CHAPTER IV

DESCRIPTION OF THE LANDFORMS

The Ping and the Wang river basin is characterized by numerous landforms along its course. In this chapter a description of the individual terrace parts and other landforms will be given. The landforms were first identified by aerial photograph interpretation as a principal geomorphologic map and were subsequently examined in detail and mapped on the basis of the more intensive field study. Then, the sedimentary petrography of the deposits will be discussed, concluded, and the correlation of the various terraces and other landforms will be carried out in the next chapter.

On aerial photographs, different geomorphologic features were thus reflected not only in evident morphological contrasts and variations in plan pattern, but also in tonal and textural contrasts on photographs because subtle differences of surface configuration and material produced slight but important contrasts in ground moisture conditions and plant response. These tonal and textural contrasts facilitated not only the mapping of boundaries between geomorphologic units but also of their associated materials by extrapolation. For such a reasons aerial photographs were used in all stages of work so that airphoto characteristics could be interpreted in terms of field and laboratory information (Thiramongkol, 1975).

Geomorphological map of the study area is present in Figure 4.1.Various landforms present in this study area can be classified mainly into 3 categories as denudational origin, colluvial origin and fluvial origin, which are described in detail below.

Unit of denudational origin

According to Piyasin (1974) and Boripatkosol et al. (1989), the Ping and Wang river basin consists of various rock units. Four rock units are characterized. They are Precambrian (?) gneiss, Silurian-Devonian quartzite (Don Chai Group) in the western part of the area, predominantly granite in the eastern part and the rhyolitic tuff of Lower Triassic extrusive igneous rock that occurs in the northeast of the region.

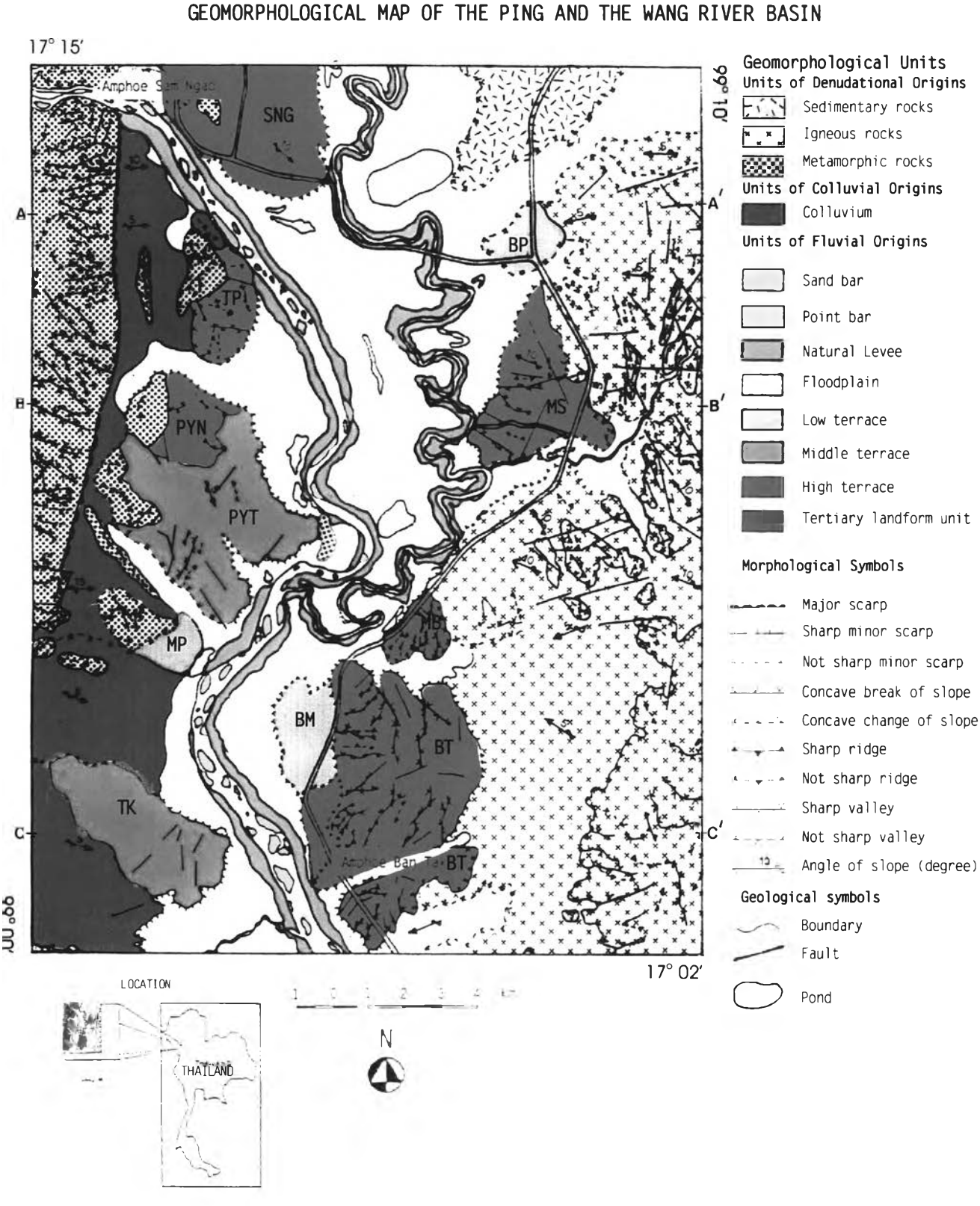

Figure 4.1 Geomorphologic map of the Ping and the Wang River Basin

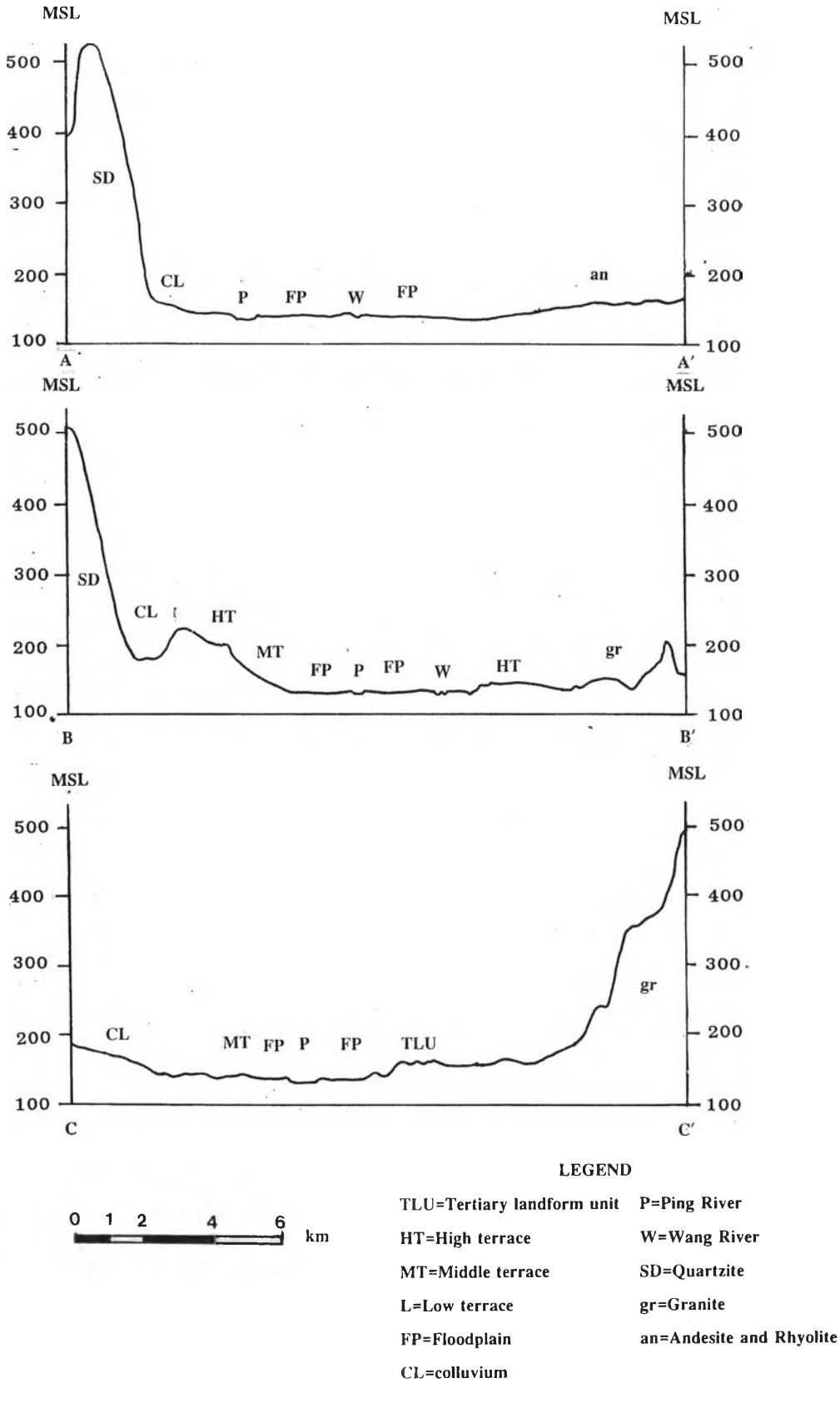

Figure 4.2 Topographic cross section along line AA′, BB′, CC′ illustrated topography in the study area.

Denudational mountains are considered to project at least 300 m above the surrounding land whereas elevations of denudational area of hills lie less than 300 m (Bates and Jackson, 1984). The unit of denudational origin can be subdivided into 3 geomorphologic categories.

1) Denudational mountains of metamorphic rocks occupy large area of western part of the study area around the Bhumipol dam and Doi Mun Luang. This mountain range lies in North-South direction and can be divided into 2 parts, Precambrian (?) gneiss in the west and Silurian-Devonian quartzite in the east. The highest elevation of Precambrian (?) gneiss is 627 m above mean sea level with relief about 450 m. Silurian-Devonian mountain is composed of quartzite, quartz-schist, mica schist and phyllite with highest elevation is 561 m above mean sea level with relief about 400 m. The eastern boundary of this unit also occurs as cliffs that can be clearly seen in the aerial photographs.
2) Denudational mountains and hills of Triassic granite occur as large batholith that occurs in the southeastern part of the area in Khao Luang. The highest elevation is 681 m above mean sea level with relief about 500 m.
3) Denudational hills of Lower Triassic rhyolitic tuff covers an area in the northeast. The highest elevation is 189 m above mean sea level. Relief of the hills is approximately 60 m.

