CHAPTER IV

RESULTS AND ANALYSIS

This chapter provides a result of study from each area within Prachuap Khiri Khan Province using data materials and methodology described in chapter III. This chapter explains area by area, starting with the detailed description of coastal geomorphology from remote sensing interpretation and also provides a result of field investigation, which is composed of measuring beach profile by surveying, the result from field checking and observation, and including with sediment description from coring. Result from data analysis phase was shown in this chapter, which provides the coastal change in comparison from different period of aerial photographs.

4.1 Pranburi truncated barrier area

4.1.1 Result from remote sensing interpretation

From remote sensing interpretation, there are two primary types of coastal landform; (1) beach ridges and lagoon (2) tidal flat (Figure 4.1). The orientation of truncated barriers at Pranburi area is slightly curved and changes slightly from a north – south to a northwest – southeast direction, the net longshore sand transporting direction for this area is recently in the north – south direction. The barrier area tied to the Permian headland and alluvium substrate that looks likely to be the terrestrial source for sediment transportation along the coastline around this area. This is clearly indicated by the coastal geomorphology, which displays severe erosional line at least three times during the Holocene period. In the economic area within Pranburi truncated barrier, protecting wall was constructed but erosion seems to occur, especially during storm season.

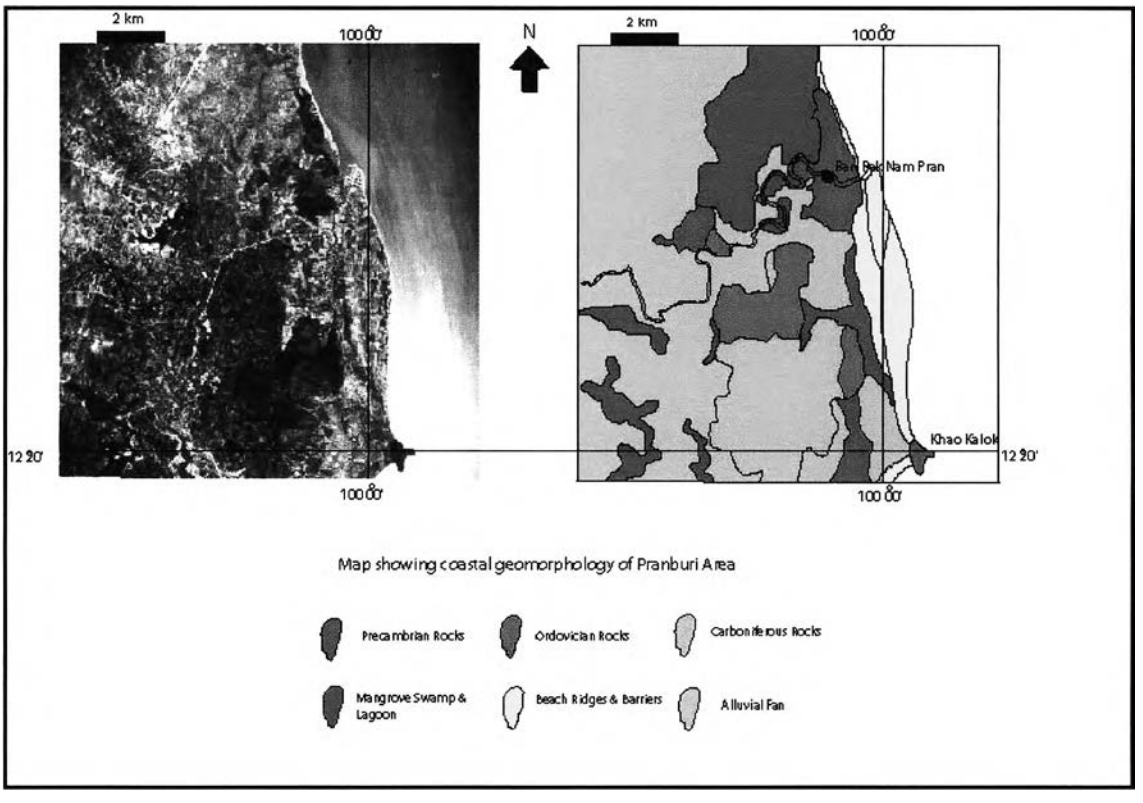

Figure 4.1 Map showing coastal geomorphology at Pranburi area. Truncated barriers extend from Khao Kalok headland and straight to the north.

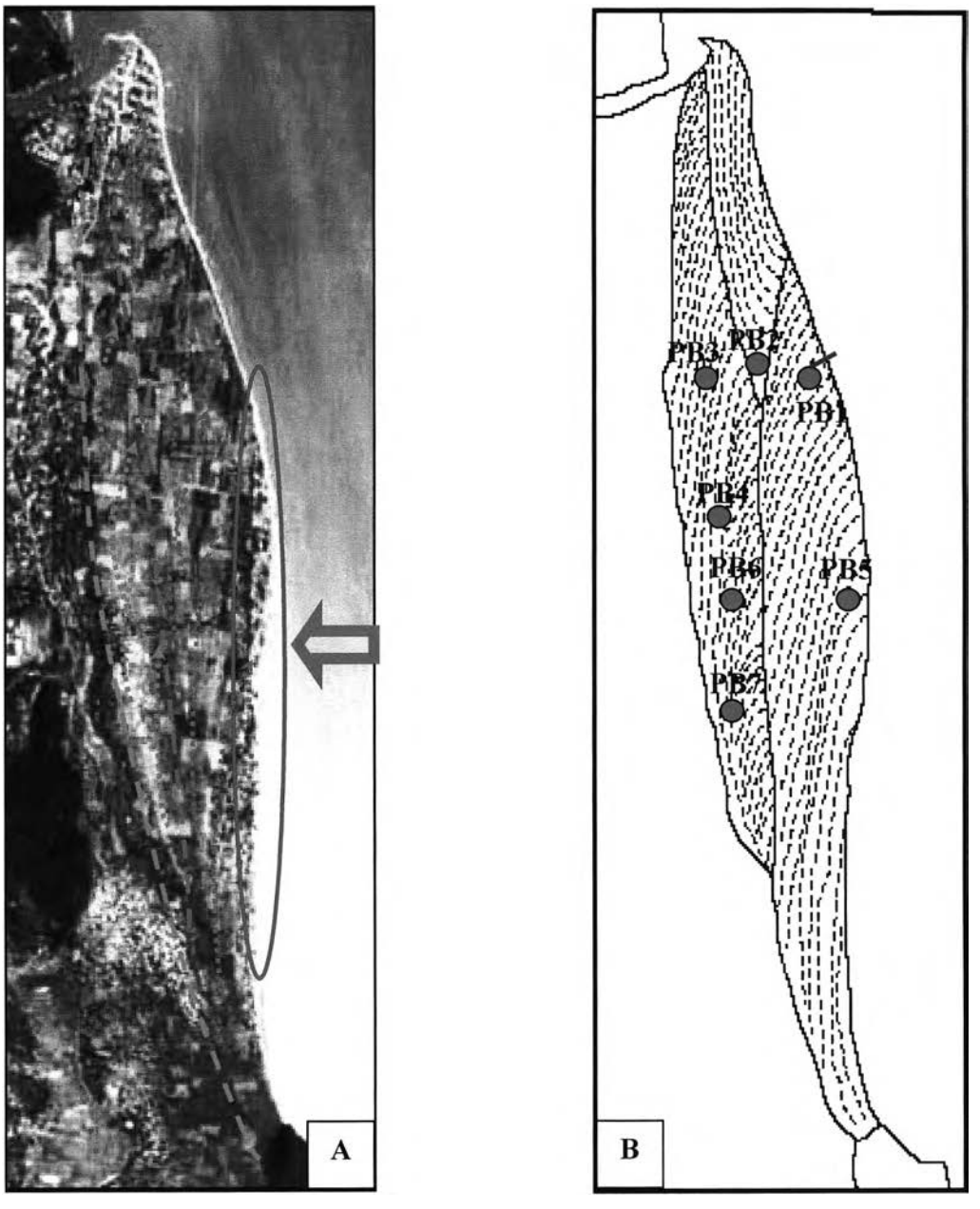

Figure 4.2 Aerial photograph showing the erosional area (red circle) reported by DMR (picture A), and color arrows show directions of beach deposition in 3 different periods of time. Picture B show beach ridges with 3 series of deposition in northward direction. Inner beach ridges plain stated as 1st series that was truncated and left very clear erosional line observed from air-photos. Red dots are locations of sediment sampling in 3 series of truncated barrier areas.

4.1.2 Result from field investigation

4.1.2.1 Measurement of shoreface slope

As stated in previous chapters, measurement of beach step or shoreface profiles will be the best way to see the change in shoreface configuration in different season. In this research, the measurement has been carried out since 20 November 2003, 4 April 2004 and 22 November 2004. Figure 4.3 summarizes the shoreface profiles from precise survey. It is clear in figure 4.3 that shoreface has changed vertically.

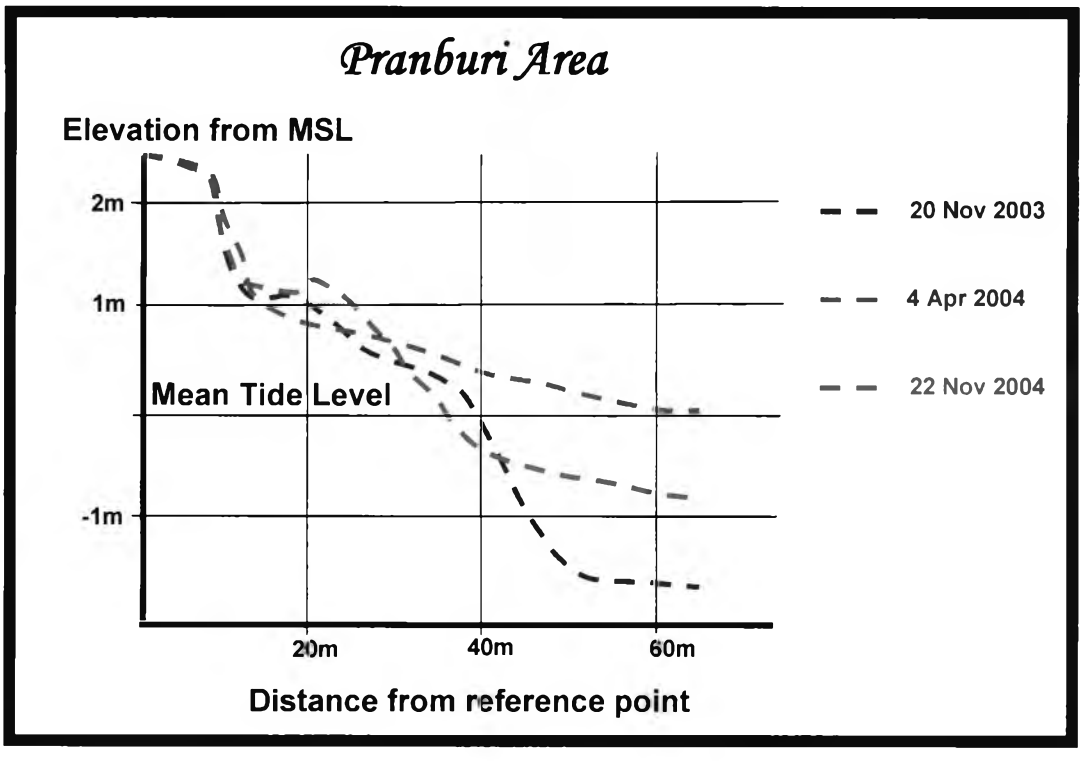

Figure 4.3 Shoreface profiles for Pranburi area showing configuration changed annually.

In analyzing shoreface changes through time, for instance, between the initial survey in November 2003 and the survey of April 2004, it seems likely that the toe of shoreface accreted more than eroded (Figure 4.4). However, the April 2004 to November 2004, the eroded of shoreface was markedly over steepened (Figure 4.5). The resulted since November 2003 to November 2004, further accretion of the shoreface was occurred, together with some retreats of shoreface (Figure 4.6). Therefore, it appears to be a trend for ongoing net shoreface accretion in this area.

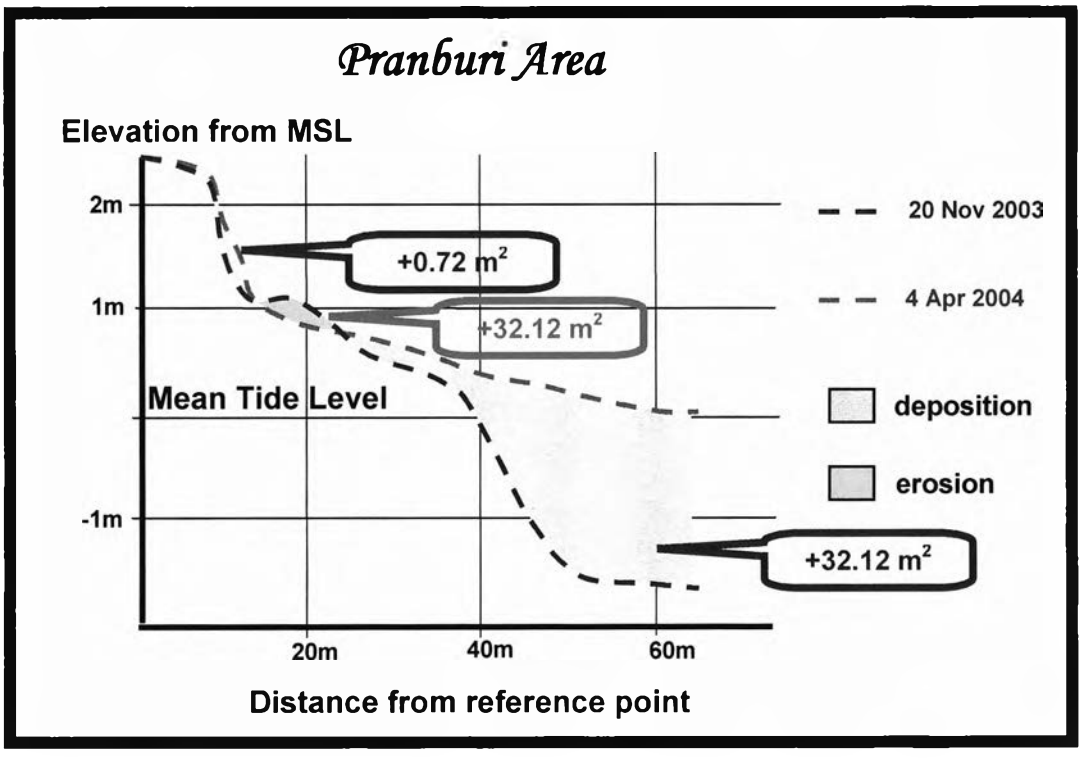

Figure 4.4 Plot of beach profiles from Pranburi area in between November 2003 to April 2004 showing deposition more than erosion during winter and summer season.

