan sungai maupun laut sekitar muara Sungai Batanghari purba dan pesisir purba Jambi, evolusi garis pantai purba tersebut mengakibatkan efek pendangkalan di kawasan hulu sungai. Proses pendangkalan, yang disebabkan oleh deposisi sedimen dan penurunan muka laut, akan membatasi aktivitas pelayaran yang merupakan bagian dari perdagangan, sehingga harus dibangun pelabuhan-pelabuhan baru yang lokasinya digeser ke arah timurlaut. Dengan demikian terbentuk garis pantai baru, sedangkan garis pantai yang lama menjadi daratan. Pemindahan pusat kegiatan perdagangan pada periode Sriwijaya ke timurlaut Jambi (wilayah di luar kota Jambi) mengakibatkan menurunnya atau bahkan matinya kegiatan ekonomi di wilayah pedalaman baru Sriwijaya. Penelitian geologi di wilayah itu mengungkapkan bahwa penurunan muka laut secara drastis, penurunan muka tanah (denudasi), serta aktivitas tektonik dan sedimentasi boleh jadi merupakan faktor penyebab terjadinya inflasi dan penurunan kemakmuran Kerajaan Sriwijaya hingga titik terendah.

Kata Kunci: garis pantai purba, Sungai Batanghari, Jambi, Kerajaan Sriwijaya

Abstract. Paleocoastal line analysis around Jawa indicates similar development to Sumatra, at least there are five paleocoastal lines that could be reconstructed due to periodically sea level raised periods along Late Pleistocene - Recent sea level fluctuations. Field studies both in Jawa and Sumatra which supported by laboratory analysis also show that coastal line evolution was shifted to the present seaward, which reveals the dropped sea level globally at the same time. In terms of Srivijaya Kingdom's trading activity in Jambi area that predicted as river ports around the mouth of paleo-Batanghari River and as beach ports surrounding paleocoastal of Jambi, the paleocoastal lines evolution as mentioned above would gave a shallow effect in the upper reaches of the river. This shallowing up process due to the sedimentary deposition and dropped sea level would restrict the shipping activity for trading process. It means a new port, both beach and river ones as central trading places have to be built and shifted also to the north-eastern part where a new coastal line formed and previous coastal lines became terrestrial. Movement of central trading activity in Srivijaya period to the northeast-outer area of Jambi will decrease or even put an end to economic activity in the new hinterland part of Srivijaya. Field geological investigation in Jambi area revealed that dropped sea level, denudation, tectonic and sedimentation were most probably responsible to the inflation and declining of Srivijaya Kingdom until its last prosperity.

Keywords: paleocoastal line, Batanghari river, Jambi, Srivijaya Kingdom

1. Introduction

Human living will create cultures where their culture traces will be recorded as a cultural history. In general, cultural development through time and space will influenced social, climate, environment, politics, and security that give an effect to human condition. In this case, social, security and politics is the product of interaction between humans, where climate and environment are natural aspects.

Earth saves human living for their residence and cultivation. Nation with fertile land environment condition will create different culture compared to unproductive condition. Tectonically active region with disasters such as earthquake and flood also will construct different culture condition compared to stable region. It concludes that natural aspects will strongly influence the human and their living environment condition as well as their culture properly. However, only a few archaeologists or researchers took attention to the natural factors in the development of Indonesian cultural history. In general, cultural development of Indonesian history recorded based on oral communication, ancient inscriptions, archaeological and historical sites building such as temples as an evidence of historical culture. Declining of the cultural prosperity could also indicates a disappearance or collapsed of its nation, although in some case, the culture in the collapsed nation could be survive and continued by the next generations such as several historical cultures in some Indonesian region where still survive until present days.

Development or collapsed of the one nation and its cultures are not complete enough if its recorded just based on their socio-cultural factor without any consideration on its natural condition data.

Collapsed and declining prosperity of Sriwijaya Kingdom for example, believed were only due to socio-cultural influence, although it could also be due to the influence and changed of their natural and environmental conditions.