Unit of colluvial origin

The colluvial deposits, westerly bounded by scarp of Silurian-Devonian rocks, occur most widespread in the east of the Doi Mun Luang Range, western marginal zone of the study area. The only part of colluvial slope which is gentle convex extends up to 200 meters from the source rocks. The slope lies between 160 and 180 m above mean sea level. In place it can occurs as a scarp, known as Sam Ngao Cliff, in the northwestern part of the study area (Figures 4.4 and 4.5) which is formed by erosion of the Ping River.

Colluvium consists of very poor-sorted rock fragments that has moved downslope mainly under the influence of gravity. The colluvium in this area consists mainly of subangular to angular rock fragments of pebbles, cobbles, and small boulder size, with the minor content of larger blocks. Rock fragments are weathered and ferruginized and sandy matrix is also present.

The colluvial deposits consist both of loose (Figure 4.3) and consolidated (Figure 4.4), subangular to angular rock fragments of Silurian-Devonian quartzite with sandy matrix. More silty and sandy materials are present interlayering downslope. The silt layer is 0.6 m thick. It is sandy and contains small amount of Fe/Mn concretions. The sand dispersed in silt is fine- to coarse-grained, angular and poorly sorted. The sand layer is over 0.7 m in thickness and is grayish brown to moderate brown.

Based on the degree of sediment consolidation, the age of colluvium could be Recent because it occurs as loose surficial materials. However, the surficial materials at Sam Ngao Cliff, which considered to be the relief of the older colluvium, show higher degree of consolidation and contain iron oxide concentrations or patch of iron oxide. Thus, its age could be Late Pleistocene to Holocene.

Unit of fluvial origin

The Ping-Wang River Basin has been a site for deposition of fluvialtile sediments. The dominant features of fluvial origin consist of terraces and floodplains that occur extensively on both sides of the Ping and the Wang rivers. However, the geomorphologic unit of fluvial origin of this basin can be subdivided into 8 geomorphologic units, including (1) Tertiary landform unit, (2) high terrace, (3) middle terrace, (4) low terrace, (5) floodplain, (6) natural levee, (7) point bar and (8) sand bar.

Tertiary landform unit

The Tertiary landform unit occurs in the south and middle parts of the area at Amphoe Ban Tak (BT) and Ban Mae Bon (MB). They lie between 180-244 m above mean sea level or up to 104 m above ground level. The Tertiary landform unit has slopes commonly up to 15 degrees. Its also occur as a strong undulating terrain and is dissected by many streams which is more likely associated with minor faults. Thus, network of drainage is well developed in this unit. It can be clearly seen in the aerial photographs.

The Ban Tak (BT) Tertiary landform unit, the largest part of fluvial origin unit, is separated into 2 parts by NEE-SWW fault. The unit is to 4 km wide and lies 244 m above mean sea level with relief about 120 m. There are many outcrops well exposed in this unit both along the road cut of highway No.1 and quarries. Sediments of the unit are composed

Figure 4.3 Colluvial deposits in the western part which characterized by angular rock fragments.

Figure 4.4 Colluvial deposits at Sam Ngao Cliff in the northwestern part of the area.

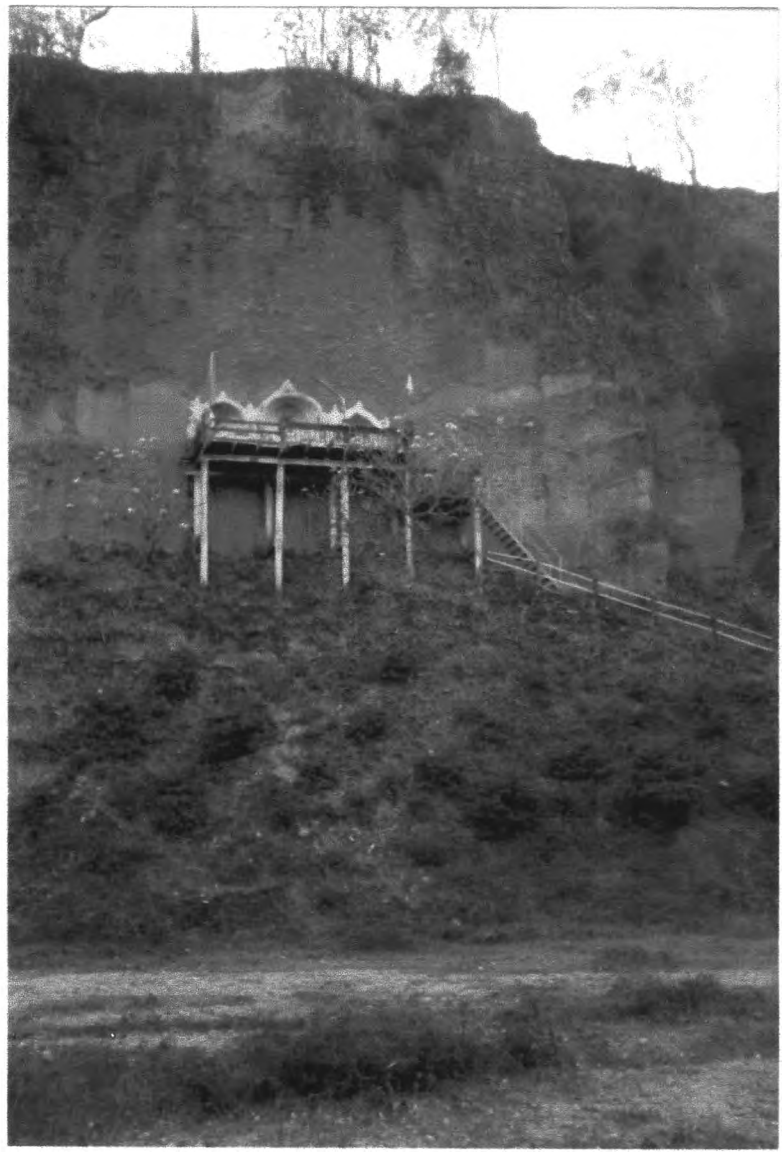

Figure 4.5 Sam Ngao Cliff, northwestern part of the area, is one of the deposit of colluvial landform unit.

of 2 parts, semi-consolidated pebbly sand in the lower part and unconsolidated gravels in the upper part. The unconsolidated sediments (Figures 4.8, 4.9 and 4.10) contain iron oxide cement. Semi-consolidated pebbly sand (Figures 4.7c and 4.7d) contains some calcareous cement. The top layer consists of reddish brown gravels subrounded to well rounded. The gravels are quartzite, quartz, chert, sandstone, metasandstone, and some pebbly sandstone. These gravel beds are interbeded with sand beds. The sand varies in grain-size from very fine to very coarse, subrounded and poorly sorted. It also shows a structure of horizontal lamination and cross lamination (Figures 4.10c and 4.10d). In the lower part, semi-consolidated pebbly sand is highly weathered. It is mainly composed of subrounded pebbles of quartz, quartzite, and schist. Abundance of Fe/Mn concretions are found at various levels in the unit. Moreover, large amounts of petrified wood were commonly found in this unit. Bedding this part is also horizontal.

The Mae Bon terrace part (MB) is situated at the north of the Ban Tak Tertiary landform unit. It is 2 km wide and lies 180 m above mean sea level with relief about 60 m. The upper part of deposit is composed mainly of unconsolidated gravel beds (Figures 4.8 and 4.9). Greenish gray conglomerate or pebbly sandstone with calcareous cement is present in the lower part (Figure 4.11). According to Takaya (1968), these conglomerate and pebbly sandstone which are dominantly composed of subrounded Paleozoic rocks 3 to 10 cm across are assumed to be Palaeogene or Mesozoic. The unconsolidated gravel of the upper part consists of pebbles and cobbles of quartz, quartzite, schist, sandstone, metasandstone, and pebbly sandstone. They are subrounded to well-rounded. Petrified wood debris is also found in this unit. The unit shows horizontal bedding as well.

The Tertiary age of this unit is assumed by using the degree of diagenesis of conglomerate and pebbly sandstone in the lower part of the deposit. Also, the higher degree of dissection of the unit is used as an evidence to separate this unit from high terrace. Moreover, the present of faults pass through the deposit, higher relief from the ground surface, and thickness of the sediments which is about 100 m are the additional evidences to separate this unit from other units. Unfortunately, hard laterite that can be used to estimate the age of the deposit is not found in this unit.

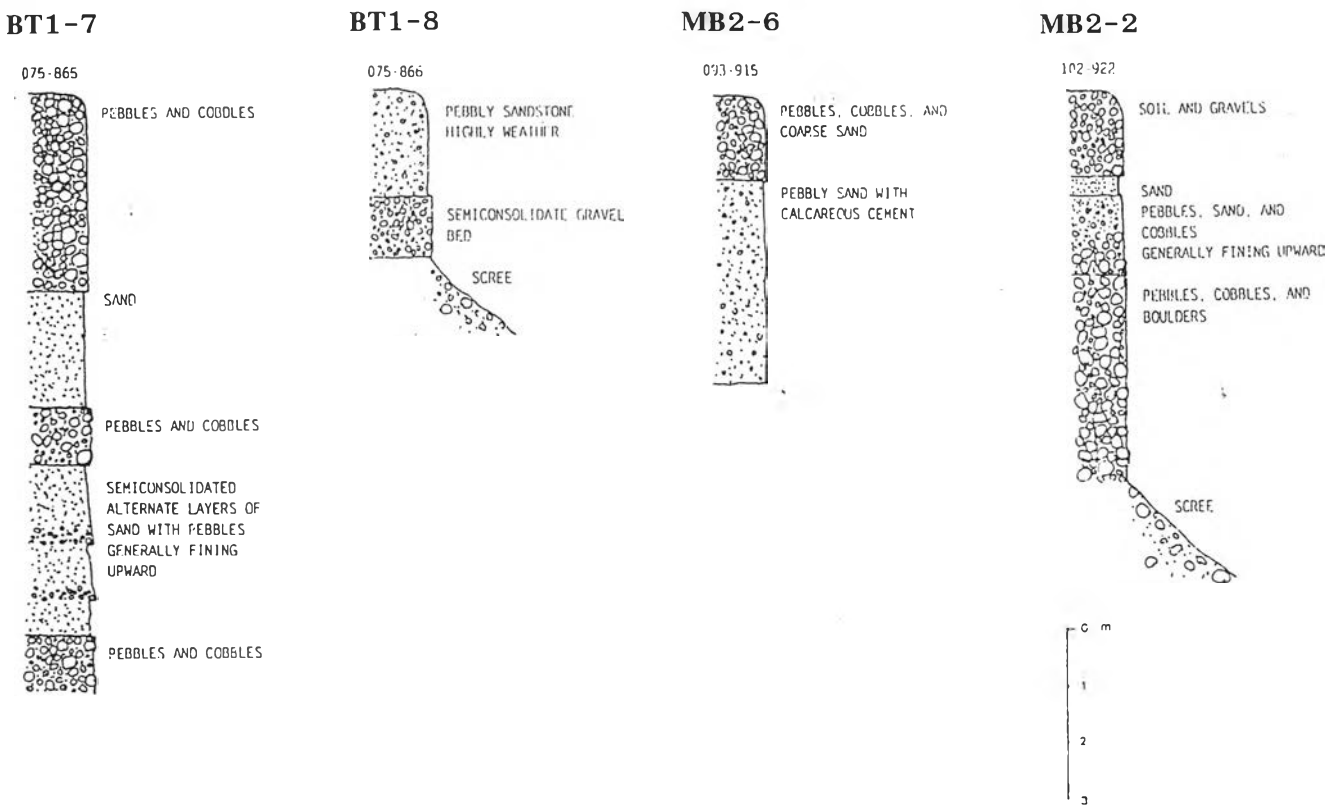

Figure 4.6 Sections of the Tertiary deposits.