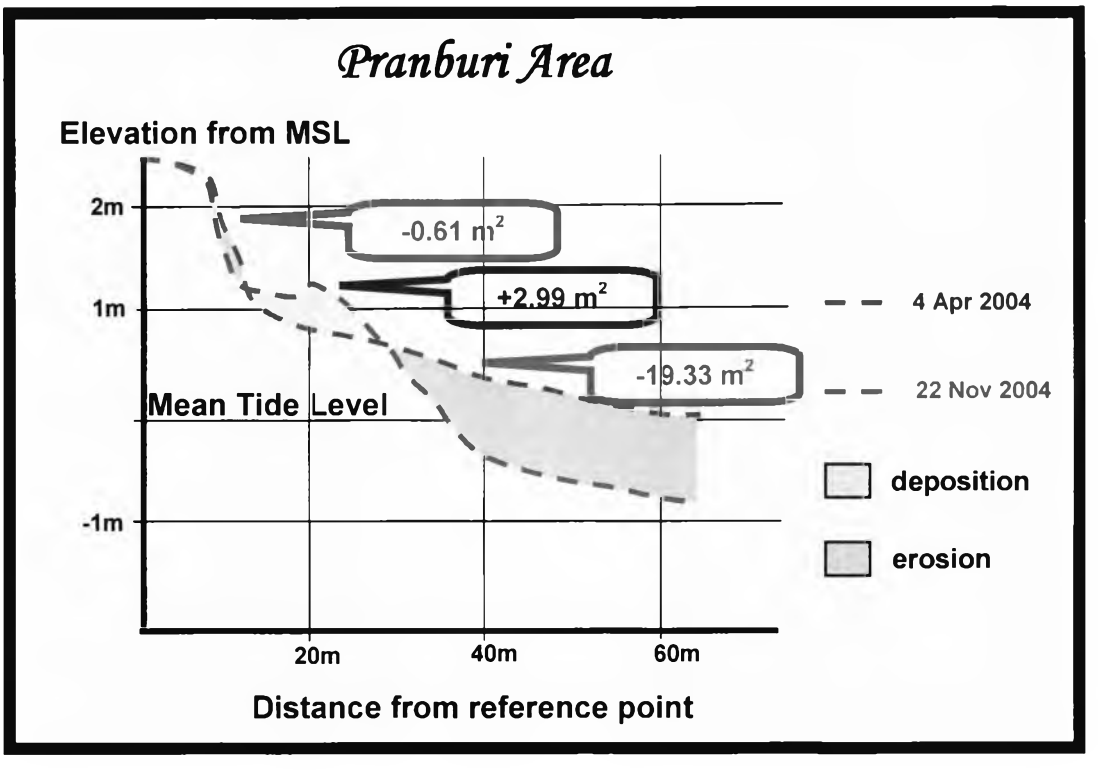

Figure 4.5 Plot of beach profiles from Pranburi area in between April 2004 to November 2004 showing shoreface with more erosion than deposition during rainy season.

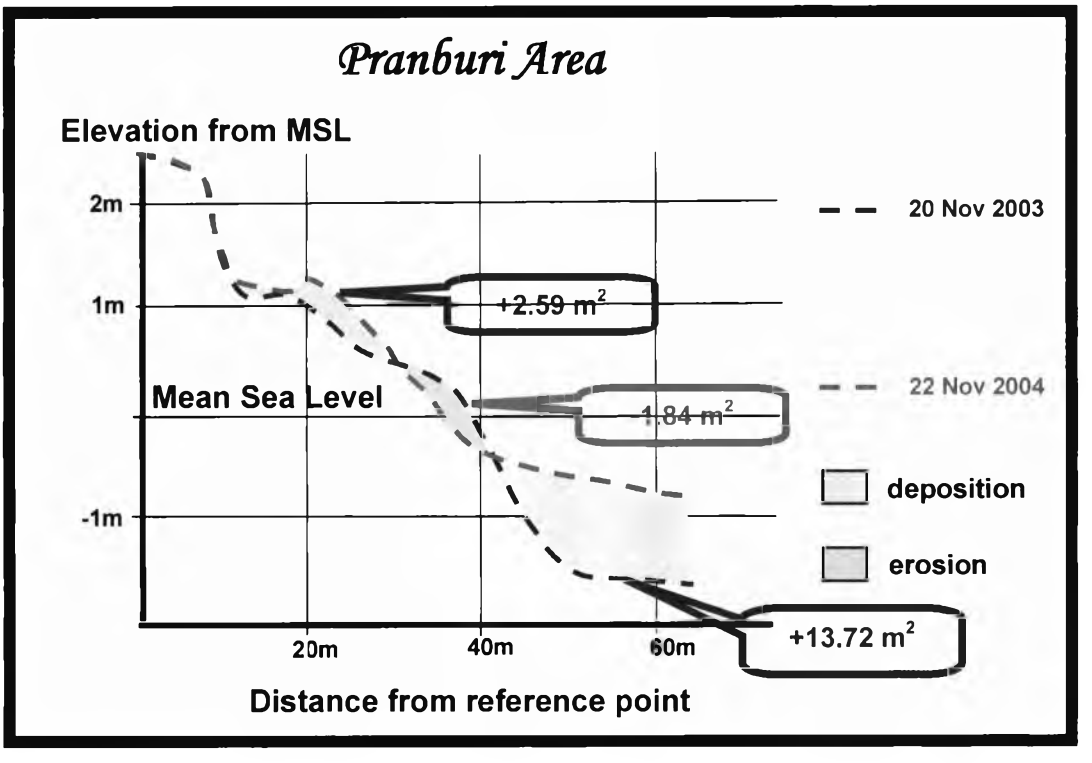

Figure 4.6 Plot of beach profiles from Pranburi area in between November 2003 to November 2004, one year cycle, showing deposition more than erosion.

4.1.2.2 Field observation

This shoreline located on the south of Pranburi river mouth. Coastal erosion occurred along the shoreline, that sediment was transported from the south to the north. Eroding occurred from south, sediment moved to the north developed into sand split at the Pranburi river mouth.

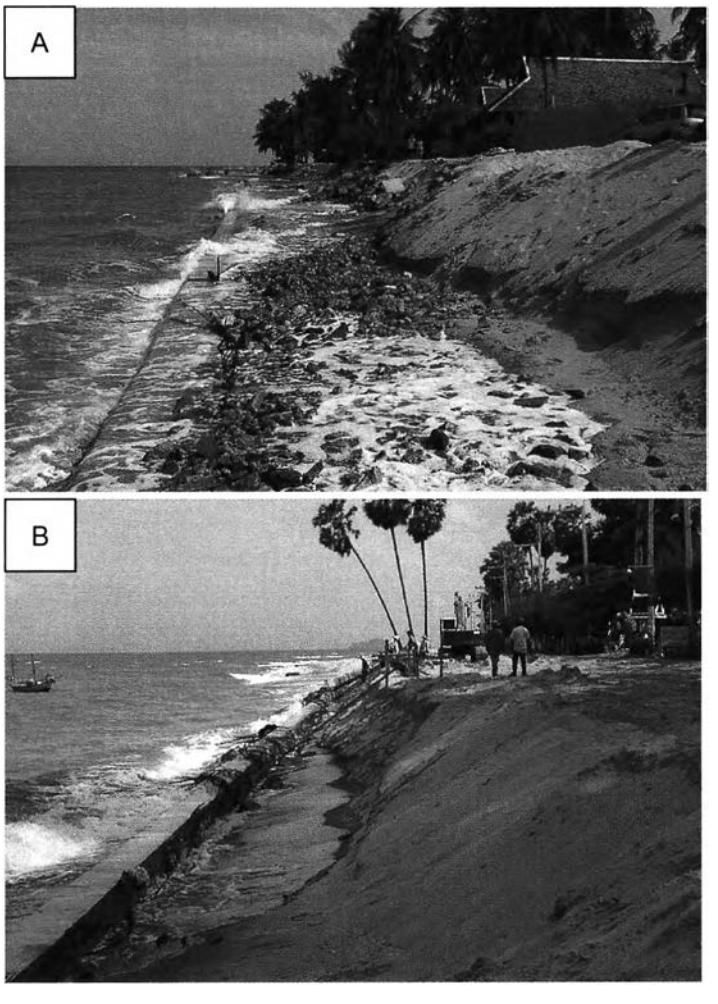

Figure 4.7 Photographs showing the erosion still occurs in the middle part of Pranburi truncated barriers, especially in rainy season which to the result from shoreface measurement. Sea wall was constructed (Both Pictures taken in August 2003 from UTM grid reference 609350N, 1367440E and looking south).

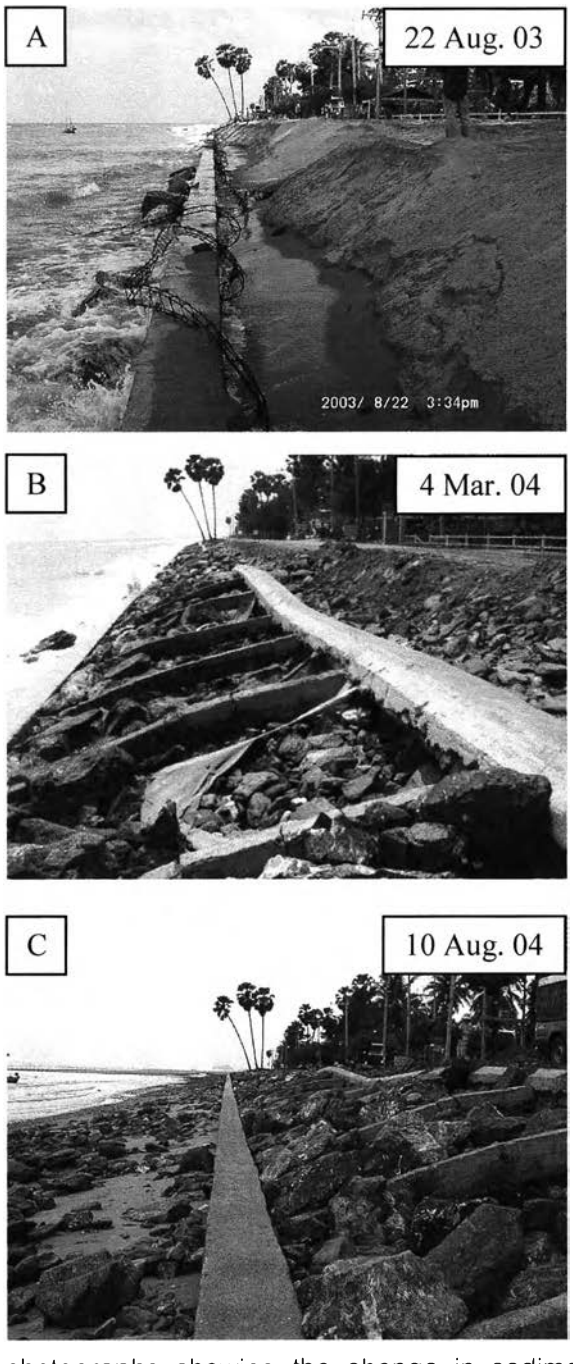

Figure 4.8 Series of photographs showing the change in sediment transport behavior annually (UTM grid reference 609350N, 1367440E and pictures taken to the south) The sea wall was constructed, but sediment transportation still occur extensively during rainy season, eroded beach sediment seawards, leading to erosion along construction line.

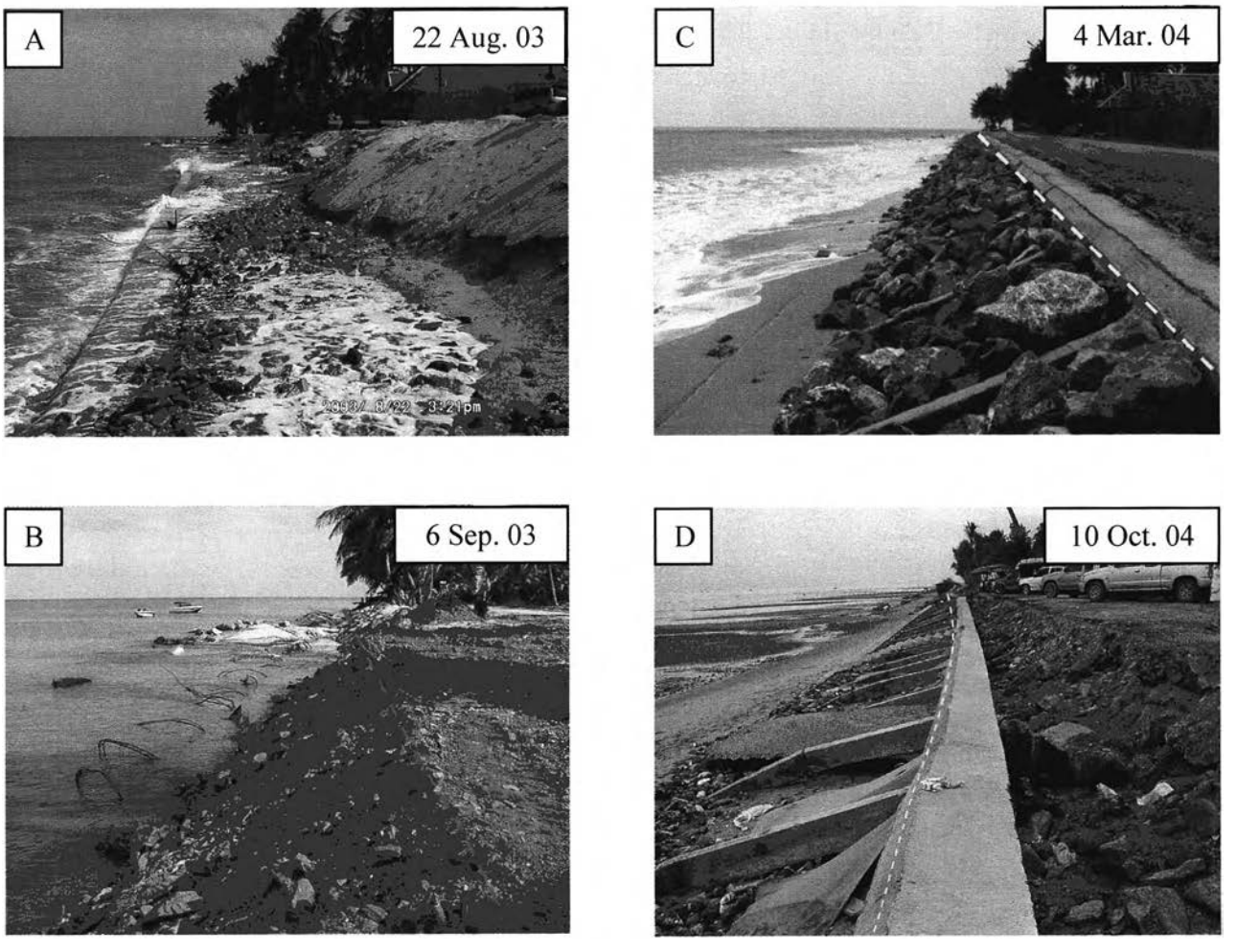

Figure 4.9 Series of photographs showing the collapse of sea wall (picture D) due to the movement of clay underneath the wall (photos taken from 22 Aug 03 to10 Oct 04 (UTM grid reference 609250N, 1367850E and pictures taken to the south). Yellow dot line is the border of the sea wall. After sea wall was constructed, the rim of the road still collapsed down to seaward (red dot in picture D).