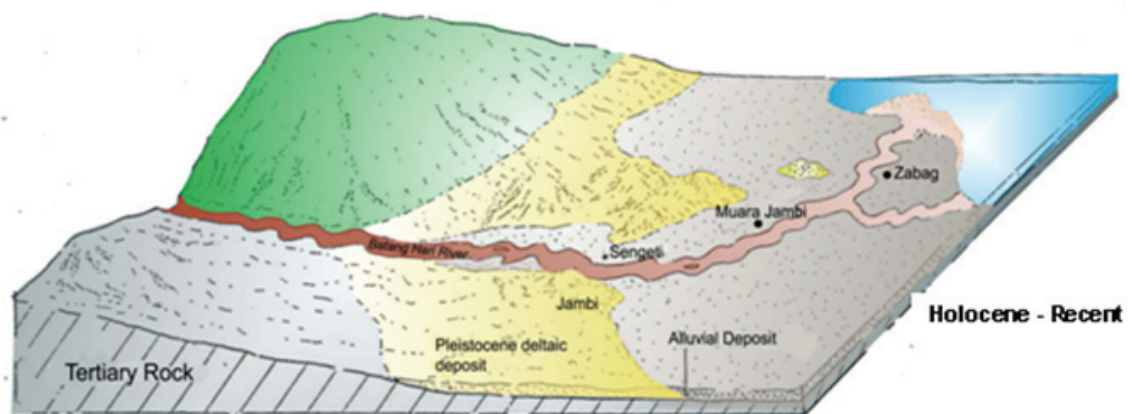
The development of environmental condition in Sumatra Island were mentioned previously by several authors were indicated by active denudation and sedimentation in Sumatra Island formed the development of rapid coastal accretion, particularly in the east coastal plain during Quaternary and the Sriwijaya Period (Sartono 1978; Soekmono 1978; Tjia *et al.* 1968; and Zaim 1982).

2. General Quaternary Geology of Jambi Area

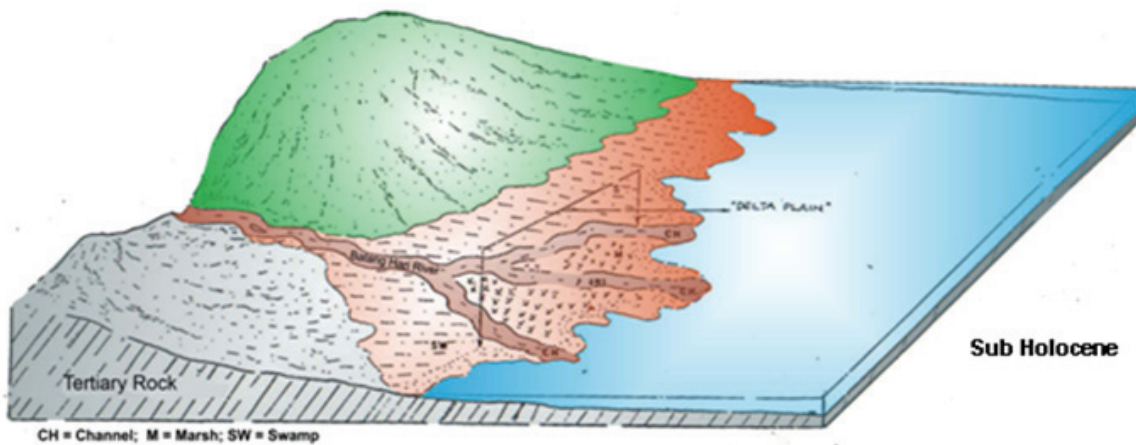
Morphologically, Jambi Area could be divided into hilly and low land areas. The low land is found from a part of the city of Jambi to the north and widely continue to north-east and south-east of the city of Jambi and along of Batanghari River. The hilly areas are found from west part of the city of Jambi and continue to the west and south of the city.

Detailed geological field study of the Jambi Area have been performed by Zaim (1982), which stated that the good lithological data cropped out in the hilly area, particularly in Kenali Besar and Sengeti Areas. The quaternary sediments of these areas were laid unconformable above the tertiary and other older folded rock units.