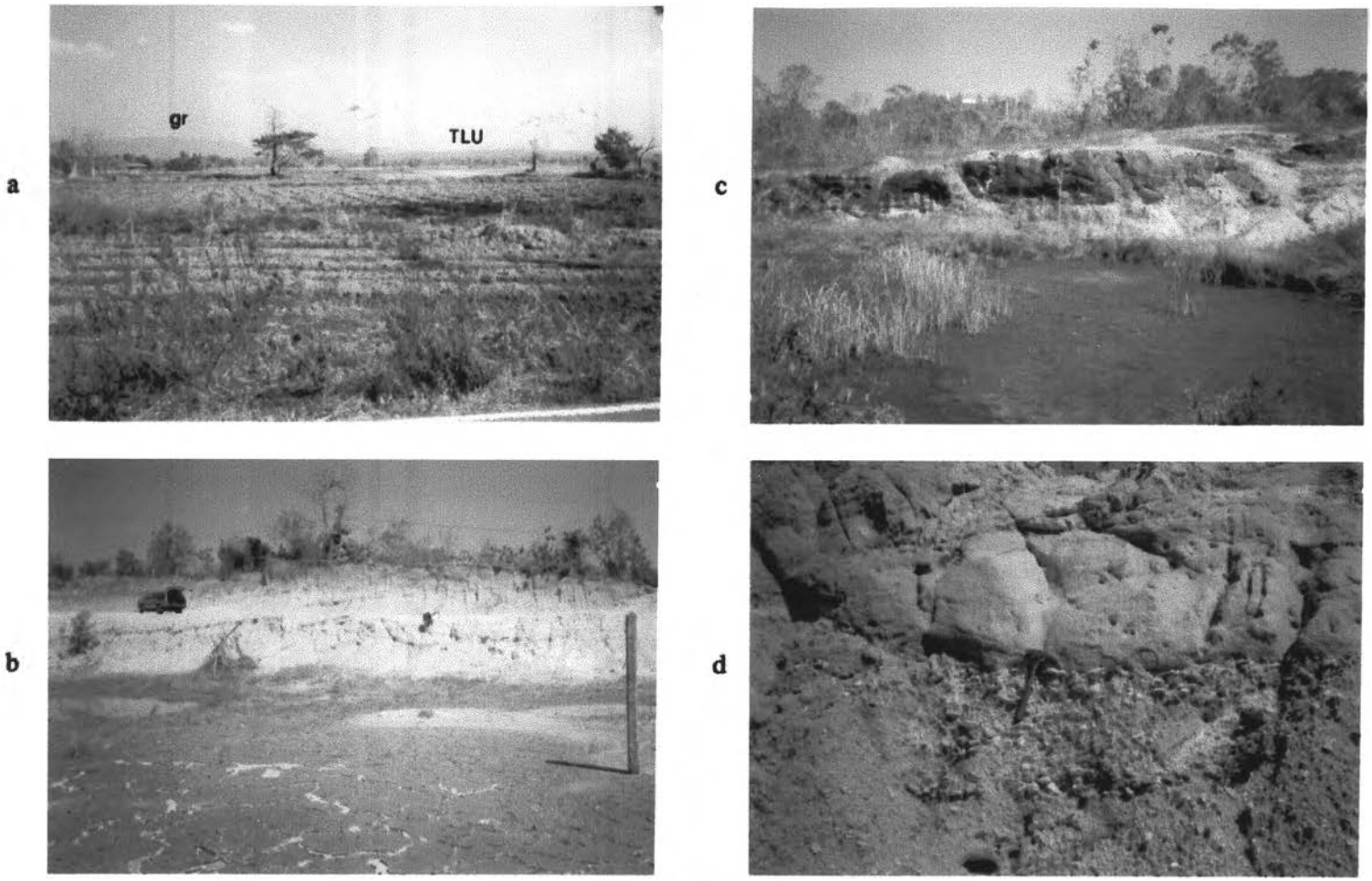

Figure 4.7 Tertiary landform unit, along the eastern part of the area, characterized by semi-consolidated pebbly sand. (grid reference 074865)

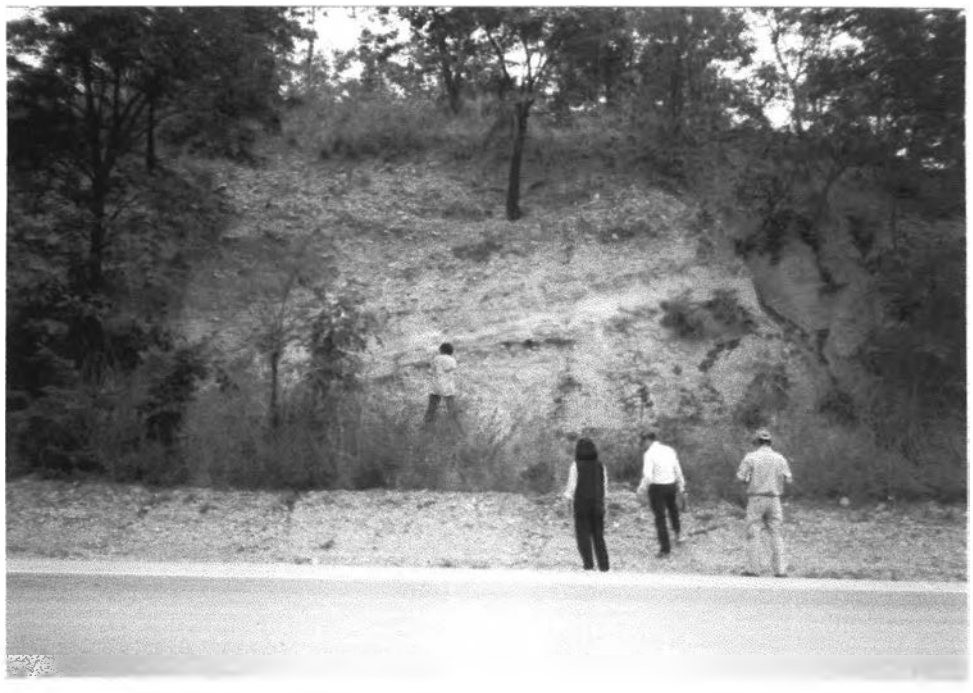

Figure 4.8 The Mae Bon Tertiary landform unit in the middle part of the area is characterized by gravel beds interbeded with sand layers.

Figure 4.9 Gravel bed is interbeded with laminar sand layer, which is varies in grain size from fine to very coarse.

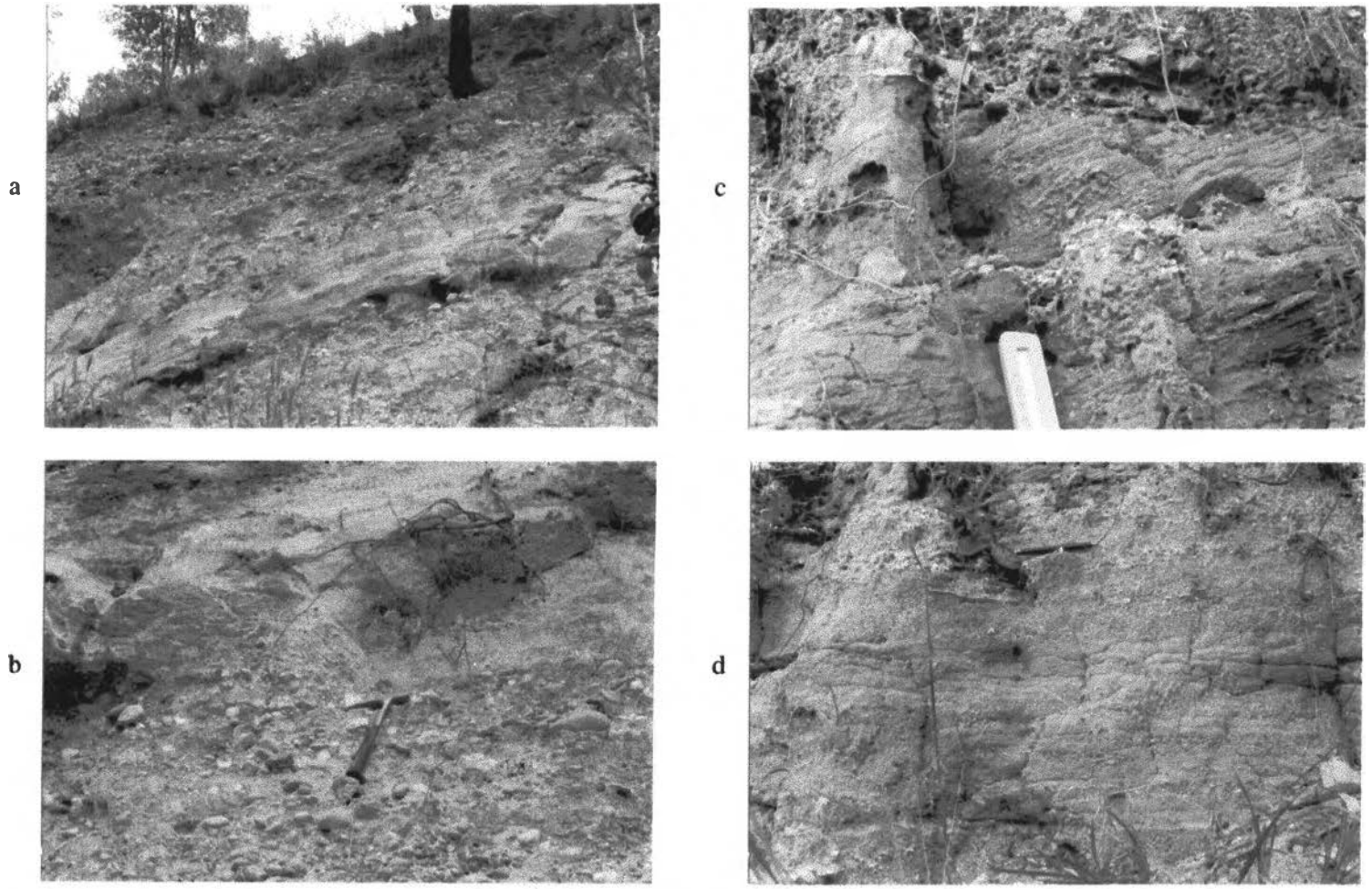

Figure 4.10 Sedimentary structure of Ban Tak Tertiary landform unit; a, b are alternating semi-consolidated sand and gravels with moderate reddish orange (10 R 6/6) in color. c, d show cross lamina and laminar of sand layer with pale reddish brown (10 R 5/4). (grid reference 078861)