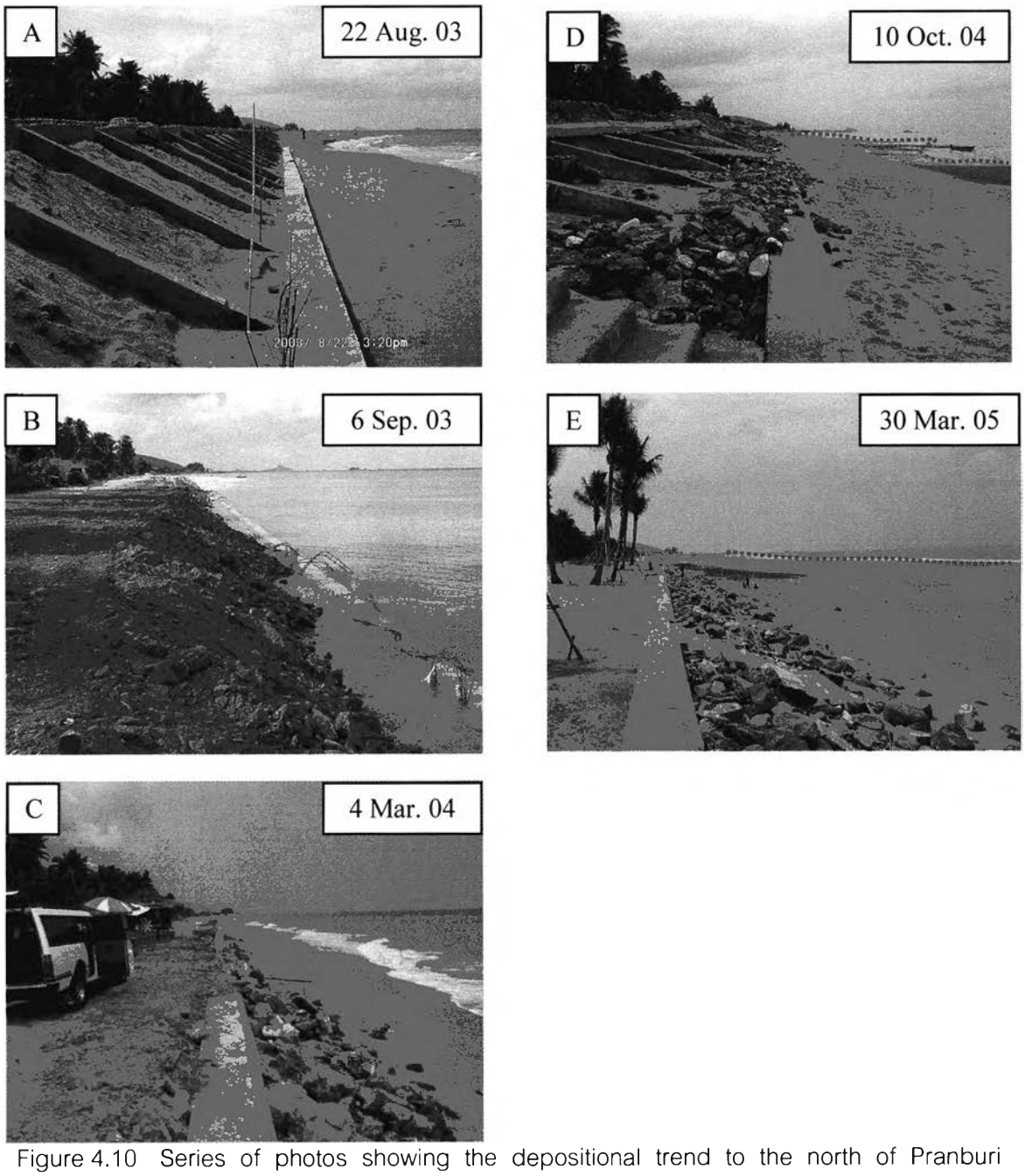

Figure 4.10 Series of photos showing the depositional trend to the north of Pranburi truncated barriers that show eroding. Photos were taken from 22 Aug 03 to 30 Mar 05 (UTM grid reference 609250N, 1367850E and looking to the north). Beach sediments were eroded along sea wall in the middle part of the area and moved to deposit in form of cuspated beaches in the north and recently forms as sand barrier in the northern end of Pranburi inlet (red dot in picture D, E).

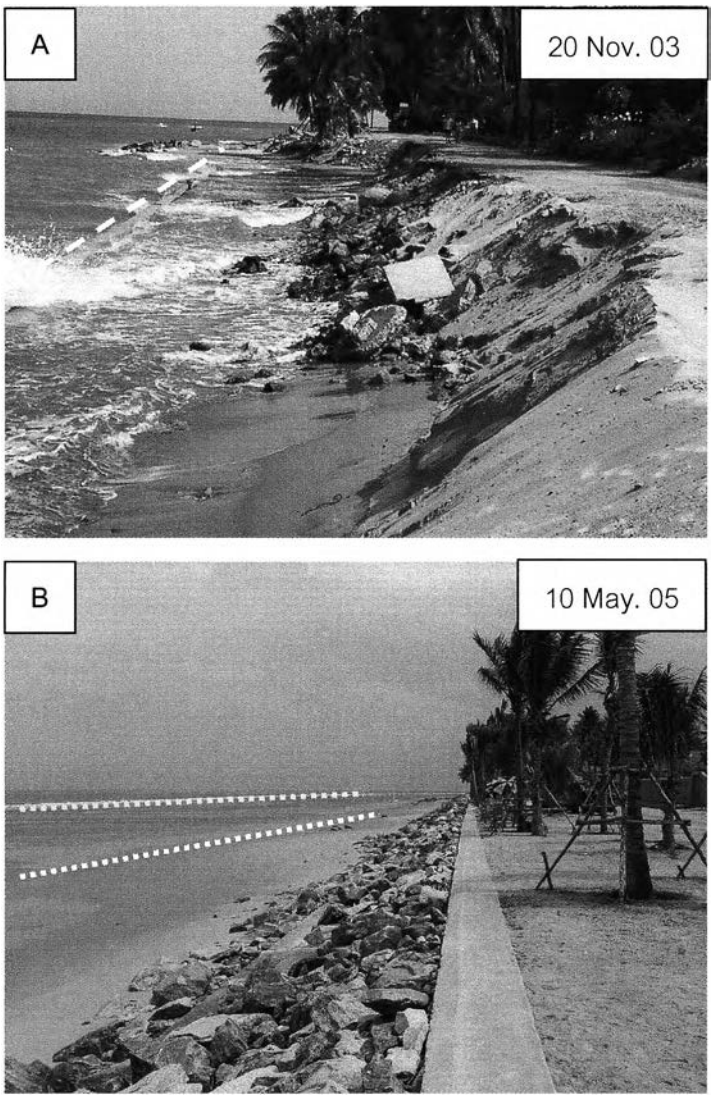

Figure 4.11 Photos showing sediment transportation behavior in the Pranburi area in front of Avason Resort). Picture A was taken on 20 Nov 03 during high tide period, white dot is the line of submerged sea wall. Picture B was taken on 10 May 05 in low tide period. It shows that shoreface beach sediments are likely to deposit normally during calm weather (from white dot to yellow dot in bottom picture).

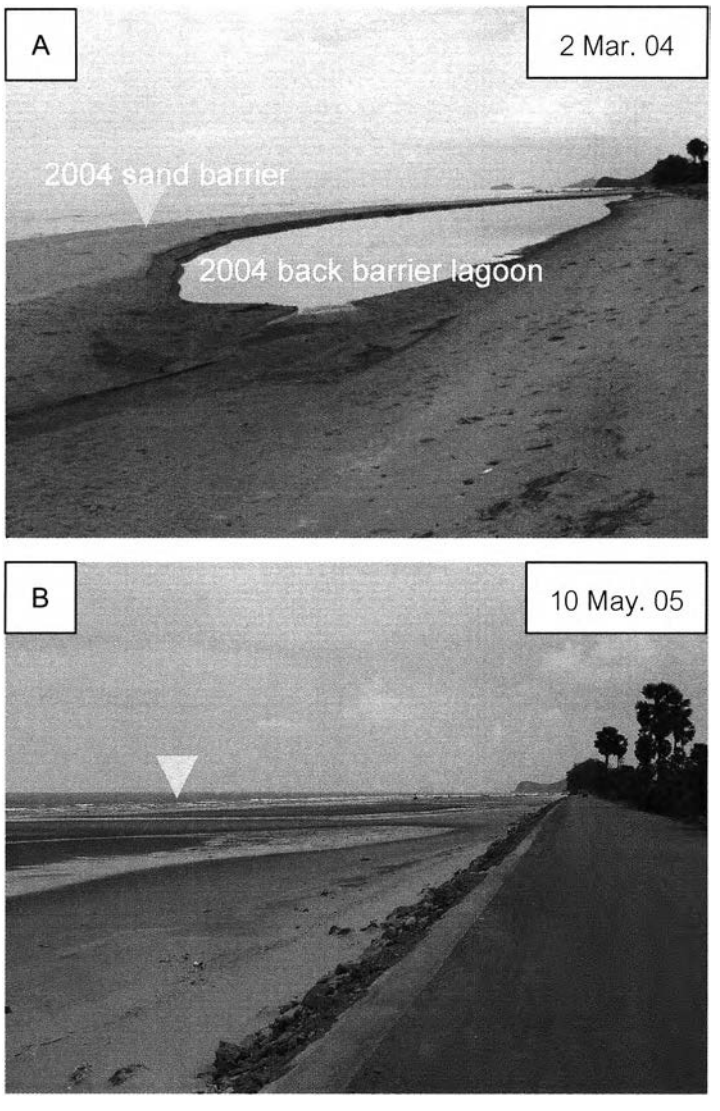

Figure 4.12 Photos showing the extension of the beach in the south of Pranburi river mouth (UTM grid reference 609050N, 1366450E). Both pictures were taken in low tide period; picture A was taken on 2 Mar 04. The developing of sand barrier enclosed and made up of back barrier lagoon inside. On the other hand, picture B (taken on 10 May 05) shows the more developed of sand barrier, and back barrier lagoon became smaller. Trend of sediment expanded to the north by the influence of longshore current. Source of sediment came from Khao Kalok at the south part of the area.

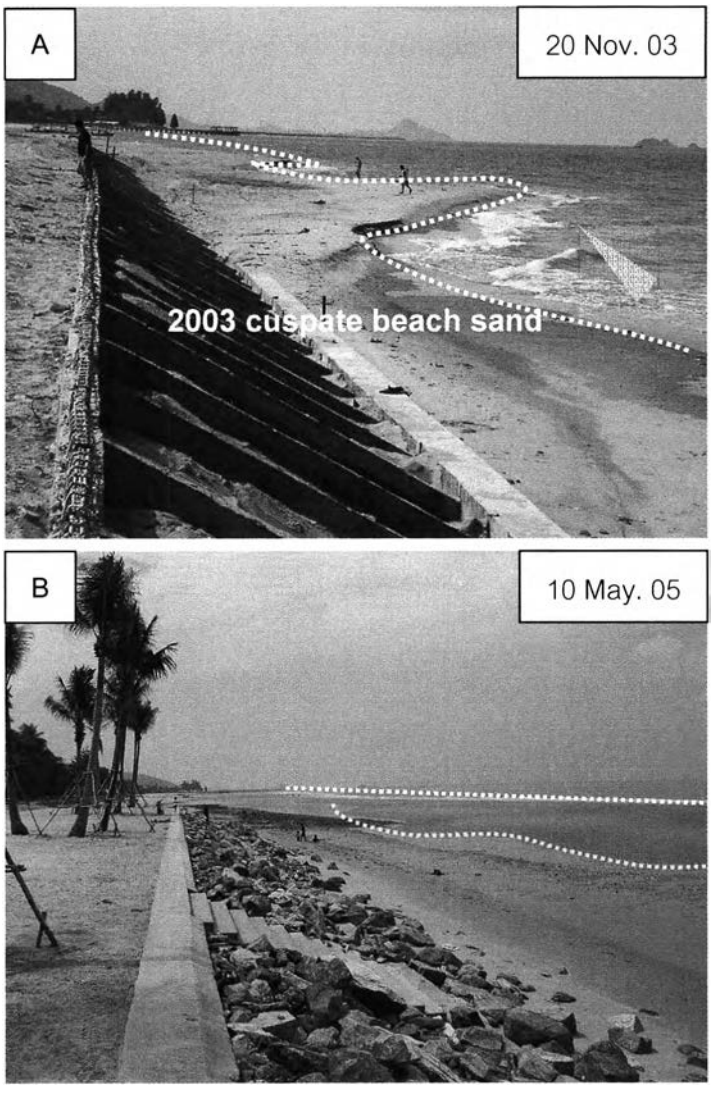

Figure 4.13 Photos showing the pattern of sediment accretion in the Pranburi area (UTM grid reference 609250N, 1367850N). Picture A is the pattern of cuspate beach sand (white dot in picture A taken on 20 Nov 03 in low tide period). Sediments accrete along the beach barrier by the north longshore current. Picture B shows the developing of emerged sand bar, and developed into back barrier lagoon (picture was taken on 10 May 05). Pattern of sediment transportation and beach geomorphology, indicated that the deposition is more than erosion in this area. The erosion may be occurred in high monsoon season only.