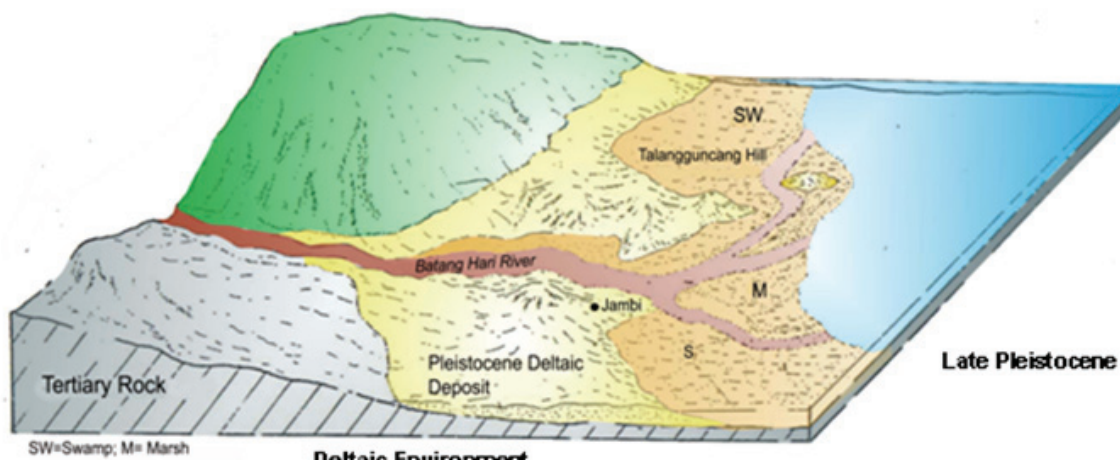
In Kenali Besar Area, the quaternary sediments are in horizontal form of strata, the lower part consists of medium to fine sands and silt, light and yellowish grey colors rich with plant remains and bioturbation, flaser and wavy laminations as well as parallel lamination are often found in these sediments. Above these sediments found tuffaceous clays, reddish brown colors soft and sticky. At the base of the layer is found oxidized thin layer (5 – 10 cm) of very fine sands and silt, hard and compacted, reddish dark brown colors contains of iron oxide. Above this layer is found again a layer of tuffaceous clays, light and yellowish brown colors, soft and sticky with small lenses of breccias or conglomerates. In Sengeti Area the sediments



Fluvial, Swamp and Marsh Environments



Fluvial, Swamp and Marsh Environments



Deltaic Environment

Figure 1. Development of the depositional environment of Jambi and surrounding areas (Modified after Zaim 1982)

		SOUTH		NORTH	
AREA		KENALI BESAR		SOUTH SENGETI	NORTH SENGETI
FORMATION/AGE		River terraces		River terraces	River terraces
HOLOCENE/RECENT		Silty clay with breccia lens		-	-
SENGETI FORMATION	LATE PLEISTOCENE	Tuffaceous clay		Tuffaceous clay	- Quartz sandstone - Clay sandstone
		Sand - silt		Sand - silt	Sand - silt

Figure 2. General Stratigraphy of Jambi and surrounding areas (Modified after Zaim, 1982)

cropped out mainly in the road cut, show the similarity with the quaternary sediments occurred in Kenali Besar Area. However, in Sengeti Area could be found the medium to coarse quartz sands, were absent in Kenali Besar Area. All quaternary sediments in Jambi Area are grouped into Sengeti Formation of Late Pleistocene in age (Zaim 1982).

According to Zaim (1982), the Sengeti Formation has known as deltaic deposit of uplifted Batanghari River's fluvial system in Late Pleistocene. The tertiary and other older sediments in Sumatra were folded and faulted due to strong deformation that could not be found in the Late Pleistocene of the Sengeti Formation which is still in horizontal form (unfolded beds). On the contrary, Smit Sibinga (1947) believed that quaternary sediments older than Late Pleistocene in Sumatra as well as in Jawa were affected by Middle Pleistocene Orogeny as happened in Jawa that caused weakly folded of the sediments. The tectonics activities and intensity were decreased during post Middle Pleistocene yielded uplifted strata in horizontal form and terraces. The Sengeti Formation could be correlated with Late Pleistocene "High Terrace" of Tobler (*op.cit.* Smit Sibinga 1947).

Overlying Sengeti Formation, present deposit resulting from Holocene alluvial sedimentation of Batanghari River and this sediment, cropped out along river stream, swamp area and flood plain that recently form low land and flat morphology. The sediment represented by dominant soft clay, silt, medium to coarse sands and gravel. These sediments were deposited in river stream channel, flood plain, swamp and marshes environments. The development of depositional environment have been proposed by Zaim (1982, Figures 1 A-C), while the general stratigraphy of Jambi area is shown in Figure 2.