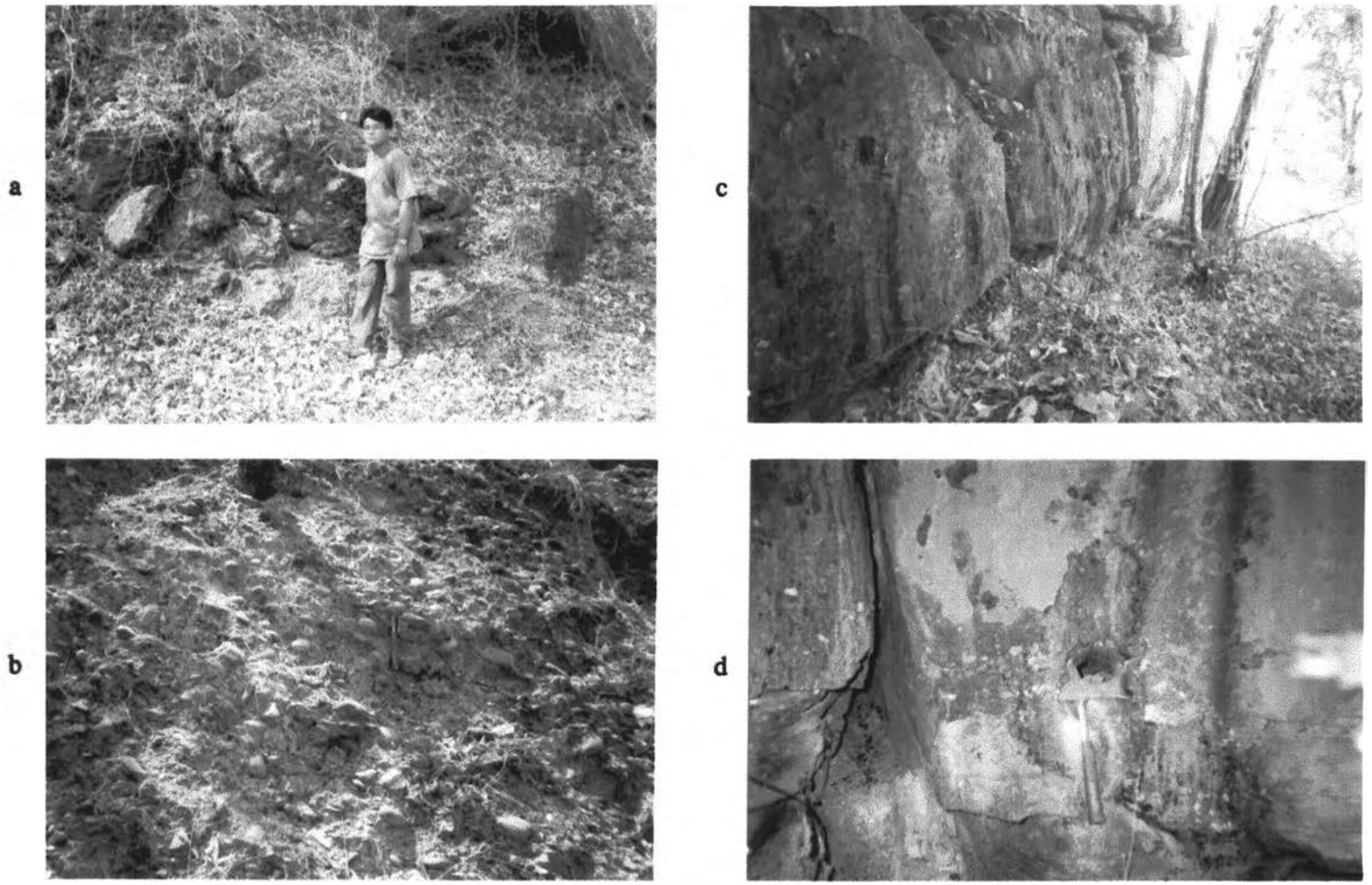

Figure 4.11 Mae Bon Tertiary landform unit marked by conglomerate (a, b) (grid reference 096916) and pebbly sandstone (c, d) with calcareous cement. (grid reference 093914)

High Terrace

High terraces form as a low hilly terrain, generally appears as discontinuous terrains at both sides of the main rivers. This is the result of erosion of the Ping and the Wang River. They lie between 176-180 m above mean sea level. Their relief varies between 46 to 50 m. Their surface expression shows a gently undulating. The less complicate surface expression and relief of them are features use to separate from Tertiary landform unit, which shows better drainage development. Generally, the deposits of high terrace is a gravel dominant and locally characterized by several hard lateritic features. Bedding of the deposits is horizontal. The descriptions of the individual high terraces at the study area are as follows:

The Sam Ngao (SNG) high terrace is situated in the northern part of the study area. It is up to 4 km wide and lies 180 m above mean sea level with relief about 50 m. The deposits are composed mainly of gravel beds with exposed thickness more than 15 m. Alternating pebbly sand layer with thickness up to 2.4 m are formed (Figure 4.12). Gravel beds consist mainly of pebbles, cobbles, and boulders of quartz, quartzite, schist, sandstone, and metasandstone. They are rounded to well rounded. Honeycomb structured laterite (2.1m thick) and lateritic gravel is found on the upper part of the deposits (Figures 4.13a and 4.13b).

The Tha Pui (TP) high terrace is situated in the northwest of the area contact with the remnant of colluvium known as Sam Ngao Cliff in the north and Devonian quartzite in the northwest. It lies 186 m above mean sea level with relief about 50 m. The deposits are characterized by two rhythmic cycles of ferruginous cement gravel beds underlying sharply contact by greenish gray sand (Figure 4.3d). Gravel beds consist mainly of pebbles, cobbles, and boulders of quartz, quartzite, sandstone, and metasandstone. They are rounded to well rounded. Sediments at the top of this terrace gradually change to be sand size. Hard layer of laterite was not found. The deposit was dissected by streams that develop along faults (Figure 4.13c).

The Pa Yang Nua (PYN) high terrace is located in the western part of the area contact with Devonian quartzite in the west. It is 2 km wide and lies 180 m above mean sea level with relief about 40 m. The deposits are mainly gravels of quartz, quartzite, sandstone, and metasandstone. They are subrounded to well-rounded. No good outcrop such as quarry is found in this unit. However, its altitude, the degree of dissection of its surfaces and

sediment characteristic of the deposit can be correlated closely to the Tha Pui high terrace. Therefore, it is grouped to be one of the high terrace units.

The Mae Salid (MS) high terrace is found at the eastern side of the Wang River in the middle part of the study area. It occurs as gently undulating terrain and lies 176 m above mean sea level with relief about 45 m. The deposits are mainly composed of various kinds of gravels interlayered with thin lateritic layers (Figure 4.14). The upper part contains gravels of quartz, quartzite, sandstone, and metasandstone. They are well-rounded. Gravels of quartz, quartzite, sandstone, metasandstone, tuffaceous sandstone, rhyolite, dacite, schist, tuff, and metatuff are present in the lower part of the deposit. From the gravel composition, it is indicated that their sources come from volcanic terrain in the north of the area and are brought down by the Wang river. In this unit, lateritic gravel, thin lateritic layer and lateritic sand are present in the sequences (Figures 4.14, 4.15 and 4.16). The hard laterites are up to 70 cm thick (Figures 4.15a and 4.15b). Petrified wood can be found as big as log size (2m, long and 1m diameter) in the gravel bed of this unit (Figure 4.17).

Based on lithological characteristics of laterite correlated with thick laterite formation in Central plain of Thailand, these lateritic features of the unit can be correlated with Formation IV in central plain mentioned by Takaya (1968). Thus, due to the thickness of those hard laterites that range between 0.7 to 2.1 m, it can be determined that the age of this terrace in the study area is probably Early Pleistocene.

Middle Terrace

The middle terraces are clearly seen only at the western side of the Ping River in the western and southwestern part of the study area. They occur as an extensive flat terrain (Figure 4.19) and forms gentle slope with low relief amplitude that lies at elevation about 167 m above mean sea level. This terrace generally occurs about 15 meters below the high terrace, or at the heights of between 5 and 20 meters above present floodplains and swamp (Figure 4.20). In contrast to the high terrace, it developed low degree of dissection than high terrace.

The Pa Yang Tai (PYT) middle terrace is situated in the western part of the area contact with the Pa Yang Nua high terrace in the north and Silurian-Devonian quartzite hill in the west. It lies 162 m above mean sea level with relief about 35 m and up to 3 km

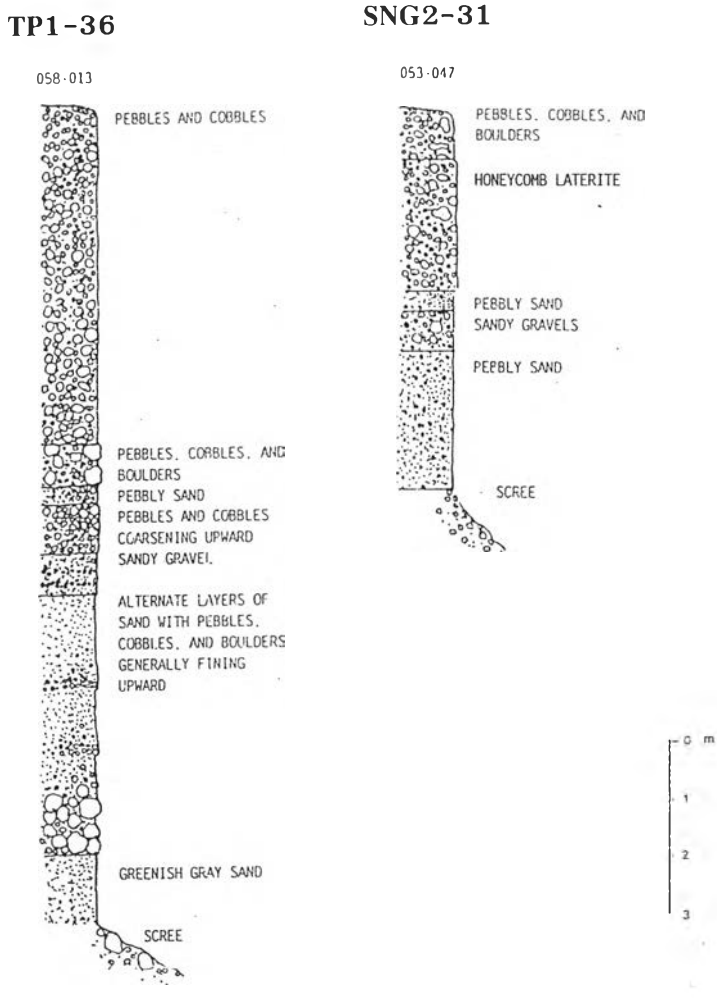

Figure 4.12 Section in high terrace of Tha Pui high terrace and Sam Ngao high terrace , which characterized by hard laterite up to 2.1 m.

