

LANDFORMS AND MANGROVE HABITAT IN THE SATUN LOWLAND, SOUTHERN THAILAND

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Introduction

The mangrove vegetated shorelines had widely developed in the south western part of the Malay Peninsula. In the latter half of the twentieth century, most mangrove vegetation in southern Thailand, however, was destroyed by human activities (Aksornkae and Paphavatist, 1993), and well preserved mangrove forests can be seen only in a few limited areas.

This study aims at examining the landforms and sediments of an estuarine lowland in relation to the mangrove habitat, and also discusses the effect of the future sea level rise caused by the green house effect to the mangrove distribution of the study area.

The study area is the Satun lowland in the southwestern part of the Thailand where the mangrove vegetation is preserved in a relatively better condition.

Regional settings

The Satun lowland locates in the southwestern part of Malay peninsula, and is surrounded by relatively low mountains and hills with height of several hundred meters. The lowland, about 25 km from north to south and 10-15 km from east to west, faces to the Strait of Malacca, and some isolated limestone hills can be seen in the lowland.

The height of the lowland is about 20m in the north, 5-8 m in the central part, lower than 2-3 m in the southern part, respectively. Most southern part of the lowland is lower than high tide level, and is covered with mangrove vegetation. Tidal range of this area

based on our observations in December 1996 and in September 1997 was approximately 2 to 3 meters.

Methods

Geomorphological and geological investigation have been done in late 1996 and middle 1997. A landform classification map was drawn using 1:40,000 scale aerial photos. To clarify the landforms and geological features of the region, the authors did field research and collected some samples using a hand auger. Some samples were collected for

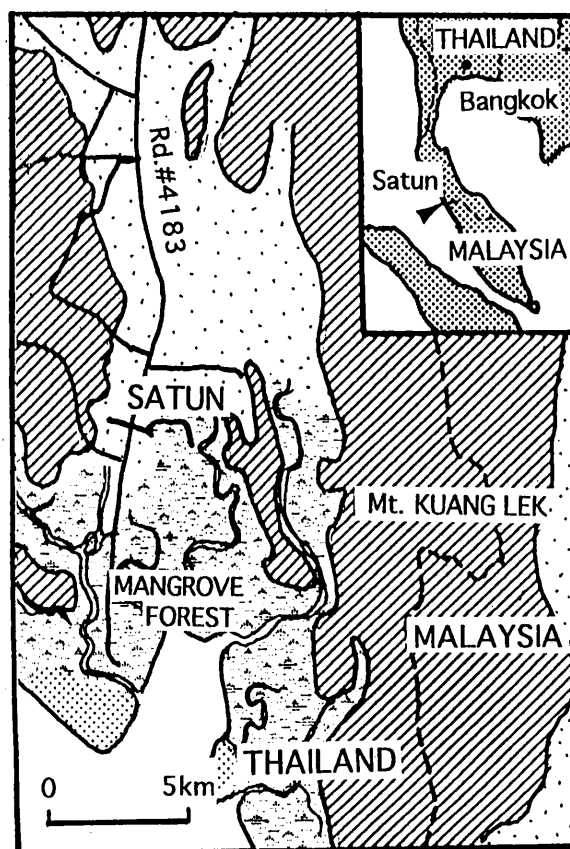


Fig. 1 Map showing the Satun lowland.

radio carbon dating and for both chemical and paleontological analyses. The boring sites in the lowland are in and around Satun urban area, and in several spots along the road number 4183 to Ferry port.

Landforms of the Satun lowland

The elevation of greater part of southern Satun lowland is between the mean tide level and high tide level, and the region is covered with tide water during the high tide. This region is classified as a tidal plain. Rivers as the Khlong Tha Chin (Chin River), Khlong Phrao (Phrao River), Khlong Bam Bang (Bam Bang River) flow in the southern part of the lowland, and many tidal creeks develop on the tidal plain. Among the tidal creeks, there are some large creeks as the Khlong Ta Miang (Ta Miang Creek) with a width of several hundred meters. The mouth of these rivers forms a large estuary, and it extends to the inland approximately 2.5 and with the maximum width is 2.0 km. Tidal flats develop along the mouth of the estuary in the level between mean tide and low tide. Mangrove forests develop on the greater part of the upper tidal plain, but muddy sediments are exposed in the tidal flat. On the other hand, the density of stream network is low in the northern half of the lowland.

Rivers cannot be seen in the central and northern lowland except the Khlong Wang Pra (Wang Pra River) and its branches and Khlong Bam Bang (Bam Bang River). These rivers dissect the surface of the lowland, and form narrow valley plains. Relative heights between the surface of the lowland and the valley plains are 3-5 meters.