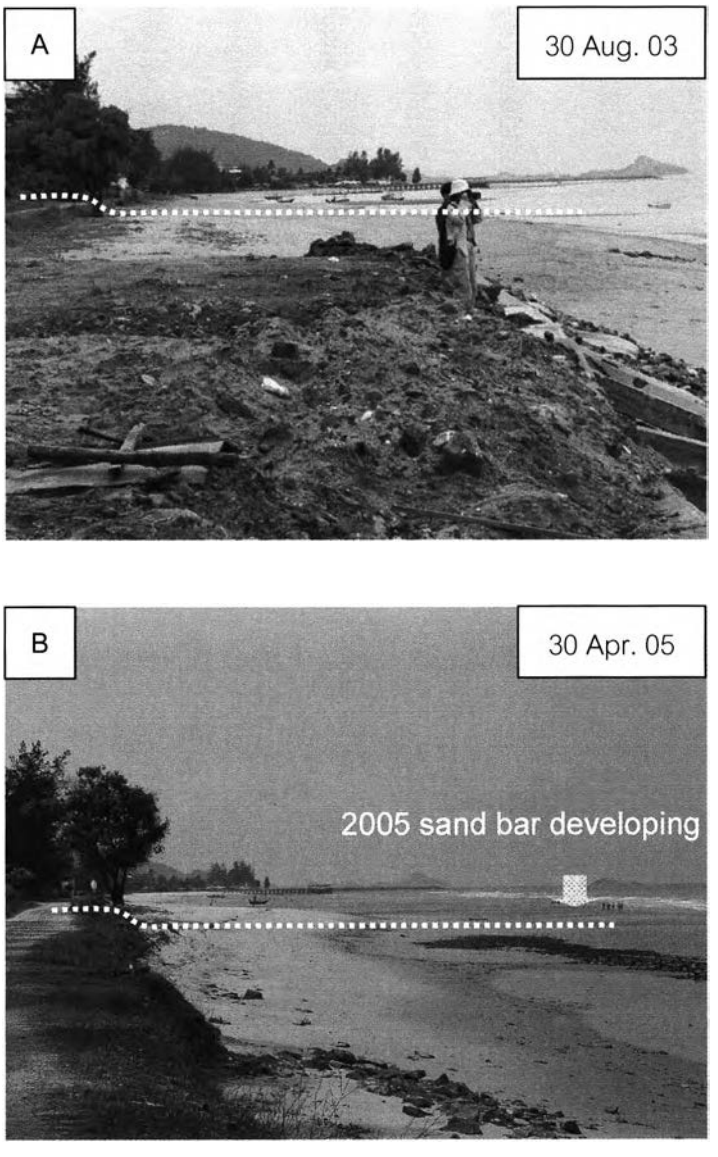

Figure 4.14 Survey line of shoreface measurement shows in the white dot. Picture A was taken on 30 Aug 03 and picture B was taken on 30 Apr 05 in the low tide period. The annual changes of shoreface are controlled by both erosion and deposition.

4.1.2.3 Sediment transportation

Estimation the direction of sediment transportation was verified by using depositional styles of coastal sediments that have formed since the mid Holocene till the present. The feature of truncated beach ridges plain and small sand spit that develop in the north can confirm that the sediment transportation direction was due north. Source of sediment is mainly Khao Kalok that was the headland in the south of the area.

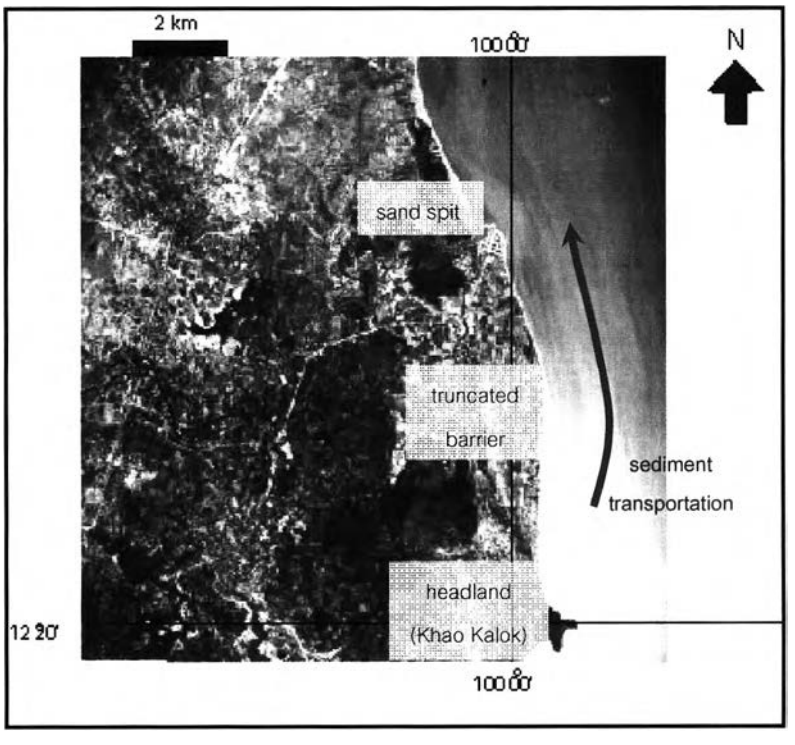

Figure 4.15 Aerial photograph showing the direction of sediment transportation in Pranburi area.

4.1.3 Analysis from aerial photographs

Spatial calculation of accretion and erosion using comparison method of air-photos taken in different periods of time shows deposition occurred in the north as small sand spit of about 47,263 m^2 and erosion occurred in the middle part of outer beach ridge plain with area of 79,085 m^2.

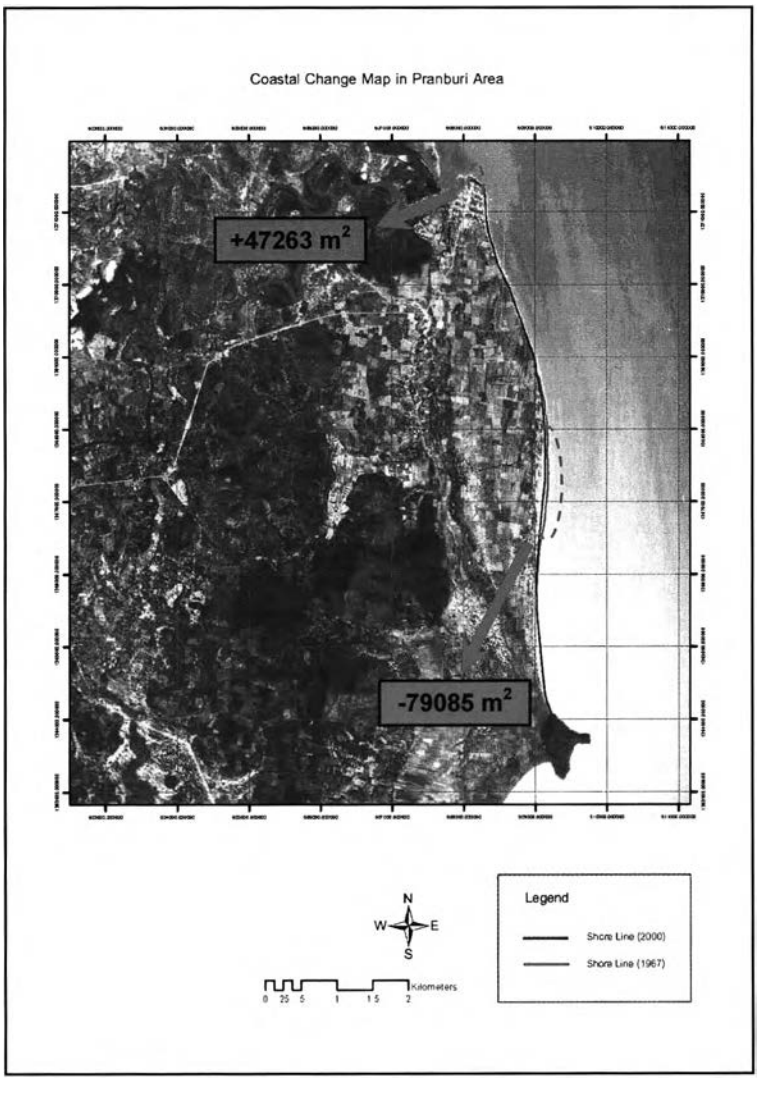

Figure 4.16 Spatial calculation of coastal change in Pranburi area using air-photos. Green circle shows area of deposition as sand spit at the mouth of Pranburi river, whereas red circle shows erosion occurred in the middle part of truncated barriers.

4.2 Prachuap Khiri Khan area

4.2.1 Result from remote sensing interpretation

The highlands to the west of the area are composed of Permo – Carboniferous sedimentary rocks. Permian limestone forms prominent coastal headlands and islands, which seem to control the direction of wave reflection, littoral sediment movement and the pattern of barrier sand accumulations along the coast. The geomorphology of the area is composed of both depositional and erosional features. The barrier system in the area contains prograded beach ridges and shows a number of depositional features. Semi – enclosed bay with tombolo connected the former islands both in the north and the south. One major tidal channel is in the middle part of the bay supplying terrestrial sediment to the coast (Figure 4.17).

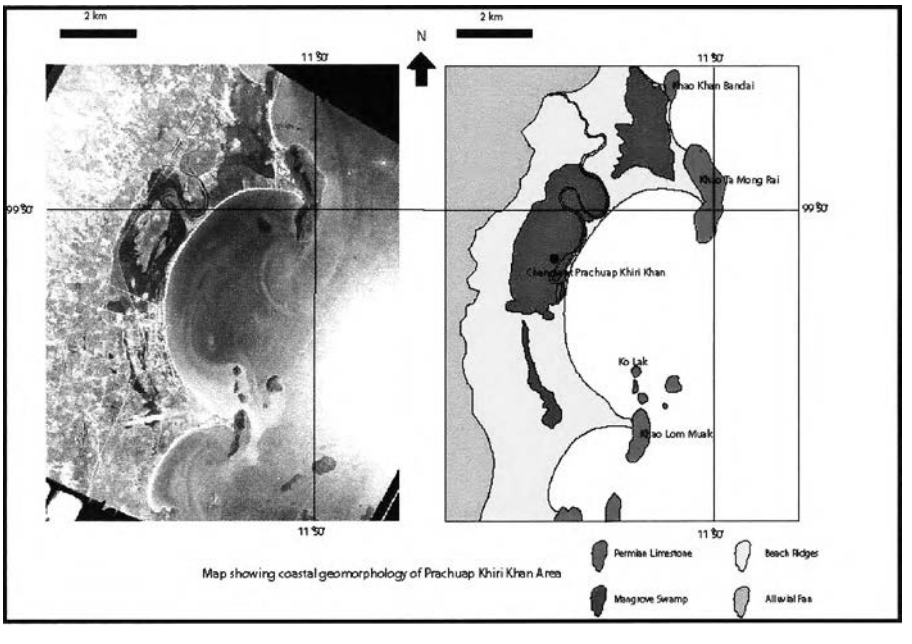

Figure 4.17 Map showing coastal geomorphology at Prachuap Khiri Khan area. Semi – enclosed bay with tombolo connected the former island both in the north and the south. One major tidal channel is in the middle part of the bay supplying terrestrial sediments to the coast.

4.2.2 Result from field investigation

4.2.2.1 Measurement of shoreface slope

- Prachuap Khiri Khan (north) area

This site has shown a clear and consistent trend for shoreface erosion over one year period since monitoring commenced (Figure 4.18). For example, in November 2003 to April 2004 the shoreface lay seaward (Figure 4.19). April 2004 to November 2004 survey, the accretion occurred in the area but not too much (Figure 4.20). As a result in one year period between the surveys of November 2003 until November 2004, the net of erosion dominant in this area (Figure 4.21).

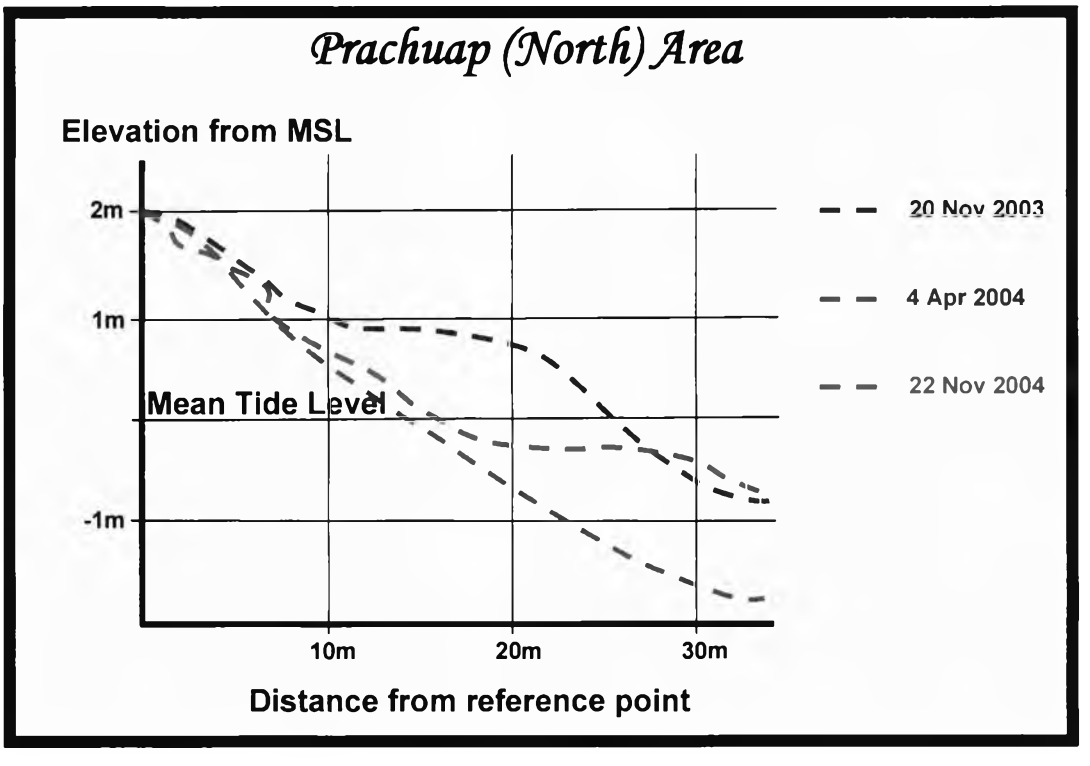

Figure 4.18 Beach profiles from Prachuap Khiri Khan (north) area.