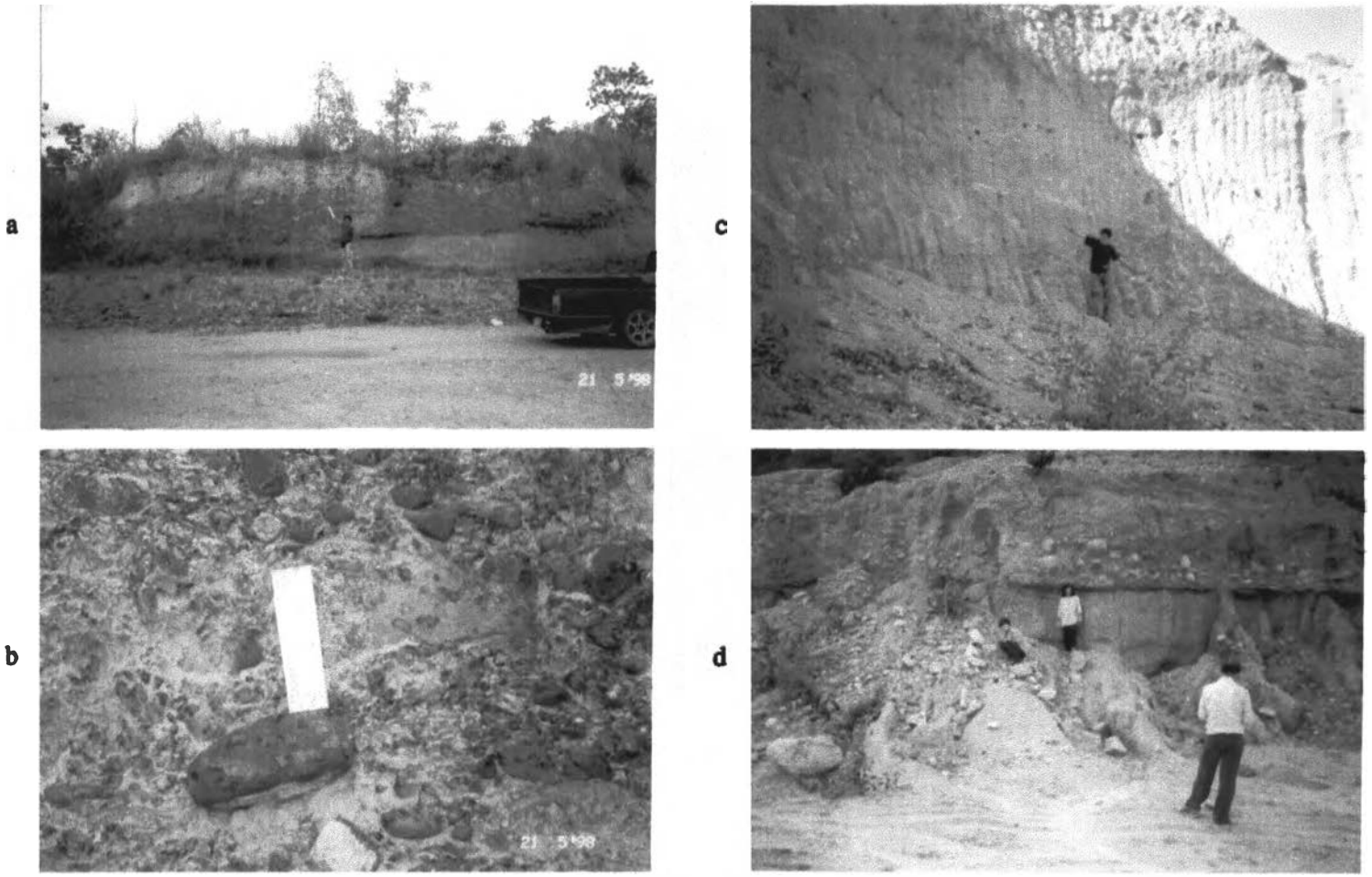

Figure 4.13 a), b) Sam Ngao terrace part, northern part of the area, is characterized by hard laterite up to 2.2 m thick. (grid reference 053047) c), d) Tha Pui terrace part, northwestern of the area, shows directions of minor fault and sharp contact between overlying gravels and underlying grayish yellow green 5 GR 7/2 sand. (grid reference 058013)

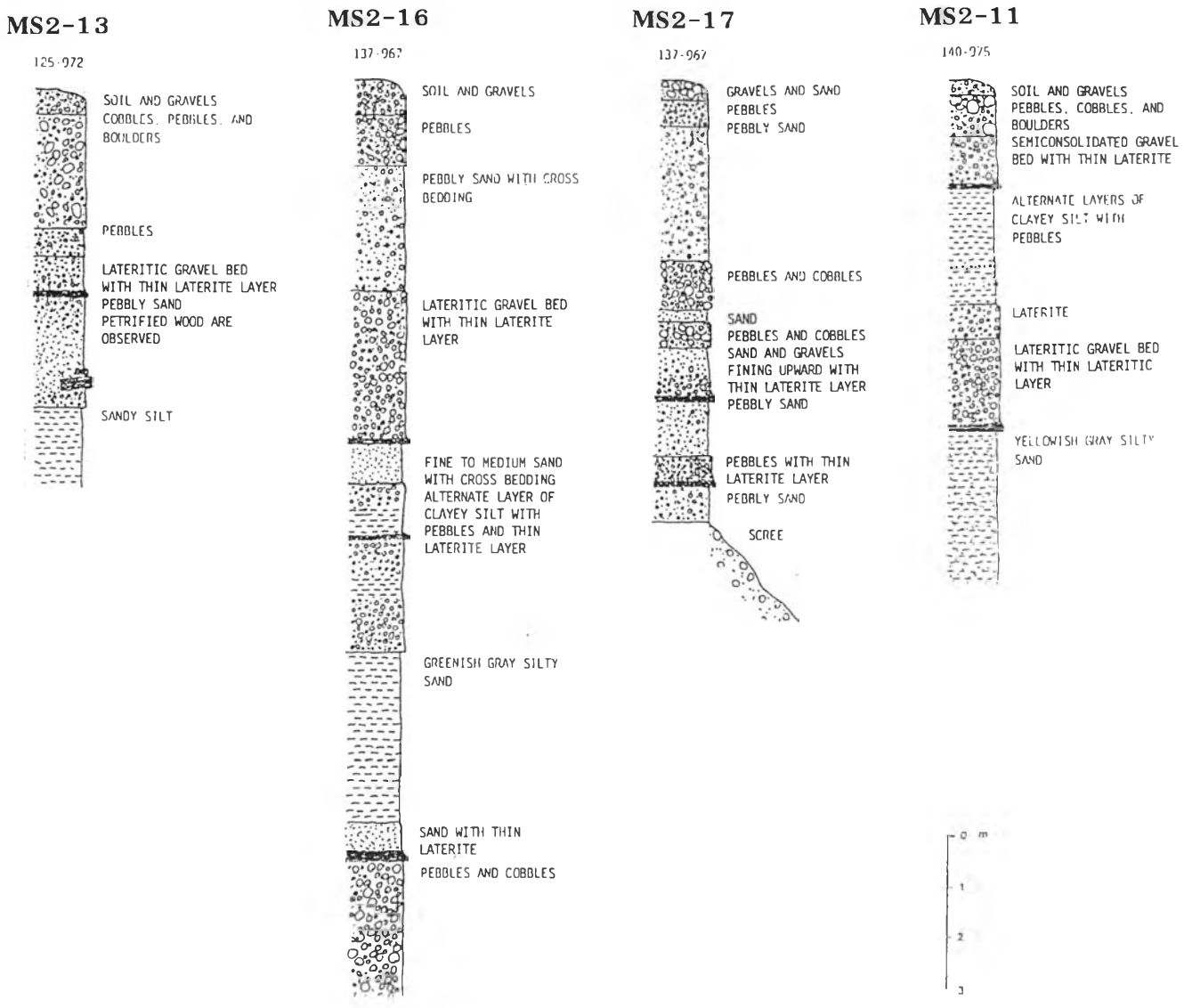

Figure 4.14 Sections of Mae Salid high terrace.