Since the eastern mountains and small hills in the central lowland are consisted of limestone, the slopes of the mountains and hills surrounded by the lowland are very steep. Low and gentle slopes and relatively flat surfaces with the height of about 20-30 m develop along the foot of mountains and hills in the western margin of the lowland. The

surface sediments of the region are oxidized in deep reddish brown color, and it is remarkably different from the sediments of the lowland.

Pleistocene sediments

Upper sediments of northern half of the lowland is remarkably different from those of the southern half. The boundary of the two regions is almost along the east-west line across the Satun urban area.

In northern part of the lowland, the surface sediments consist of the gray white and occasional reddish mottled silty sand or sandy silt. This sediments are relatively hard and compact, also seen in the outcrops near the airport which locates 2 km north of Satun Urban area. The surface sediments of the area around Ban Tha Chin which locates north of the Khao Wang Man (Mt. Wang Man) are the same. Since the sediments are not deeply weathered in comparison with the reddish weathered sediments in the surrounding region of the lowland, it seems to be formed in the late Pleistocene.

The surface of this Pleistocene sediments becomes lower and is covered with recent muddy sediments towards the southern part of the lowland. The depths of the Pleistocene surface are 0.5-1.0 m in and around the central part of Satun urban area, 2 m in the southern margin of Satun urban area which locates 10 km from the coast, and about 5 m at the site about 5 km from the coast. The surface is lower than 7 m in the region near the coast.

It is clear that the surface of this Pleistocene sediments become deeper towards the south, and it forms a low gentle surface in the northern part of the lowland. As the gradient of this Pleistocene surface is steeper than the tidal plain of the southern lowland, the Pleistocene surface is considered to be formed in the late Pleistocene or the last glacial period under the lower sea level.

Holocene sediments and their age

The sediments which cover the Pleistocene

in the southern part of Satun lowland consist of soft muddy sediments with organic materials. Sandy sediments with

occasional small gravels are seen on the top of the sediments in the region near Satun urban area.

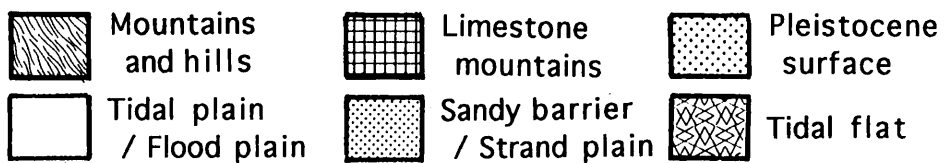
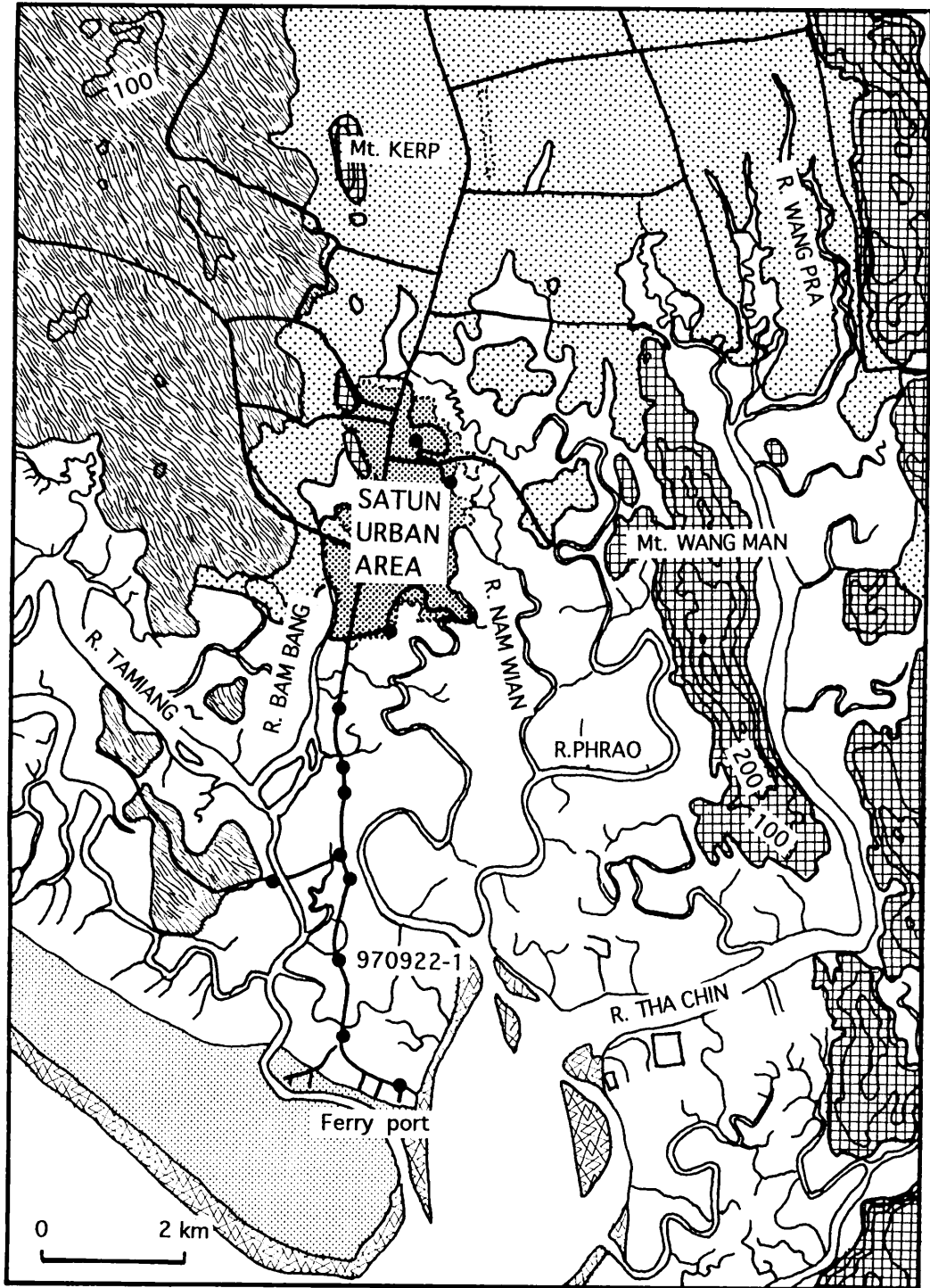