3. Coastal Line Development of Jambi Area

Coastal line accretion of Eastern Sumatra related with Sriwijaya Kingdom including Jambi area have been widely discussed by Cook, Mohnike, van Tuyn, Obdeyn (*op.cit.* Sartono 1978), van Bemmelen (1949), Amerta (1966), Tjia *et al.* (1968), Sartono (1978), Soekmono (1978), and Zaim (1982). Obdeyn (*op.cit.* Sartono 1978) believed that coastal accretion in Eastern Sumatra was due to rapid erosion and sedimentation in about 100 m/year. Soekmono (1978) studied archaeology for defining localization of Sriwijaya based on geomorphological and topographical

data and stated that rate of coastal accretion is about 75m/year of Batanghari River (Jambi) and about 100m/year for Musi River in Palembang. Sartono (1978) and Tjia *et al.* (1968) are believed that coastal accretion is not only controlled by rapid erosion and sedimentation, but also by tectonic and sea level changes. Tjia *et al.* (1968) studied coastal accretion in Western Indonesia and concluded that significant coastal growth only occurs in the vicinity of large rivers, and coastal accretion is not always indicated by the presence of deltas, for the shape of river outlets is also governed by combinations of daily and semi-daily tides. They also concluded that Java's north coast possesses accretion rates varying from 55 to 214 m/year (averaging 75-150m/year) in the vicinity of large rivers draining Neogen rocks, while the smaller streams contribute about 30 m land annually.

Zaim *et al.* (1997, 1999) studied quaternary geology of Jakarta area and they proposed coastal line accretion maps as the result of sea level changes during Late Pleistocene – Recent based on the existence of river and marine terraces. In 1998, field geological observation along Batanghari River and surroundings area and from Jambi City until the coastal areas have been done by the authors. Several terraces could be observed during the field worked, similar to those the terraces observed in Jakarta Area, except one high marine terrace found in Jambi which did not occurred in Jakarta.

The highest river terrace is found at the vicinity of Muara Tebo, is believed as old Batanghari stream channel, found at upstream of the river and lies about 50 m from present of Batanghari River. This terrace is situated at elevation about 75 m above present sea level and about 35 - 40 m above present surface water level of Batanghari River. The sediments consist of medium to coarse sands, light yellowish brown colors with the lenses of loose breccias or conglomerate of gravel size, with quartz and volcanic fragments cemented in very fine sand

and tuffaceous silty clay, were deposited in the river stream channel.

This terrace might be correlated with High Terrace of Tobler (*op.cit.* Sartono 1978), dated Late Pleistocene and might also be correlated with Cileungsi Terrace in Bogor Area, south of Jakarta dated of 40.000 yr. BP based on C14 age dating and found about 35 m above present surface water level of Cileungsi River (Zaim *et al.* 1997, 1999).

The outcrop of second terrace was found as a road cut at Telanai – North Sengeti area in Jambi City, at the back side of Governor Office Building. The outcrop consists of clean medium to coarse calcareous quartz sands contain rich of both planktonic and benthic foraminifers, white in colors with parallel and cross bedding structures, intercalated by 10 – 15 cm thick layers of calcareous clay, light grey rich with foraminifers. Sedimentological examination of the outcrop of the quartz sands, sedimentary structures as well as laboratory analysis on the foraminifers indicate that the quartz sands were deposited as beach sand bar in the very shallow (transition) marine environment. At the present day, this terrace is situated at an elevation varies at about 10 - 20 m above present sea level, where it is not occurred in Jakarta. No absolute age dating for this marine terrace, however, according to Zaim (1982) the sediments are still belong to Sengeti Formation of Late Pleistocene in age.

Another river terrace is situated at about 5 m above present surface water of present Batanghari River was found in Tanjung and Muara Kumpal areas. The sediments consist of lenses of loose conglomerate of gravel size, composed of quartz and volcanic materials cemented in very fine and tuffaceous silty clay, indicated of stream channel sediment of old Batanghari River. This terrace is comparable with the Ciliwung River terrace found in Depok Area, south of Jakarta which was found at 4 – 5 m above present water surface of Ciliwung River.

Another marine terraces were observed in Tanjung Jabung and Muara Sabak Areas, consist of fine to medium quartz sands and mud/clay contain rich of foraminifers and marine shells/ mollusks, light to dark grey colors, were found at an elevation varies from 1 - 3 m above present sea level. In Jakarta Area, the 3m marine terrace dated 1500 yr BP based on C14 age dating of mollusk shells.