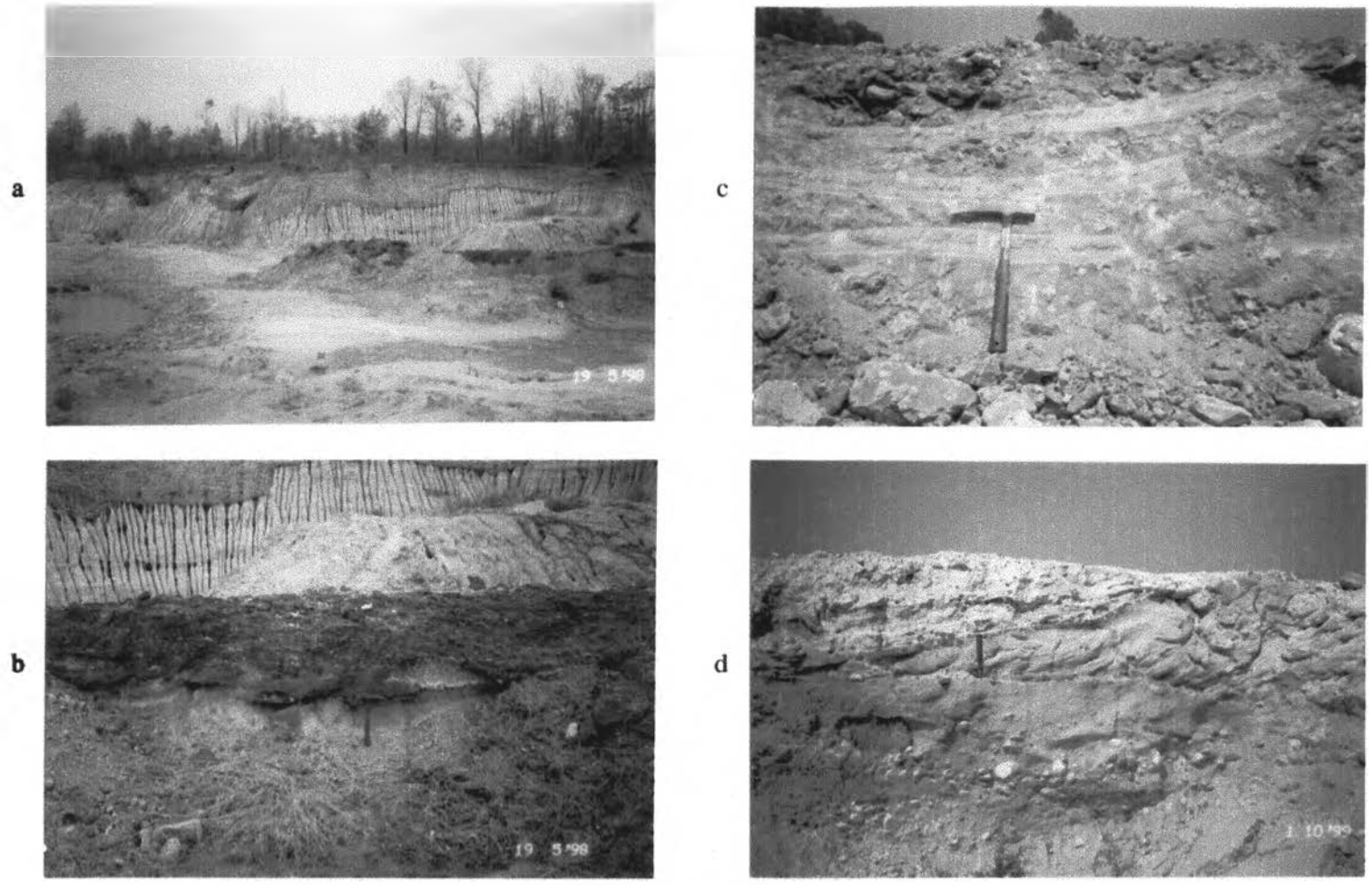

Figure 4.15 Mae Salid high terrace is characterized by hard laterite gravel (a, b) and lateritic sand (c, d) up to 70 cm.

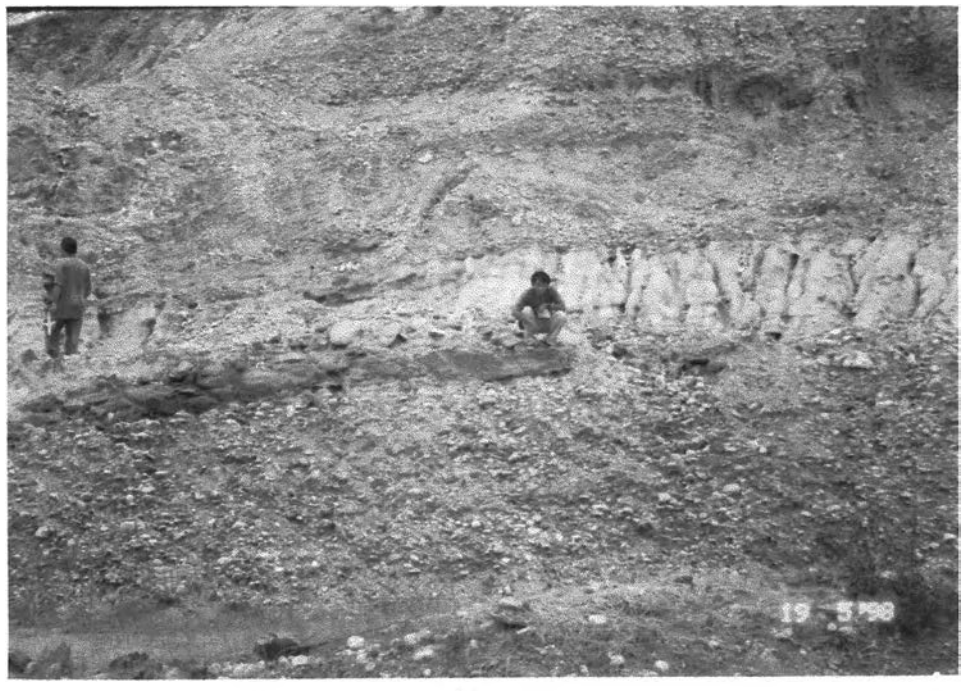

Figure 4.16 70 cm thick lateritic sand of Mae Salid high terrace. (grid reference 123963)

Figure 4.17 Petrified wood is generally observed in the gravel bed of high terrace. (grid reference125972)

wide. The deposit is mainly reddish brown gravel bed underlied by rock fragments of quartz schist; gneiss, granite and yellowish gray sand (Figures 4.18 and 4.21 c, d). It is interesting to note that these rock fragments could be the result of sudden uplift or local fault movement in the granitic and gneissic high land to the west of the study area. The upper gravel beds show imbrication and consist mainly of pebbles, cobbles, and boulders of quartz, quartzite, sandstone, metasandstone, chert and schist (Figures 4.21 a, b). They are rounded to well rounded.

The That Khunram (TK) middle terrace is found in the southwestern part of the study area contact westward by the colluvium landform unit. It is up to 2 km wide and lies between 162 m above mean sea level with relief about 35 m. The deposits of this terrace consist mainly of gravels, which comprise pebbles, cobbles, and boulders of quartz, quartzite, sandstone, and metasandstone in the upper part of the deposit (Figure 4.22a). They are rounded to well rounded. In the lower part of the deposit, it consists of pebbles of quartz, quartzite, sandstone, metasandstone, conglomerate, schist, quartzschist, gneiss and tuff (Figure 4.22b). They are subrounded and poorly sorted. The gravel bed is unconsolidated with a cover of soil (Figure 4.22c). The 25 centimeters-thick hard laterite was found near Wat Phra Borommathat (Figure 4.22d).

The deposits of this terrace can be correlated to Formation III or Terrace III in the Central Plain mentioned by Takaya (1968). Lateritic features found in this middle terraces are not as thick as found in high terrace. From these two reasons, it can be concluded that the middle terrace could be younger than the high terrace and its age should fall into middle Pleistocene.

Low Terrace

The lower terrace is present as discontinuous alluvial flats. It is found along the margin of the middle terrace and high terrace at the Ban Pak Tang (BP) in the northern part of the area, at Ban Mae Payuap (MP) in the western part of the area and at Ban Mai (BM) in the middle part of the area. They lie about 130 m above mean sea level with a relief of less than 5 meters. Gradients are mainly less than 4 degree in most parts. The gravel cans not observed on the surface because the old overbanks deposits still remain covers on its surface. The gentle slopes over a terrace and its altitude are dominant features that can be distinguished from higher terrace. The low terrace is predominantly of sandy alluvium with

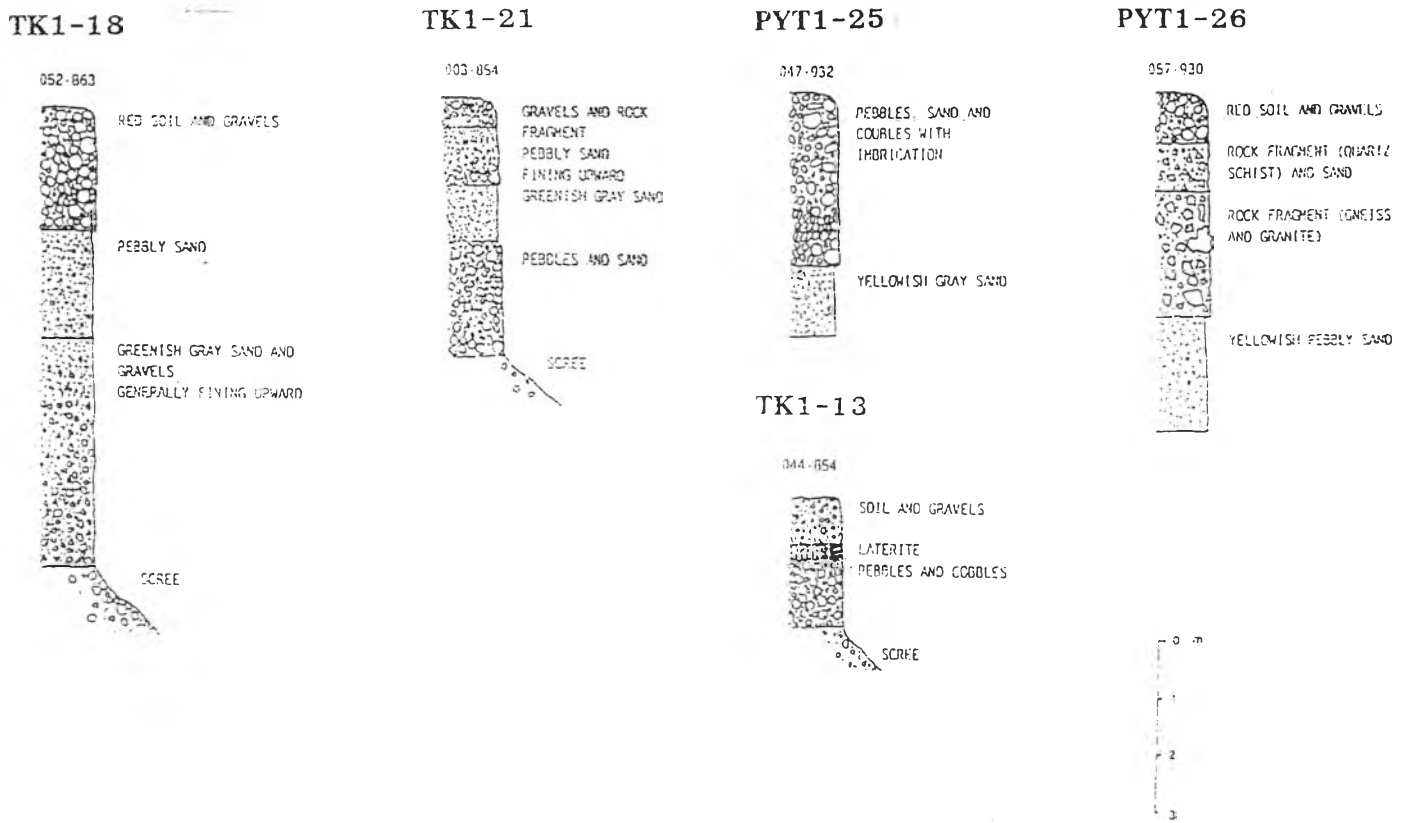

Figure 4.18 Sections in the middle terrace.