Fig. 2 Landform classification map of the Satun lowland.

Most of the sediments in the southern part of the Satun coastal lowland consist of muddy sediments with peat layer in the upper 1-1.5 m. The muddy sediments are green gray or blue gray color, and it suggests that the sediments are marine origin.

A peat layer in the muddy sediments at the site of 961130-4 can be seen in the depth of 3.10-3.30 m. Age of the peat is 6640 ± 90 yrBP (NUTA-5161). This shows that the peat layer was formed in the culmination of the Holocene transgression. Age of the peaty material in the upper part of the muddy sediments near Ban Kaian Batu at the site of 961201-1 is 5710 ± 100 yrBP (NUTA-5159). This also shows the age of the culmination of the Holocene transgression.

Concentration of woody fragments can be seen at the depths of 5.06-5.78 m and 6.18-6.94 m of the site at 970922-1, 3 km from the coast line. Sediments in between and over the woody fragments are sand or sandy mud. Ages of the wood fragments are 950 ± 130 yrBP at the top horizon and 1270 ± 200 yrBP at the bottom horizon, respectively. These ages suggest that the woody fragments are not the basal peat but the concentration of drifted

wood fragments along sand spit or bar which extended from the west.

Landforms and Mangrove habitat

As mentioned above, the land forms of the Satun lowland are not a simple geomorphic surface but the surfaces of Pleistocene and late Holocene. It is fairly hard to distinguish the boundary of two surfaces in the field, but it is possible to trace the boundary from the detail analysis of aerial photos. These boundaries can be seen not only along the Khlong Wang Pra but also along the Khlong Tha Chin (Tha Chin River) and the Khlong Khan Chin (Khan Chin River). These rivers dissected the Pleistocene surface very shallowly and formed narrow valley plains.

Upper soft sediments on the Pleistocene sediments near the central part of Satun urban area are very thin and mainly consist of sandy sediments. This suggests that mangrove vegetation haven't covered the region since the middle Holocene when the marine area expanded according to the post glacial transgression.

Mangrove vegetation develops north of Khao Wang Man (Mt. Wang Man) which locates east of Satun urban area. The