Field studies both in Jawa and Sumatra which supported by laboratory analysis also show that coastal line evolution was shifted to the present seaward reveals the dropped sea level globally at the same time. Although there is no age dating data performed on the terraces of Jambi Area, however, since the sea level changes are global phenomenon due to global climate changes, therefore it could be correlated with the age data of the terraces found in Jakarta Area, as basic data for reconstructing the coastal line development of Jambi Area. Taking account into similar consideration developed by Zaim *et al.* (1997, 1998) based on the existence of river and marine terraces found in Jambi Area, coastal lines development of the Jambi area are

constructed as follow:

1. 40.000 years BP, coastal line is situated around 35 – 40 m above present sea level and about 20 – 35 km to the south-western part of Jambi's present coastal line (Figure 3) along South-west City of Jambi – Sengeti goes to Kampungbaru (Tanjung Jabung Region). This coastal line is interpreted base on the existence of old Batanghari River terrace (found about 35 – 40 m above present surface water level) as a respond and balance to the changes of sea level that followed by the changes of river water surface level.
2. 20.000 years BP, position of coastal line was about 10 – 20 m above sea level and its position around 10 – 25 km from recent coastal line, based on the presence of marine terrace found in Telanai – North Sengeti area in Jambi City. This paleo coastal line might be from North – east of the Jambi City – North – east Tanjung Jabung Village (Figure 4).
3. 5.000 years BP, coastal line with the position 5 – 6 m above present sea level with 3 – 8 km distance from present coastal line from