Figure 4.19 Middle terrace which situated only in the western part of the area occurs as rather wide flat terrain, (Looking Northwest)

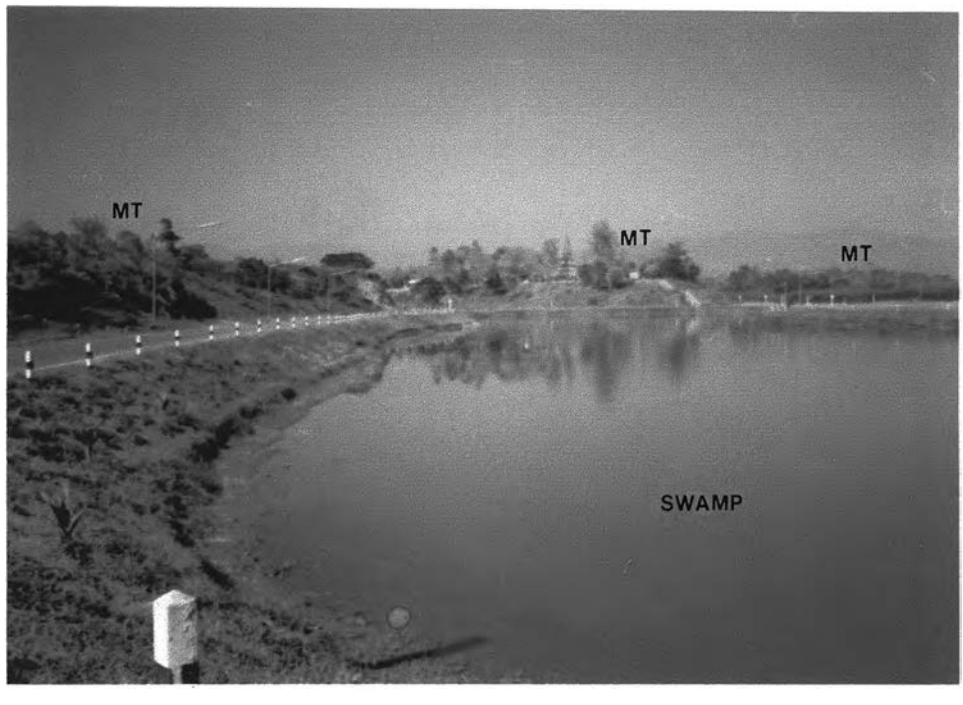

Figure 4.20 Middle terrace lies between 5-20 m above present floodplain and swamp. (grid reference 051862)

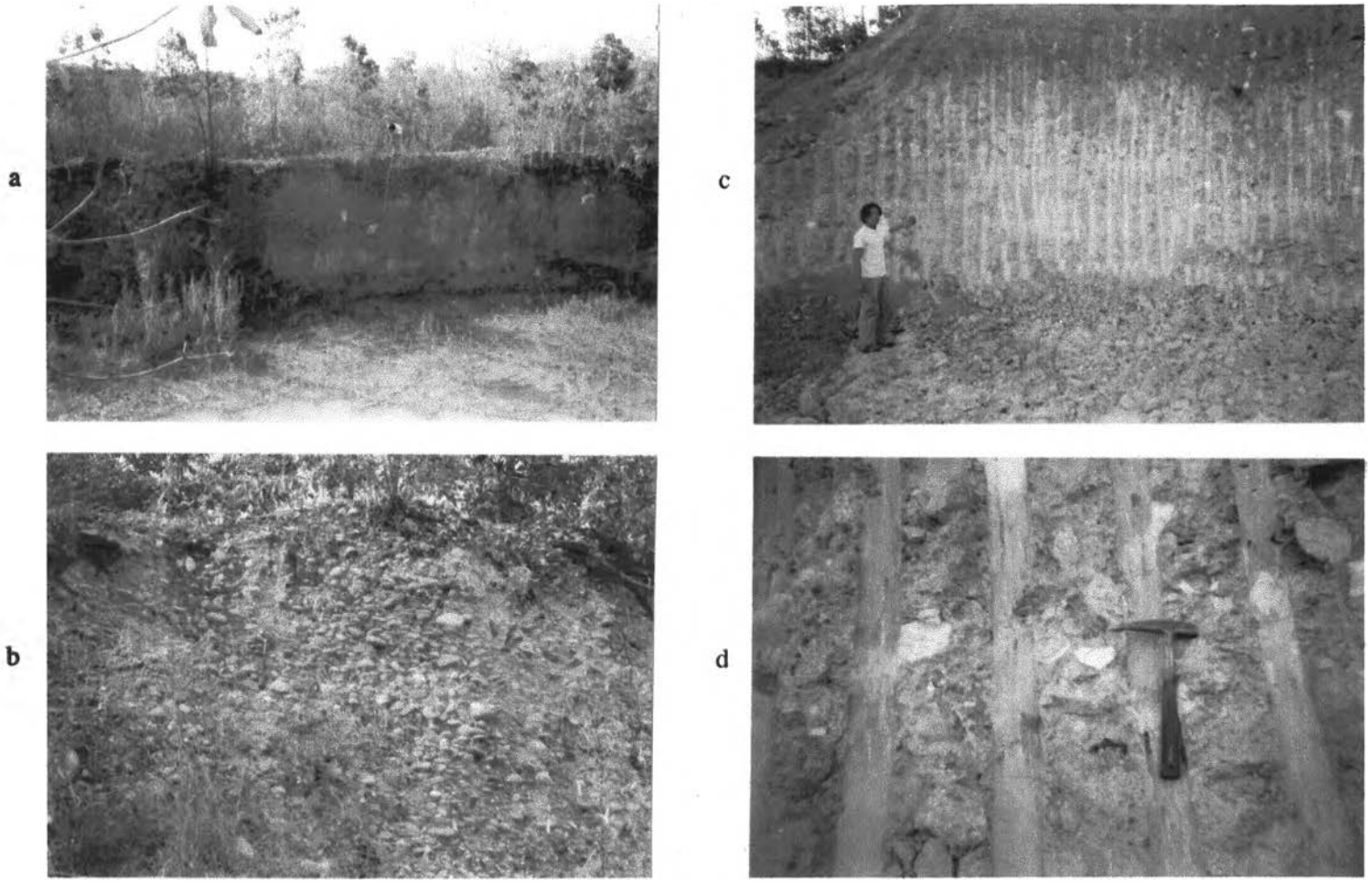

Figure 4.21 Payang Tai terrace part contains massive gravel with imbrication (a, b) (grid reference 047931); some locality gravel bed unduly by rock fragment of granite. (c, d) (grid reference 057930).

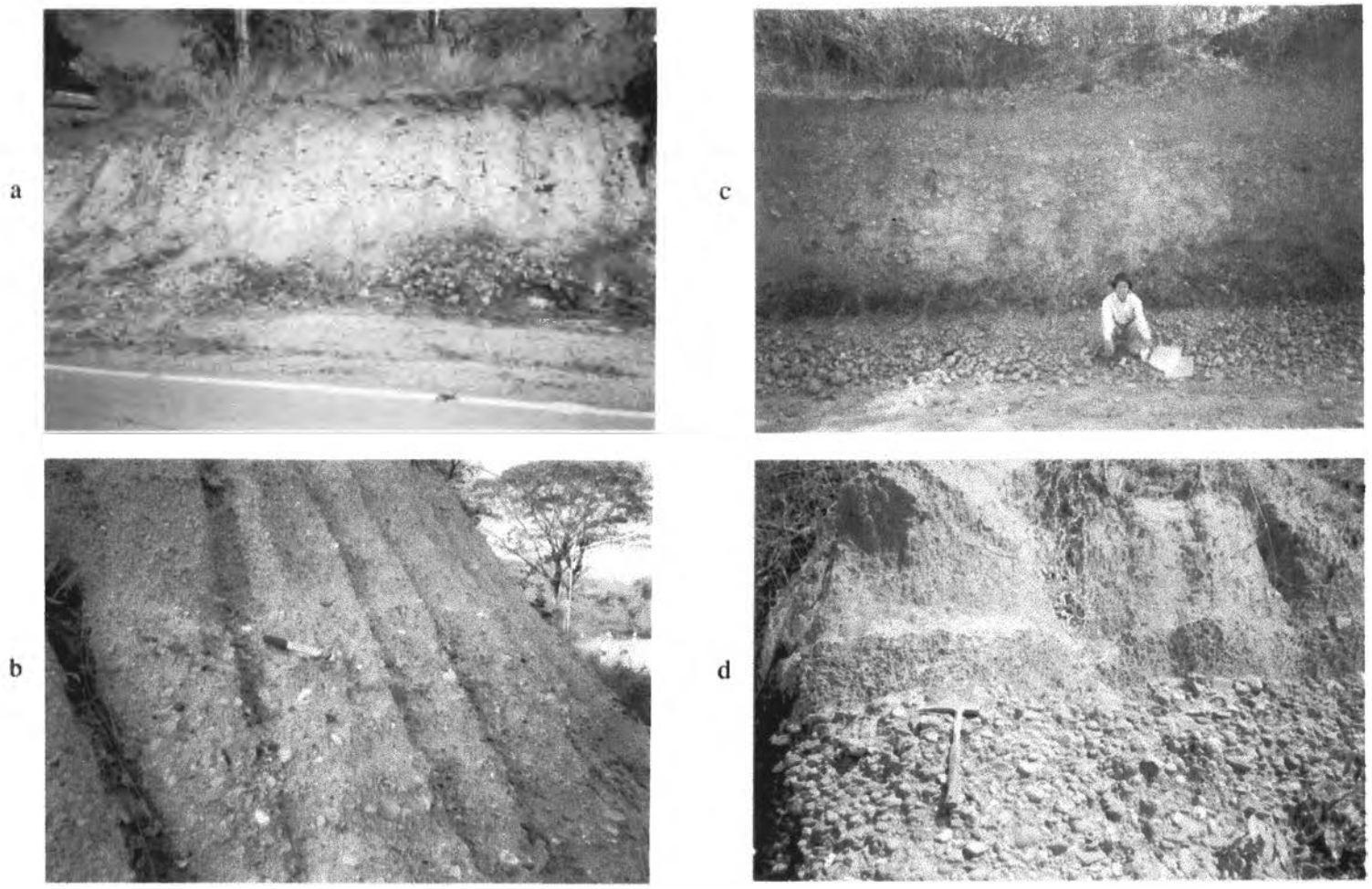

Figure 4.22 That Khunram middle terrace occurring in the western part of the area is characterized by laterite with 25 cm thick (d) (grid reference 044854)

gravels probably a few meters thick. The gravel layers consist of little-sorted, subrounded gravels, varying in size. In some places, small amount of iron oxide concretions also characterizes it.