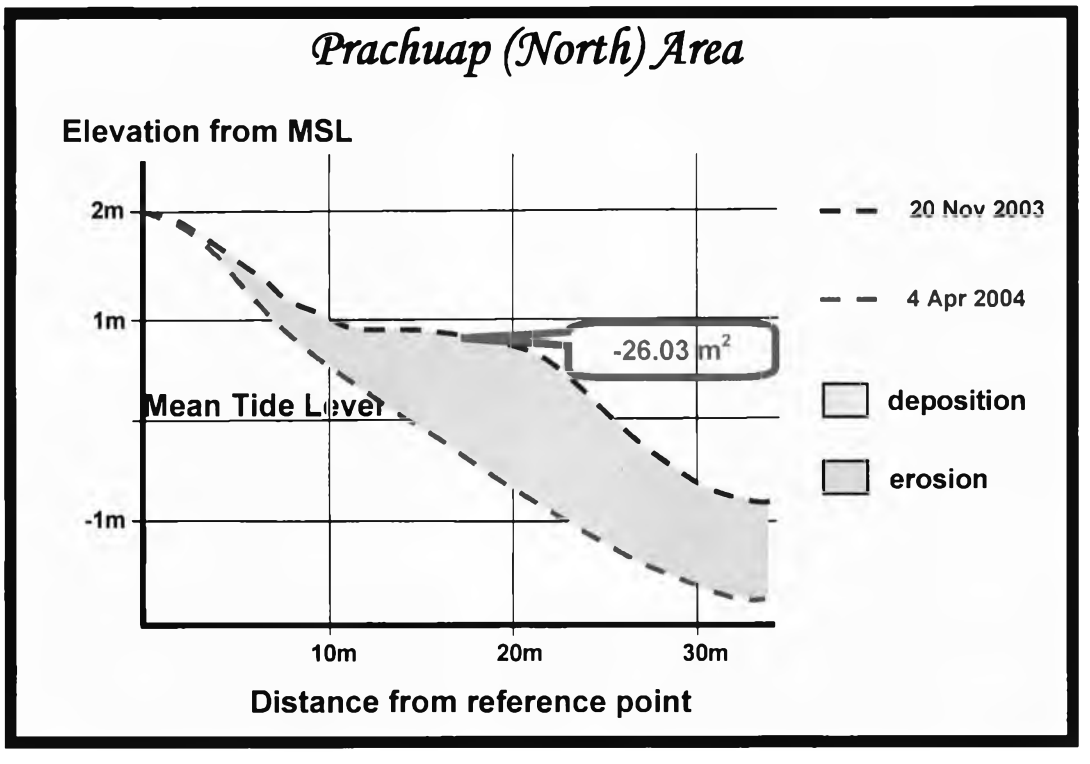

Figure 4.19 Beach profiles from Prachuap Khiri Khan (north) area measured in between November 2003 to April 2004. Erosion was detected widely.

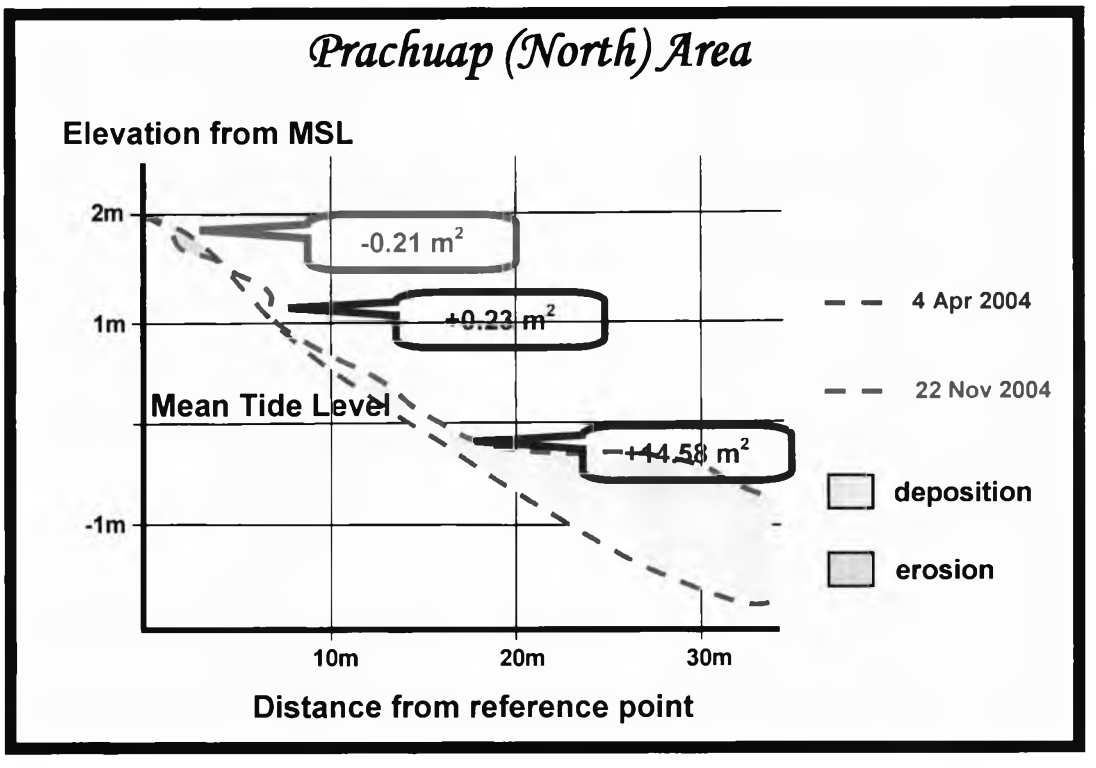

Figure 4.20 Beach profiles from Prachuap Khiri Khan (north) area measured in between April 2004 to November 2004. Configuration was changed with more deposition trend than erosion during rainy season.

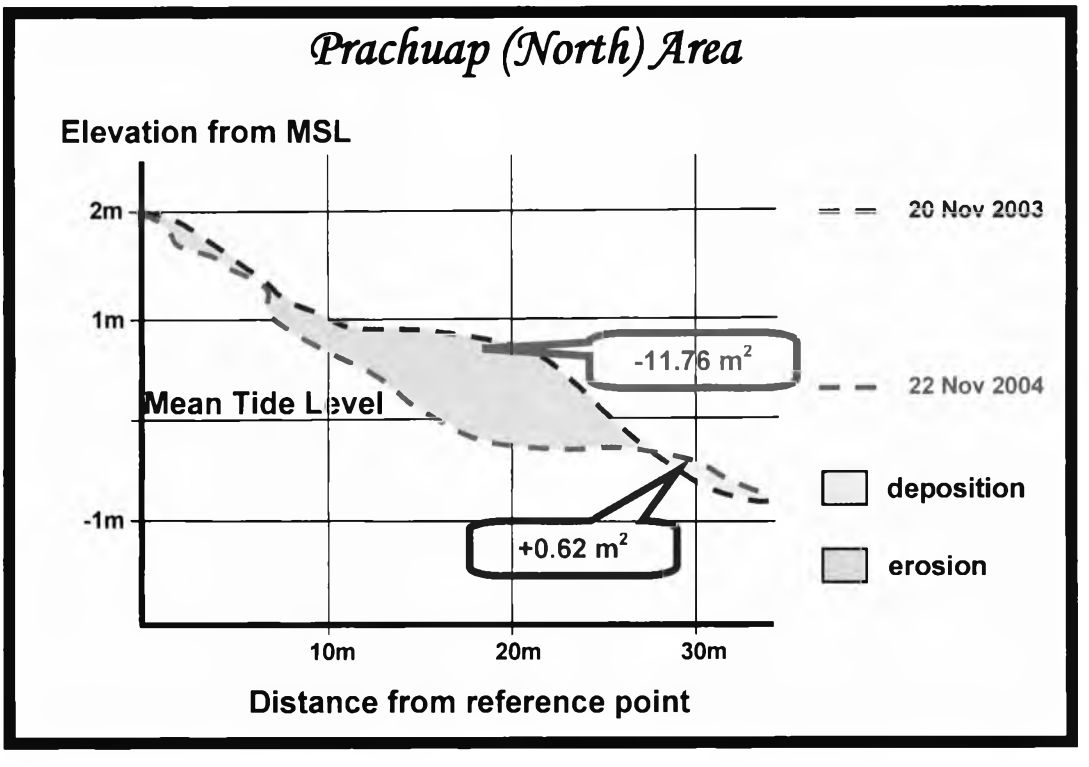

Figure 4.21 Beach profiles from Prachuap Khiri Khan (north) area measured in between November 2003 to November 2004, comparison in one year. In this part of the bay, erosion occurred extensively more than deposition.

- Prachuap Khiri Khan (south) area

This site showed a clear trend for landward advance over the one year record (Figure 4.22, 4.25). The shoreface in November 2003 shows erosion and accretion equivalent elevation in April 2004 (Figure 4.23). However, in the period between the surveys of April 2004 and November 2004, the average gradient of the landward shoreface was increasing (Figure 4.24). There does appear to be a trend for ongoing net shoreface accreted in this area (Figure 4.25).

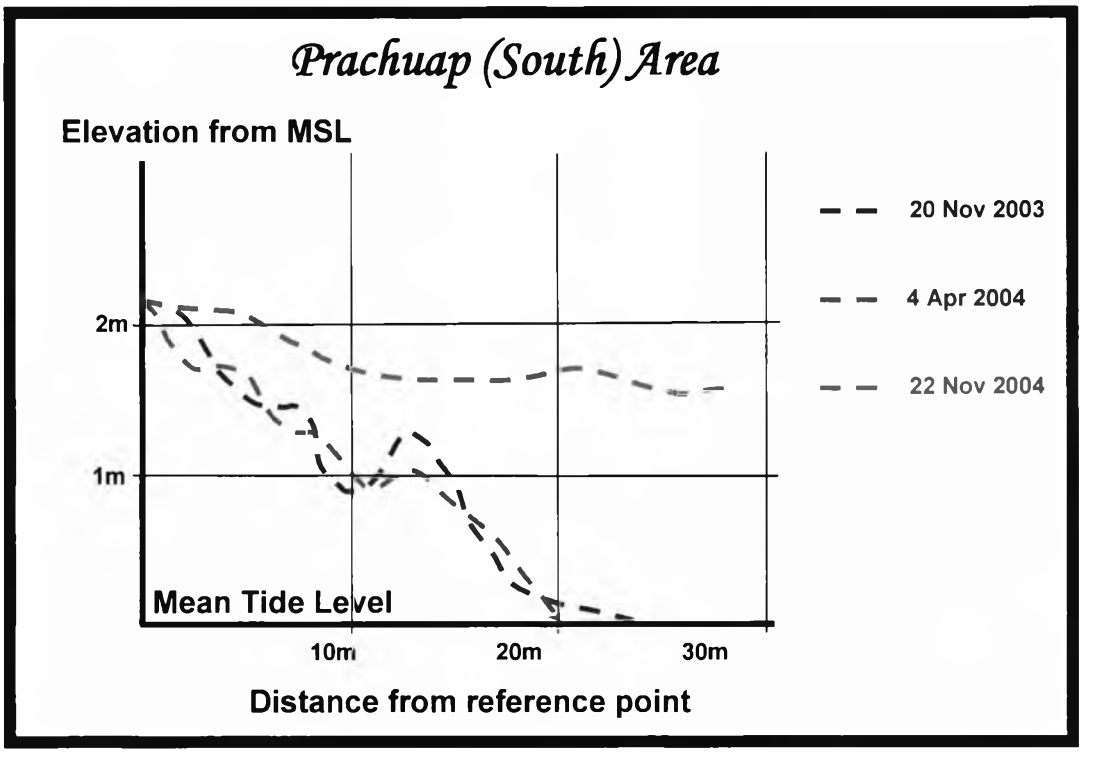

Figure 4.22 Beach profiles from Prachuap Khiri Khan (south) area showing the change in shoreface configuration. The measurement was done in one year from 20 Nov 03 to 22 Nov 04. Curves show deposition is getting much higher value from 2003 to 2004.