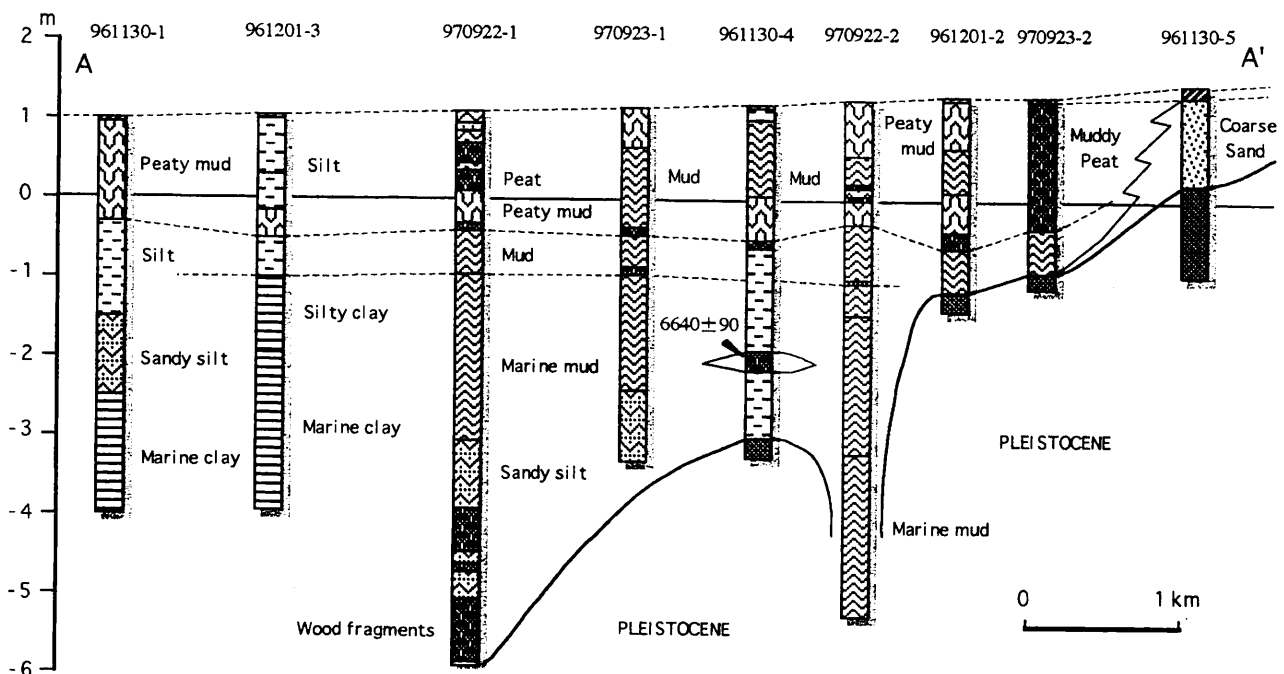


Fig. 3 Geological cross section of the Satun lowland from south to north.

Pleistocene surface, however, develops just north of the present mangrove forest. This means that the mangrove forest of the area in the middle Holocene expanded almost to the southern end of the Pleistocene surface.

Mangrove vegetation near the eastern part of Satun urban area in the middle Holocene also expanded to the southern end of the Pleistocene surface. The present mangrove limit of the area is also very close to the southern Pleistocene limit. It is about 1 km south from the Pleistocene surface.

Southern most part of the Satun urban area, however, is not covered with mangrove forests, and the area is submerged by flood tide in the time of high tide. This means that the present limit of the mangrove habitat in the area is not the natural condition but the condition controlled by the human activity. Furthermore, the distance between the southern end of the Pleistocene surface and the northern end of the present Mangrove forests along the Khlong Phrao (the Phrao River), just east of Satun urban area is only 1 km. This suggests the middle Holocene mangrove limit was not far from the present mangrove limit.

There is no detail record of the middle Holocene sea level in the Satun region. Even if the sea level in the middle Holocene was higher than the present sea level, the limit of mangrove vegetation at that time was not so different from that of the present, because the southern limit of the Pleistocene surface is very close to the present mangrove limit.

Concluding remarks

Landforms of the Satun lowland consist of Pleistocene and late Holocene surfaces. The Holocene surface consist of the late Holocene sediments which deposited in and after the Holocene transgression. Southern part of the lowland is classified as a tidal plain, and the level of the tidal plain is between high tide and low tide. Present mangrove vegetation develops on the tidal plain. In the middle or late Holocene, mangrove forest developed

along the expanded inlet of the Satun bay and southern limit of the Pleistocene surface. Distance between the northern limit of mangrove forest in the middle Holocene and that of the present one is less than 2 km in maximum.

ICPP (1995) estimates the sea level rise until 2100 AD to be about 50 cm as the mean value and about 1 m as the maximum value. These values aren't higher than the middle Holocene sea level in the Malay peninsula region reported by Sinsakl (1992). And since the Pleistocene surface of the Satun lowland is relatively steeper and higher than the Holocene surface, southernmost part of the Pleistocene surface will not be covered by the expanded inlet caused by the sea level rise. Therefore, even if it is assumed that the sea level reaches to the estimated value in 2100 AD under the predicted sea-level rise caused by the green house effect, mangrove forest will not expand further north of the limit of the Middle Holocene mangrove forest.

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