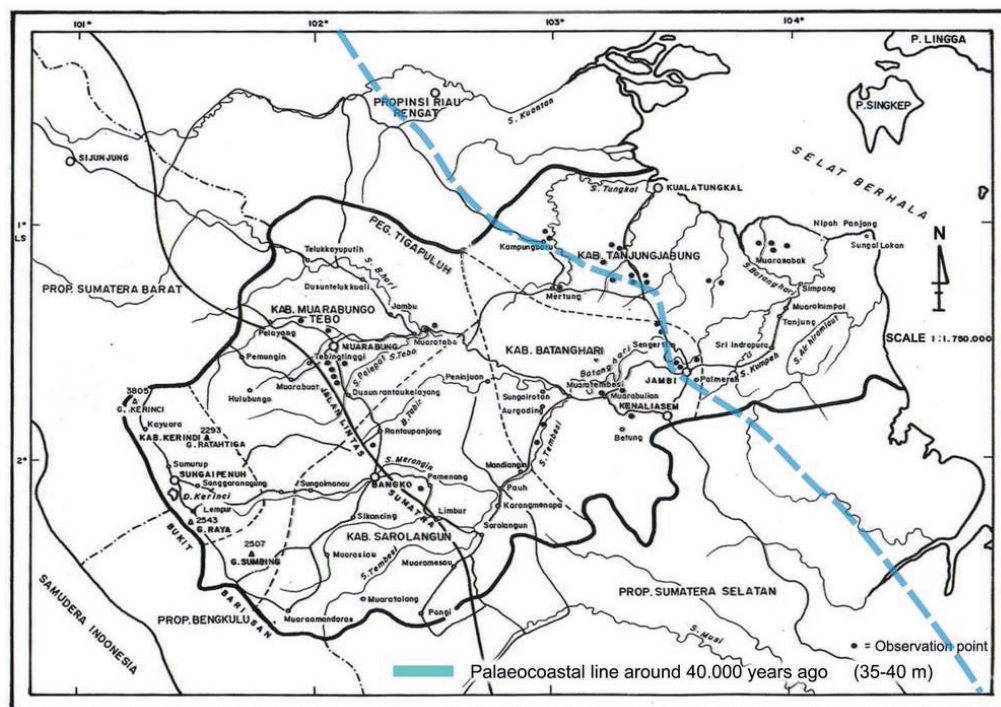


Figure 3. Paleocoastal line of Jambi Area during 40.000 yr BP

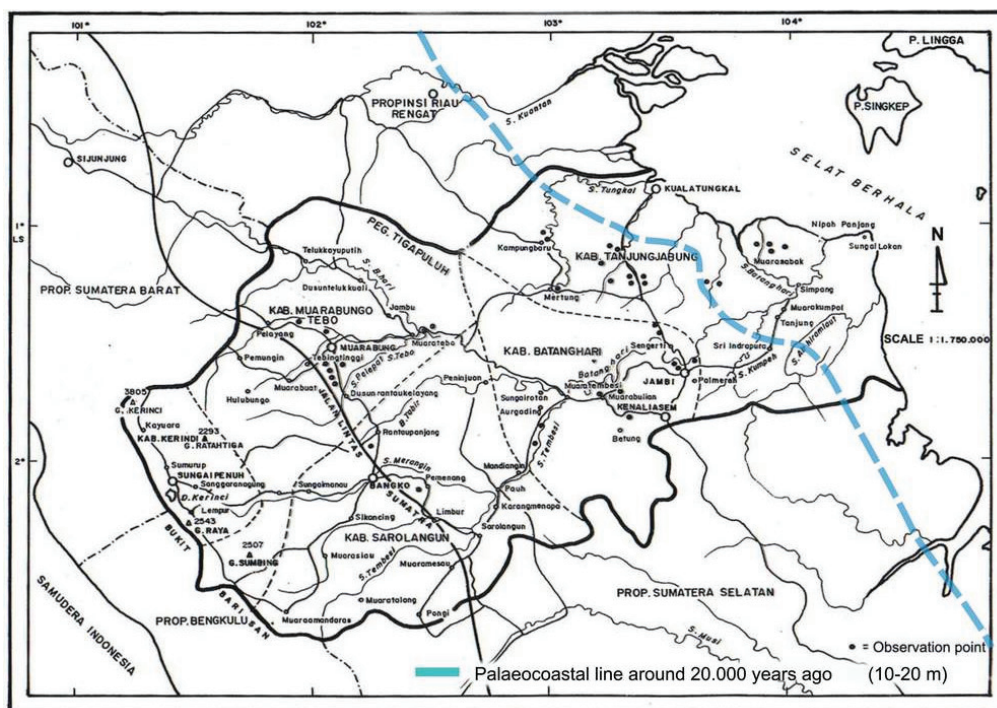


Figure 4. Paleocoastal line of Jambi Area during 20.000 yr BP

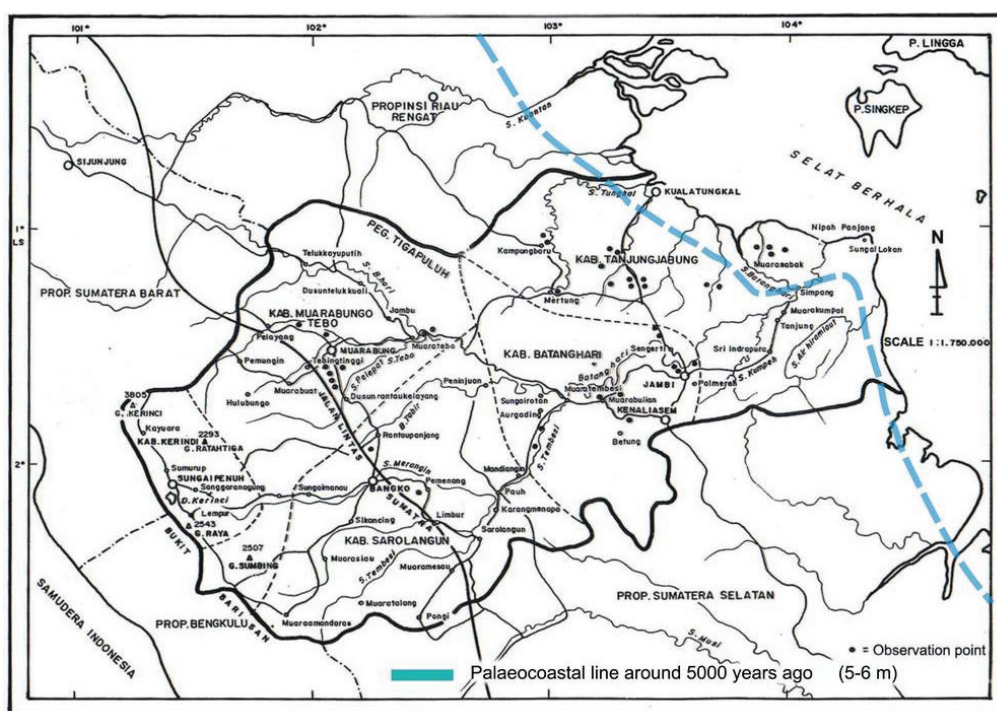


Figure 5. Paleocoastal line of Jambi Area during 5.000 yr BP

Simpang – South-west Kuala Tungkal (Figure 5). This coastal line were interpreted following sea level curve of de Klerk (1983, *op.cit.* Maathuis *et al.* 1996, Figure 6).