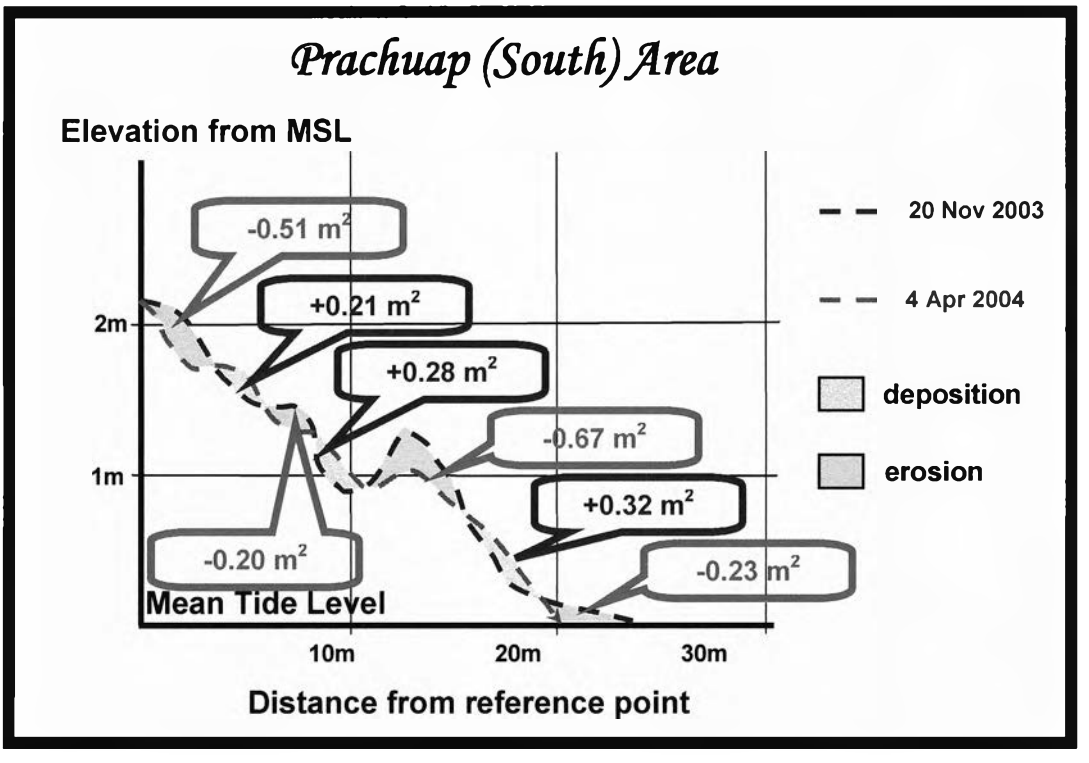

Figure 4.23 Beach profiles and comparison of deposition and erosion of shoreface sediment from Prachuap Khiri Khan (south) area during 20 Nov 03 to 4 Apr 04, winter season. The net value of erosion and accretion is almost the same.

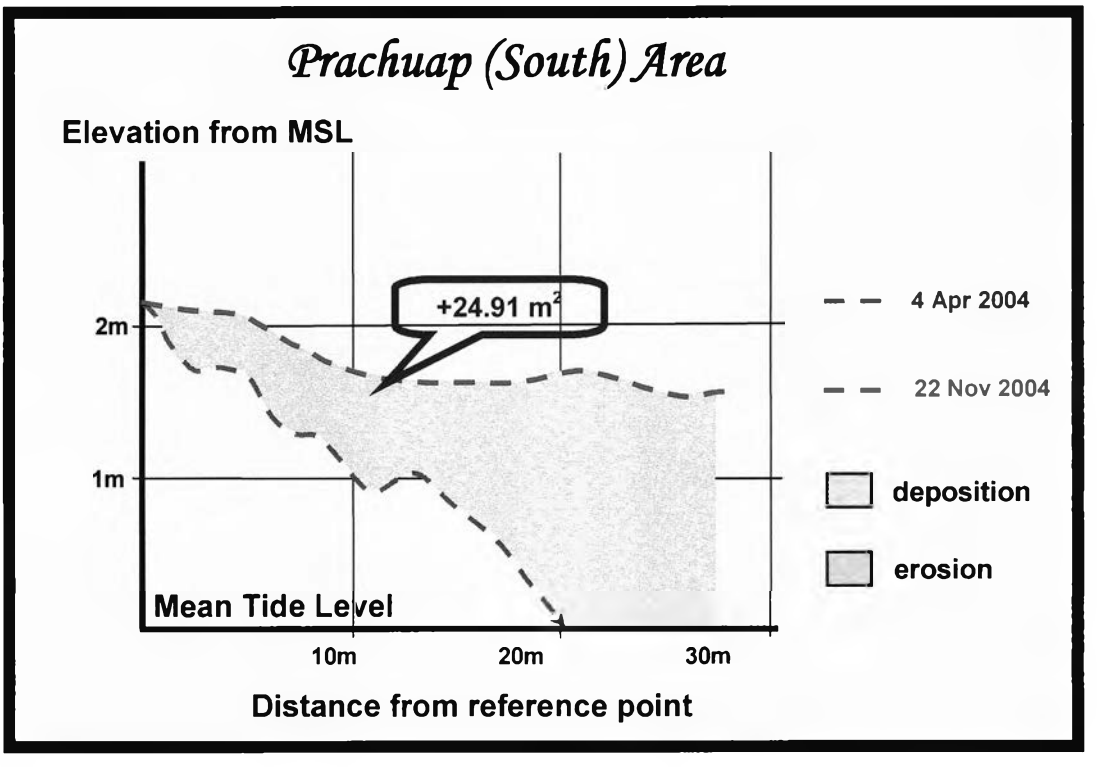

Figure 4.24 Beach profiles from Prachuap Khiri Khan (south) area comparing between April 2004 to November 2004. Depositional trend seems to occur extensively during this rainy season.

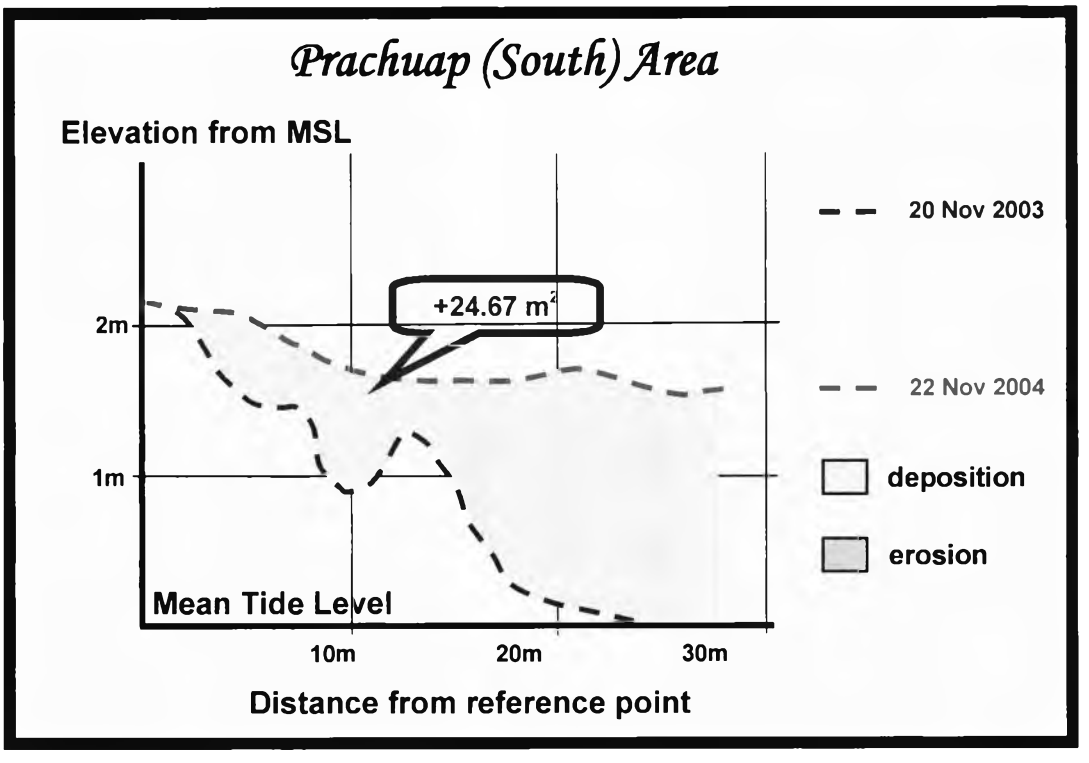

Figure 4.25 Comparison in beach profiles from Prachuap Khiri Khan (south) area in one year round between November 2003 to November 2004 showing abundant deposition.

4.2.2.2 Field observation

This section was focused on the changing of beach appearance along the study area by taking photographs in different period time. The comparison of the photographs reveals some changes in beach appearance of the area.

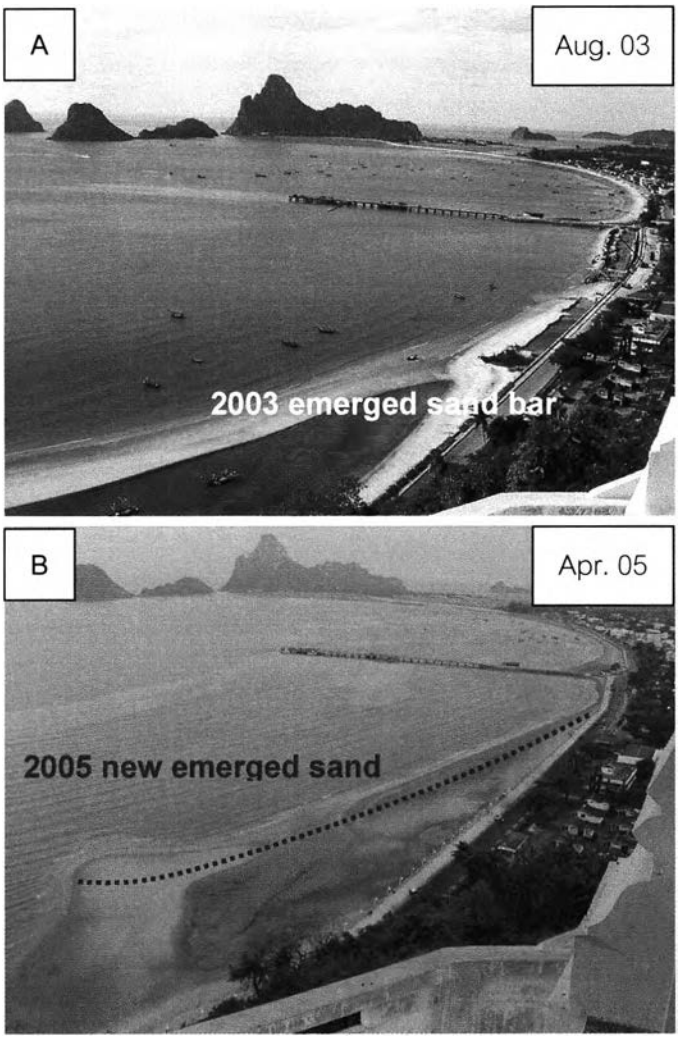

Figure 4.26 The photographs showing sediment movement in the area during low tide period. Both pictures were taken to the south of Prachuap Khiri Khan Bay. From picture A (taken on Aug 03), the sediments were moved by longshore current to the north (brown arrow), provided new sand bar.

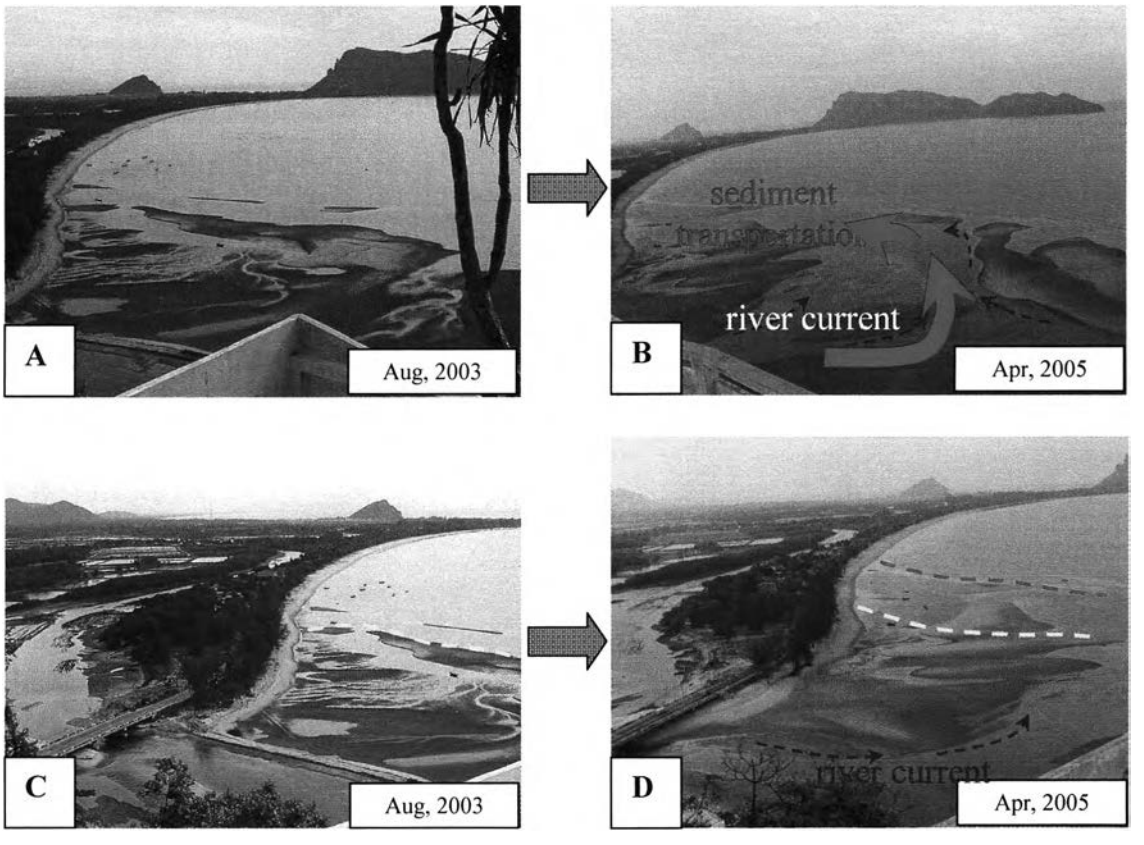

Figure 4.27 Khlong Bang Nang Rom is the pathway of terrestrial sediments supplying to the sea. All pictures were taken in low tide period. From left to right (time different around 1 1/2 year), sediments from Khlong Bang Nang Rom move to the sea via river current, and deposit as tidal delta at river mouth expanding seaward.