4. 1500 years BP, the coastal line was about 2 – 3 m above the present sea level and horizontal

distance to the recent coastal line is about 3 – 8 km, from North-west Simpang – South Muara Sabak (Figure 7), based on the 3 m marine terrace dated 1500 yr BP based on C14 age dating of mollusca shells.

- ### 5. 500 years BP coastal lines occupied position

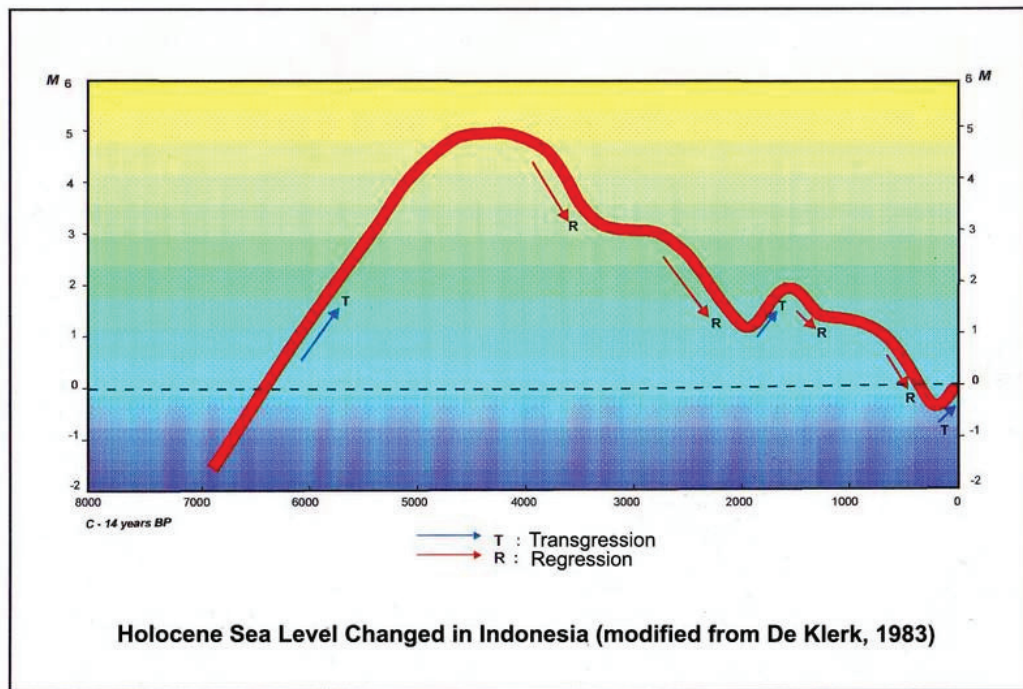


Figure 6. Holocene Sea Level Curve in Indonesia after de Klerk (1983)

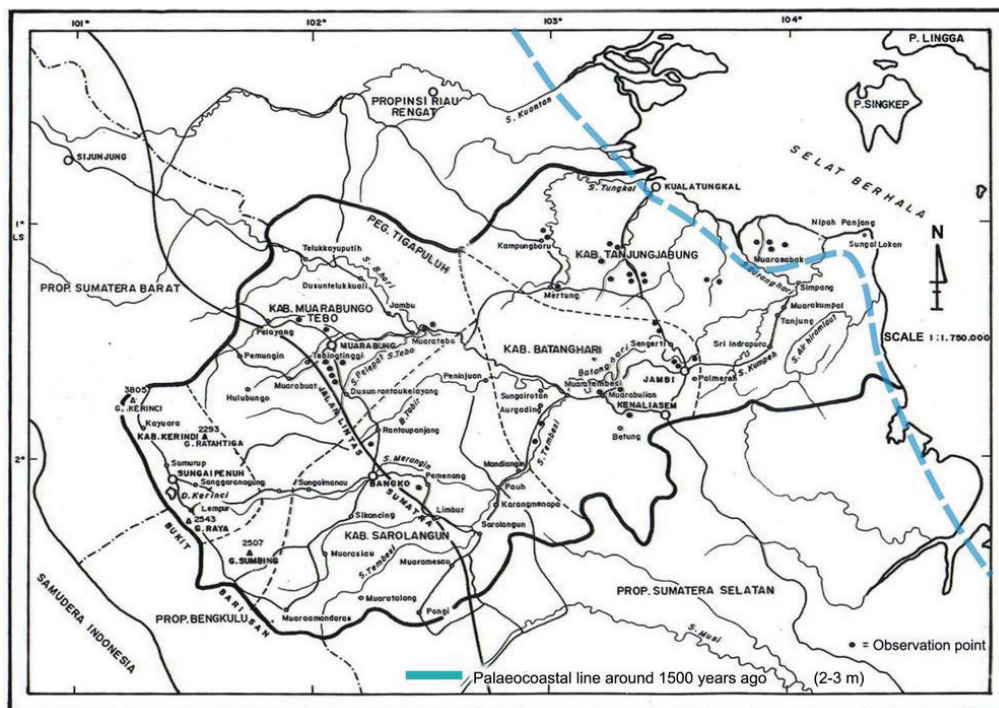
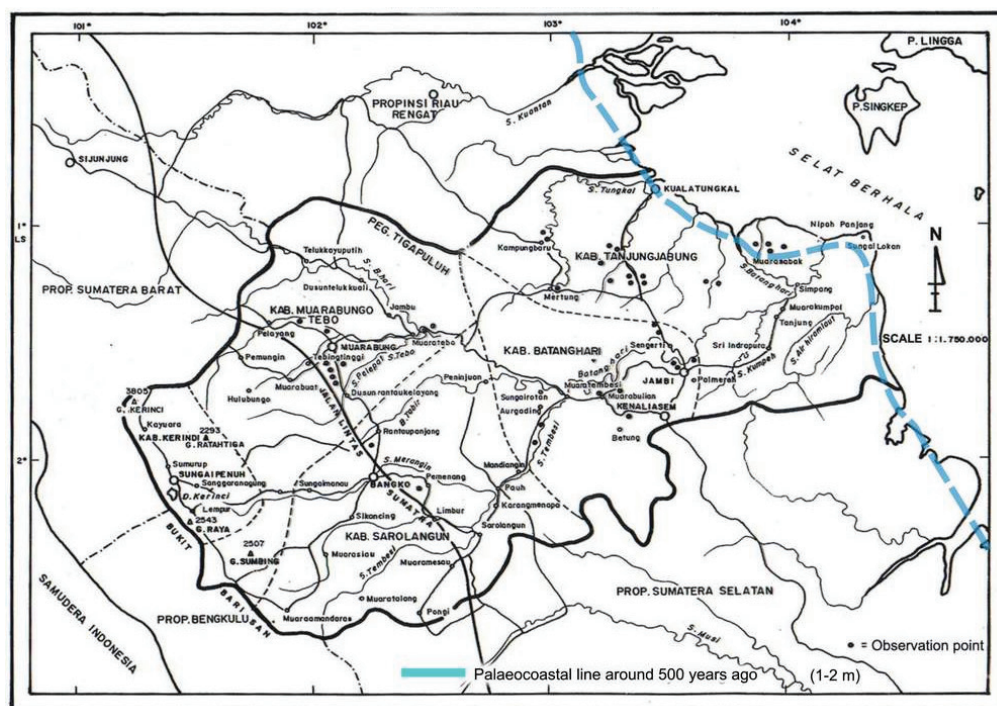


Figure 7. Paleocoastal line of Jambi Area during 1500 yr BP

about 1 – 2 m height from present sea level and 1 – 3 km from present coastal line based on the marine beach sands from Sungai Lokan – Muara Sabak – Kuala Tungkal (Figure 8), correlated with sea level curve of de Klerk (1983, *op.cit.* Maathuis *et al.* 1996).

4. Conclusion

The impact of coastal line development on decline of the Sriwijaya Kingdom prosperity. Tectonic activity and sea level changes as well as denudation and rapid sedimentation during Late Pleistocene – Recent would give a shallowing



effect or an accretion of beach area (regression) that also changed its coastal line.

Coastal line changes and shallowing up process would give a significant influence to the Sriwijaya's port as a central trading and main economic activity of this kingdom. Shallowing up process and dropped sea level data were proved by the geological observation that reveal an appearance of river and beach terraces around Batanghari River. The field geological observation is also traced the relicts of Sriwijaya Kingdom in Jambi area, as believed by some researchers that the Jambi Region was under occupancy of Sriwijaya Kingdom.

The research could also be proved that natural factors were very significant influence to the Sriwijaya Kingdom development, particularly in Jambi Area. Shallowing process in port area will change the stability of socio-culture aspect, politics, safety and defense matters into weak condition and declining situation of Sriwijaya Kingdom prosperity and its cultures.

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