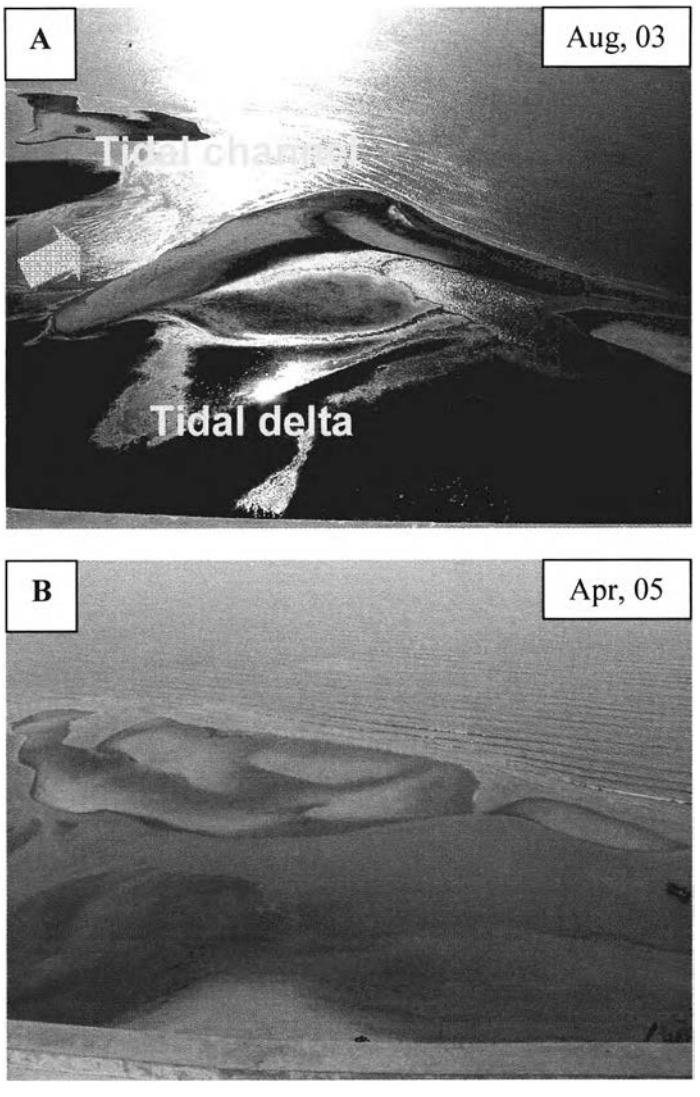

Figure 4.28 Comparison of tidal inlet/outlet channel in the middle part of Prachuap Khiri Khan bay (photos were taken during low tide period). Terrestrial sediments supply to the sea by Khlong Bang Nang Rom, depositional form into the tidal delta. From 2003 to 2005, sediments seem likely to increase in volume.

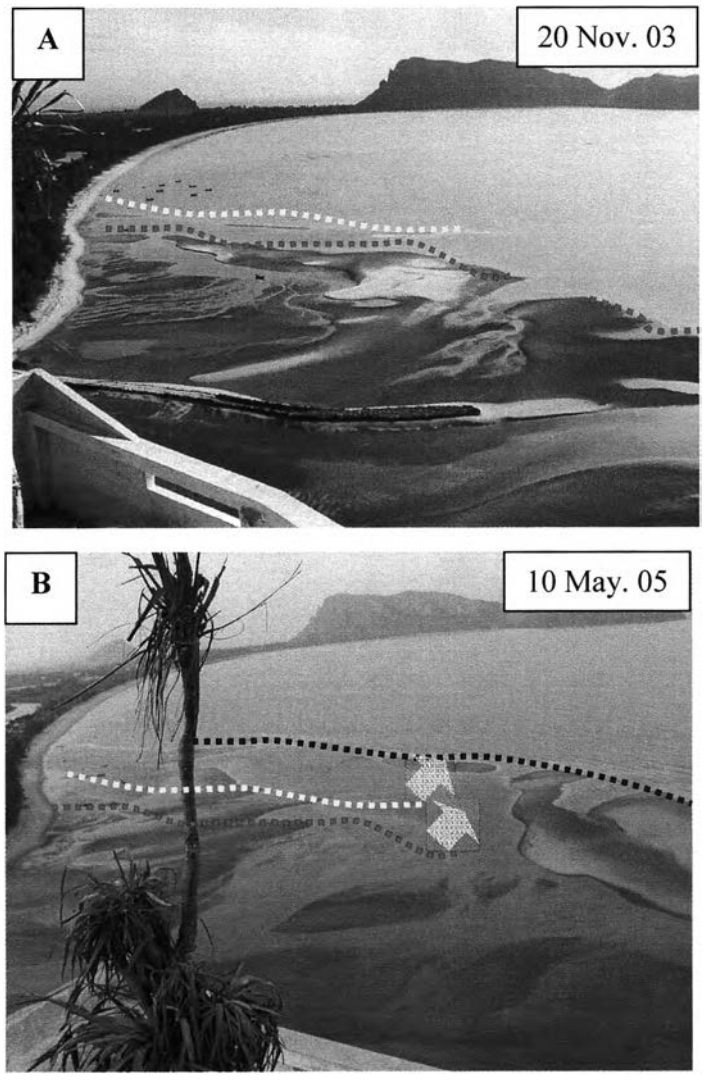

Figure 4.29 A pattern of tidal delta is formed in the middle part of Prachuap Bay. Sediments always increase in volume comparison within 2 years. Both pictures were taken on low tide period, picture A was taken on 20 Nov 03 and picture B taken on 10 May 05. Tidal sediment patterns suggest the deposition along the coast by littoral drift.

4.2.2.3 Sediment transportation

The estimation of deposition styles can give a lot of information on the history of shoreline changes in each individual area that will be very important key to understand the previous transportation cycles and trend. Prachuap Khiri Khan area is dominated by semi - enclosed bay with tombolo connected the former islands both in the north and south. One major tidal channel is in the middle part of the bay supplying terrestrial sediment to the coast. Sediment transportation direction in this area is both southwards and northwards, supplying sediments from river mouth to the sea.

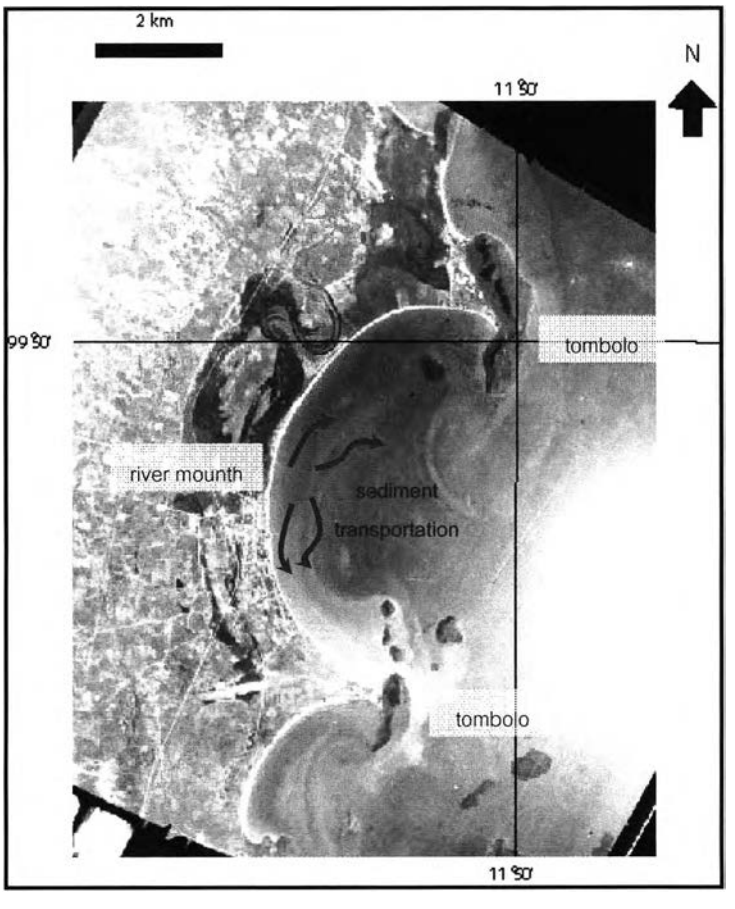

Figure 4.30 Aerial photograph showing the sediment transportation direction in Prachuap Khiri Khan area.

4.2.3 Analysis from aerial photographs

The stage of analysis was done from 2 periods of aerial photographs by scanning the images using computer. Rectifying aerial photographs was done by using program ARGGIS 8.3, fixing reference points from topographic map scale 1:50,000. The 15 reference points around the map were used for rectifying, which RMS error less than 10 m. Then, the shoreline was creating consequently. Spatial calculation of accretion and erosion show that the accretion and erosion are slightly different (+40,326 m^2 and -49,746 m^2).

Figure 4.31 Spatial calculation of coastal change in Prachuap Khiri Khan area. Erosion and deposition areas were detected and calculated. The results indicate that sediment lost and gained are slightly different in terms of area affected.

4.3 Wanakorn area

4.3.1 Result from field investigation

4.3.1.1 Measurement of shoreface slope

The result suggests that the shoreface is slowly prograding at this area (Figure 4.32). In April 2004, the shoreface lay landward with equivalent elevation in November 2003 (Figure 4.33). It is suggested that slow net landward advance in the area. The prograding shoreface is very steep and appear to have become slightly steeper at November 2004 (Figure 4.34). Therefore, it appears to be a trend for ongoing net shoreface progradation in this area (Figure 4.35).

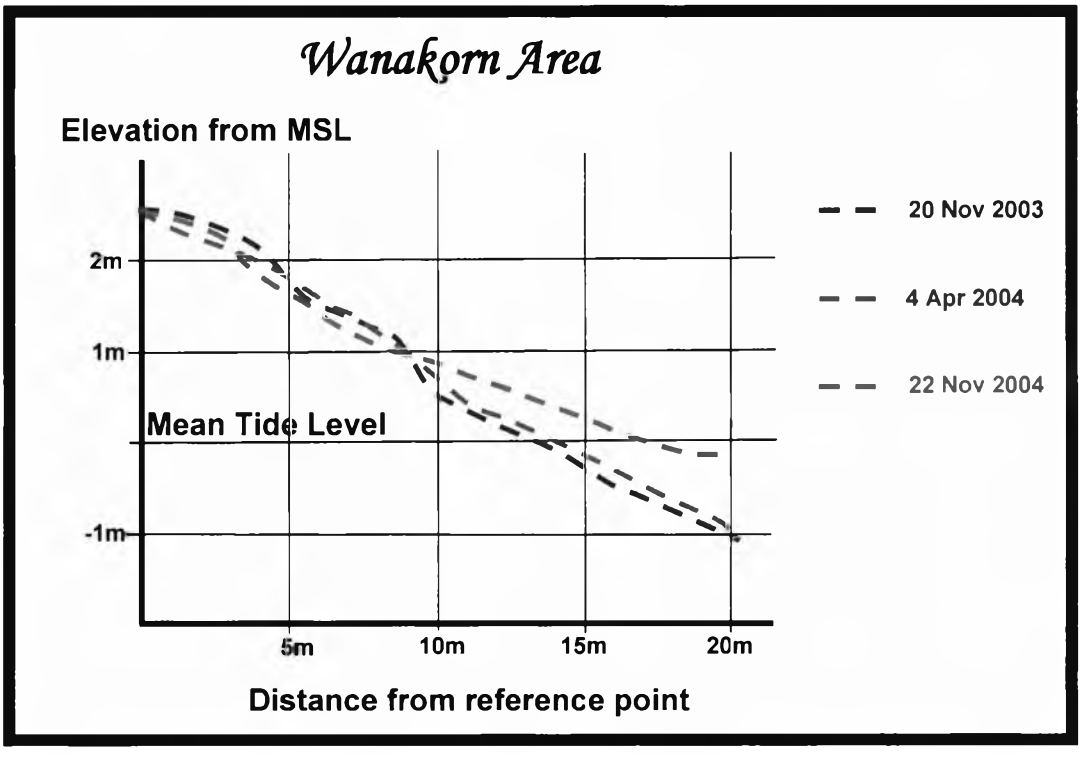

Figure 4.32 Comparison in beach profiles from Wanakorn area.

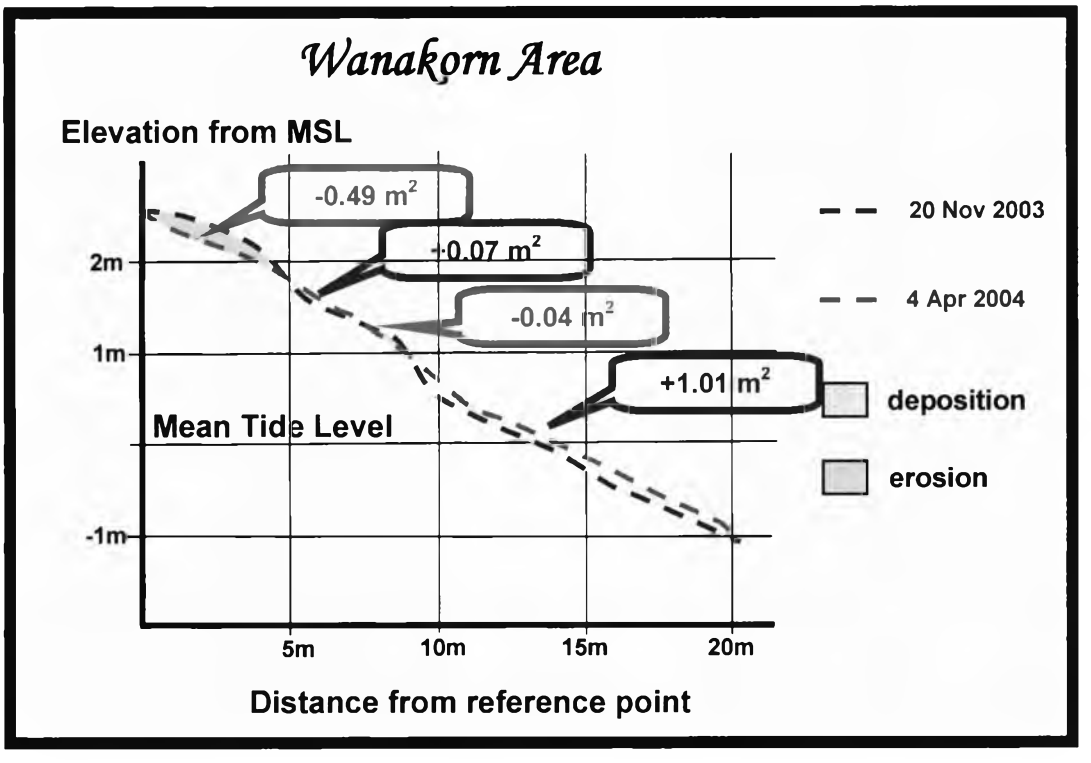

Figure 4.33 Result of beach measurement profiles from Wanakorn area showing almost similar value of deposition and erosion in between November 2003 to April 2004.

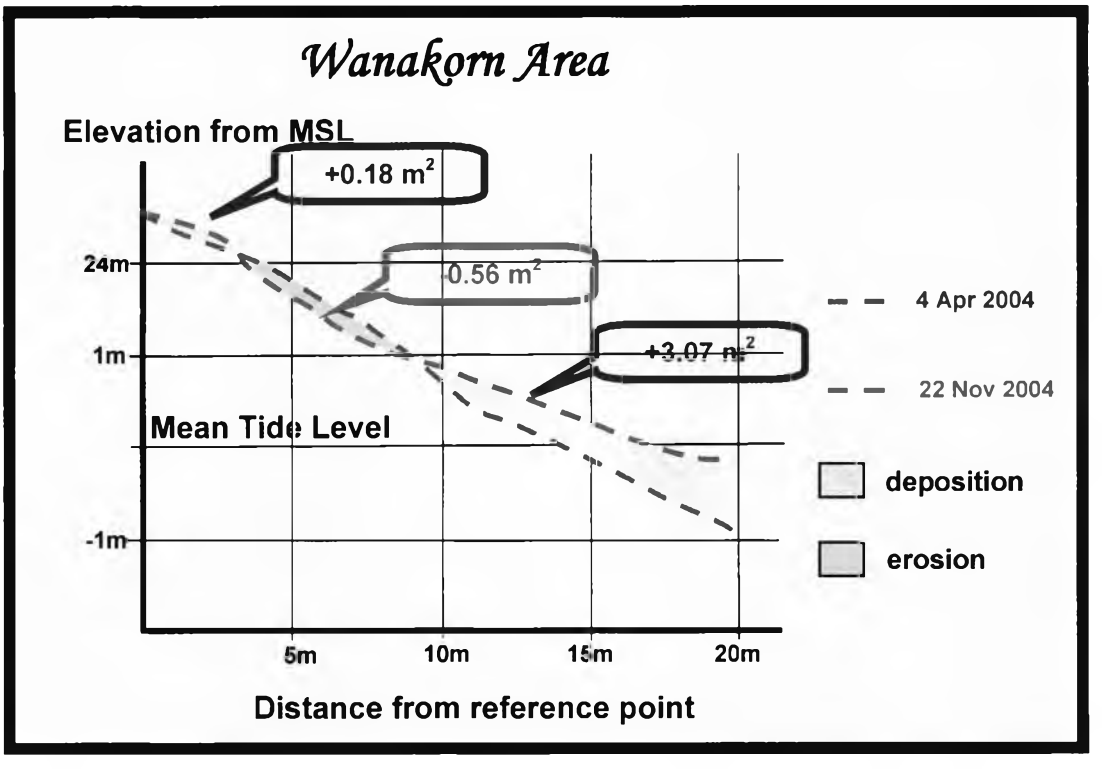

Figure 4.34 Comparison in beach profiles from Wanakorn area in between April 2004 to November 2004. Result of area calculations show almost similar values of erosion and deposition.

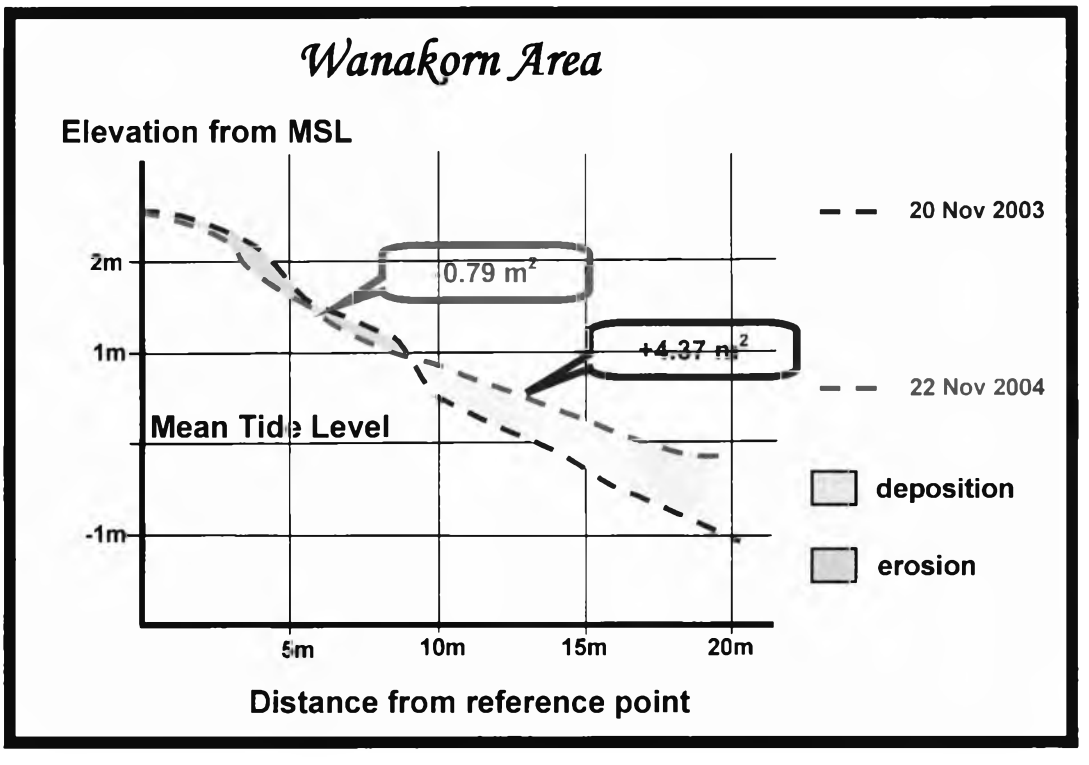

Figure 4.35 Comparison in beach profiles from Wanakorn area in between November 2003 to November 2004 showing a little higher value of deposition from erosion during one year round.

4.3.1.2 Field observation

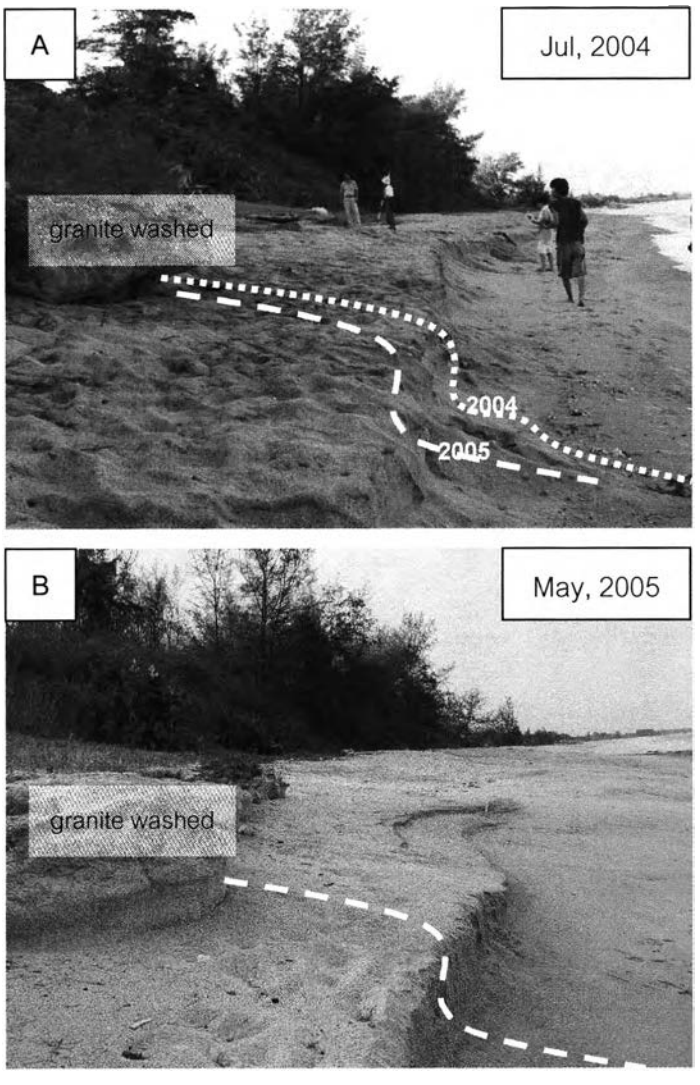

Figure 4.36 The changing in shoreface sediments from Wanakorn area. Picture A was taken from July 2004 and picture B from May 2005. It shows the decreasing of sediment because of normal tidal range. The direction of sediment transportation indicated the sediment transported from south to the north by longshore current.

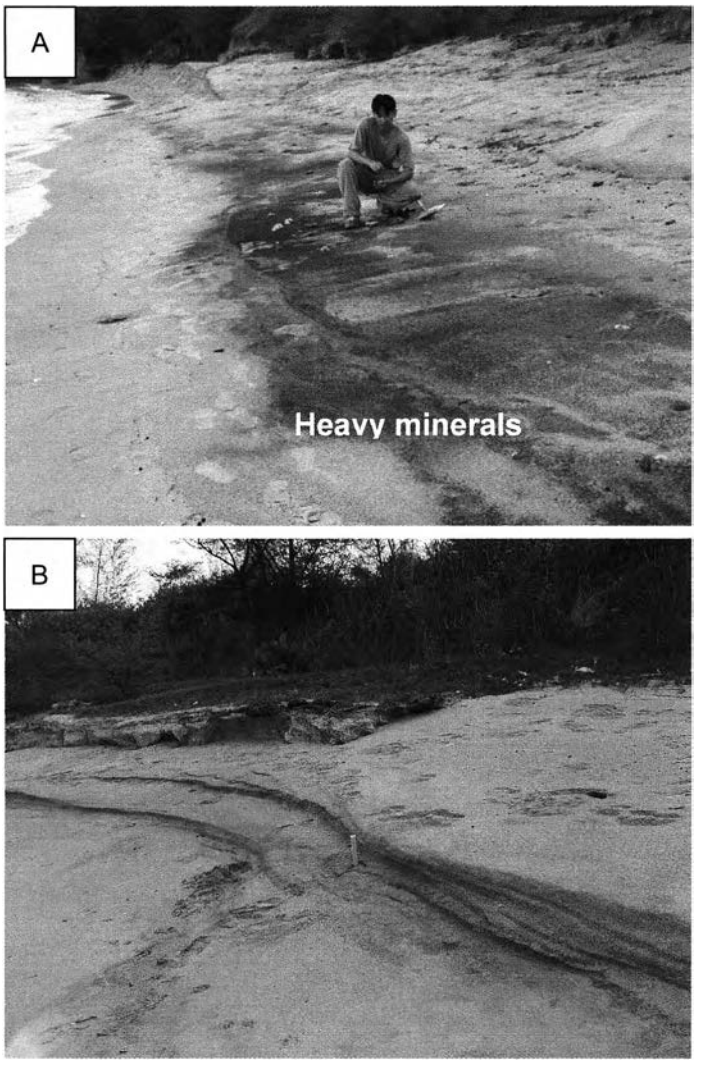

Figure 4.37 Heavy minerals, one particular type of beach sediment is the one evidence that can be used for comparing the cycle of sediment transportation in Wanakorn area. Picture A shows heavy minerals deposited on the beach, indicated source of sediment come from granite washed and granite outcrop in the area. The type of mineral indicating the sediment is from granite washed. Picture B shows the movement of low specific gravity mineral, quartz grain in particular, whereas heavy minerals were left on the beach.

4.3.1.3 Sediment transportation

The estimation of direction of sediment transportation by using depositional styles of coastal sediments they have formed since the mid Holocene till the present. Wanakorn beach area is the straight beach ridges plain located in the south of Prachuap Khiri Khan Bay. Depositional styles of beach ridges indicate main longshore current moving to the north. Granite washed in the southern part of the area is the major source of beach sediments in this area. This is evidenced by the distribution of black heavy minerals all over the beach north of the granite washed.

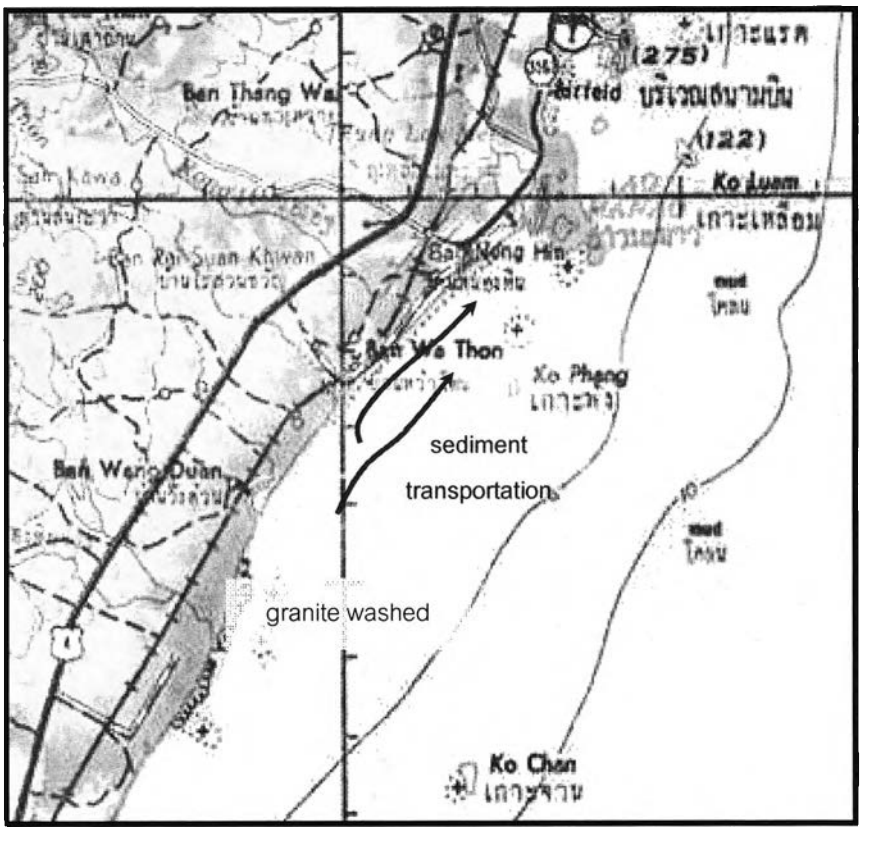

Figure 4.38 Part of topographic map showing the sediment transportation direction in Wanakorn area.