The Ban Paktang (BP) low terrace lies about 130 meters above mean sea level and form gently undulating terrain. Quarry, pit, or road cut and river cut profile was not found in this part. However, due to the evidences as mentioned in above paragraph, it can be compares with other low terrace that will be explained in the next paragraph.

The Mae Phayuap (MP) low terrace occurs as a narrow patch along the eastern margin of Silurian-Devonian quartzite, which is found in the western part of the basin. It lies about 130 meters above mean sea level. The terrace deposit consists of sand, gravels, and rock fragment of Silurian-Devonian quartzite. The sand is fine grained to medium grained, subrounded and moderately sorted. The gravel consists mainly of pebbles, cobbles, and boulders. They are composed of quartz, quartzite, sandstone, and metasandstone.

The Ban Mai (BM) low terrace lies about 125 meters above mean sea level and forms gently undulating terrain with gentle slopes. It situated from 1 to 4 m from the ground surface. The terrace deposit consists of sand and silt with fining upward tendency and cross lamination. The sand is very fine to medium, subrounded and moderately sorted. Underlying the sand is a gravel layer and clayey silt layer. The graveliferous deposits form the basal portion of the old alluvial fill. The gravel layer consists mainly of pebbles, cobbles, and boulders of quartz, quartzite, sandstone and metasandstone.

The underlying gravel layer is clayey silt layer show reddish brown in color of concentration of iron concretions was found at 6 meters up to 7 meters from ground surface (Figure 4.24). The laterite is not well developed, but indicates that the deposit is not a recent one. The deposits of this terrace correspond to Formation II in the Central Plain mentioned by Takaya (1968). Thus, it can be assumed that this terrace is probably Late Pleistocene in age.

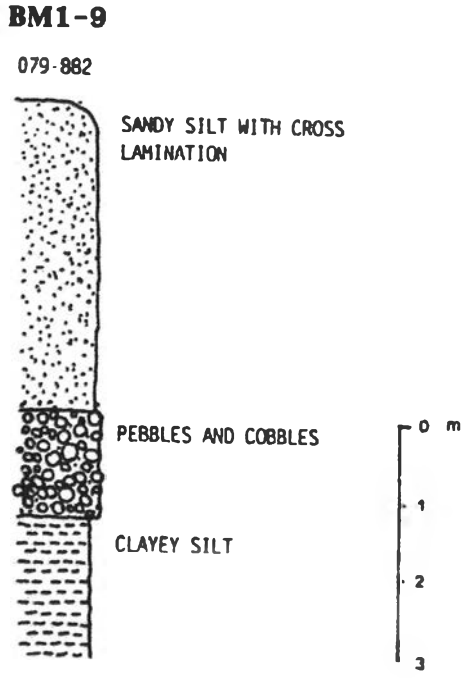

Figure 4.23 Section in the low terrace.

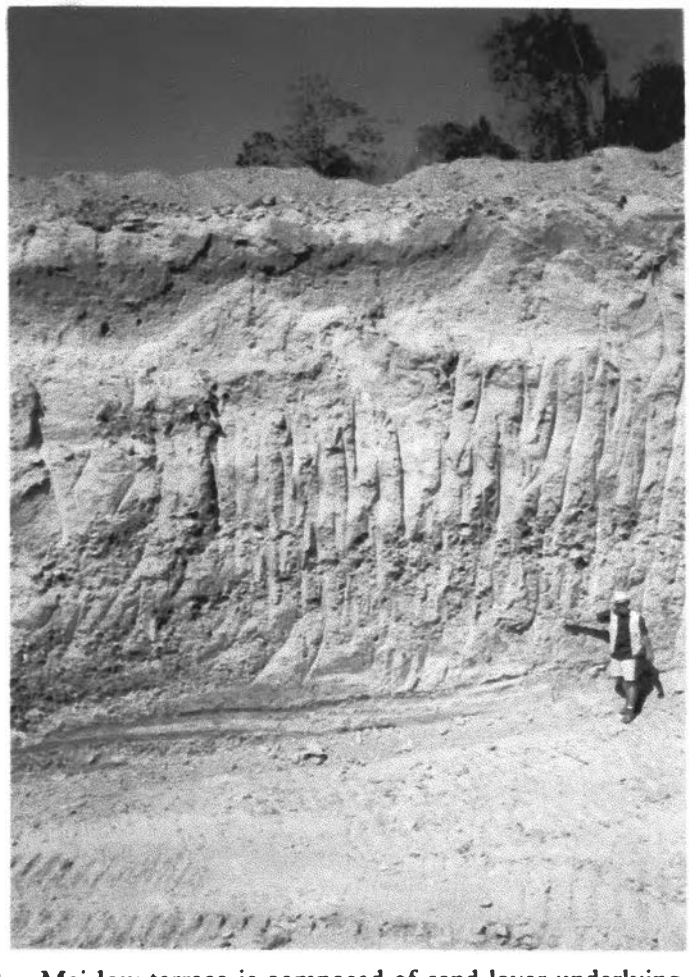

Figure 4.24 Ban Mai low terrace is composed of sand layer underlying with gravel layer and iron oxide occurs in clayey silt layer. (grid reference 079882)

In Table 4.1, the individual landforms can be group in the following levels:

Table 4.1 Individual landforms of the study area.

Landforms	relative elevation: m (MSL)	note
BT Tertiary landform unit	244	Tertiary landform unit
MB Tertiary landform unit	about 180	Tertiary landform unit
SNG high terrace	about 180	high terrace
TP high terrace	186	high terrace
PYN high terrace	about 180	high terrace
MS high terrace	176	high terrace
PYT middle terrace	162	middle terrace
TK middle terrace	162	middle terrace
MP low terrace	about 130	low terrace
BM low terrace	about 130	low terrace
BP low terrace	about 130	low terrace

Floodplain

The main channels are flanked by floodplains up to 6 km wide, which occur as extensive flat terrain and most of the area is paddy field (Figure 4.25a). They lie between 122-130 m above mean sea level. Gradient of this plain are normally less than three degree. It is characteristically formed of gray-brown alluvium (Figure 4.25b). Floodplain deposits consist of overbank silt and clay (Figures 4.25c and 4.25d) and underlying sands and gravels. Overbank silt and clay are suspended fine-grained sediment deposit on the floodplain from overbank flows during flood stages. Overbank silt and clay varies in thickness from 0.5 to over 5 meters (Figure 4.26). It is slightly sandy contain small amounts of small mica flakes. At some localities in the floodplain, the deposits contain plant remains and calcareous sand. The gravel is composed mainly of pebbles ranging from fine (4 mm) to coarse (30 mm), sub rounded and poorly sorted. The pebbles consist of quartz, quartzite, and sandstone.

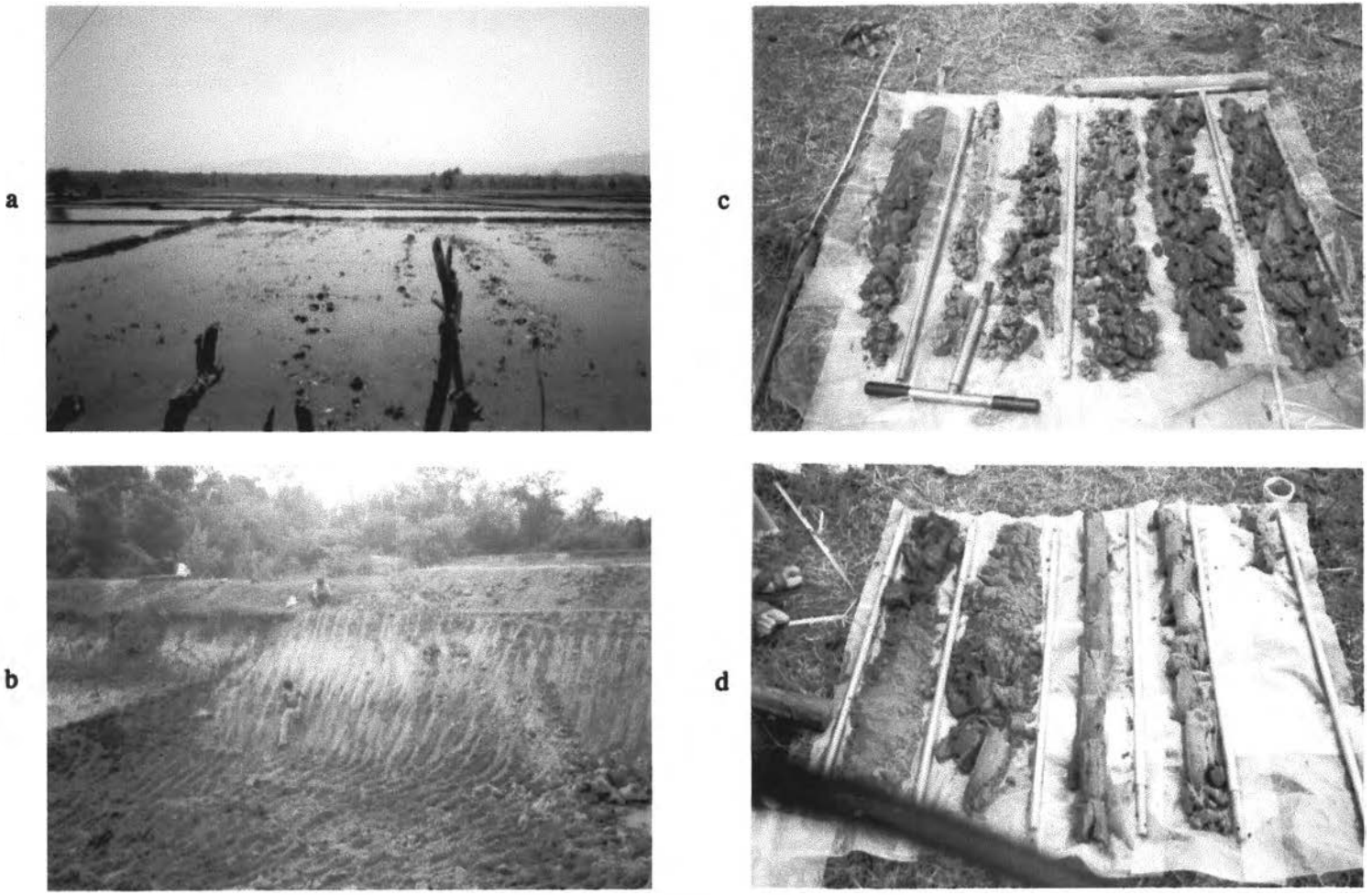

Figure 4.25 a) Floodplain is apparently flat terrain. b) The deposits consist of overbank silt and clay and underlying sands and gravels. c), d) Sample from hand auger is mostly suspended fine-grained sediment deposit.

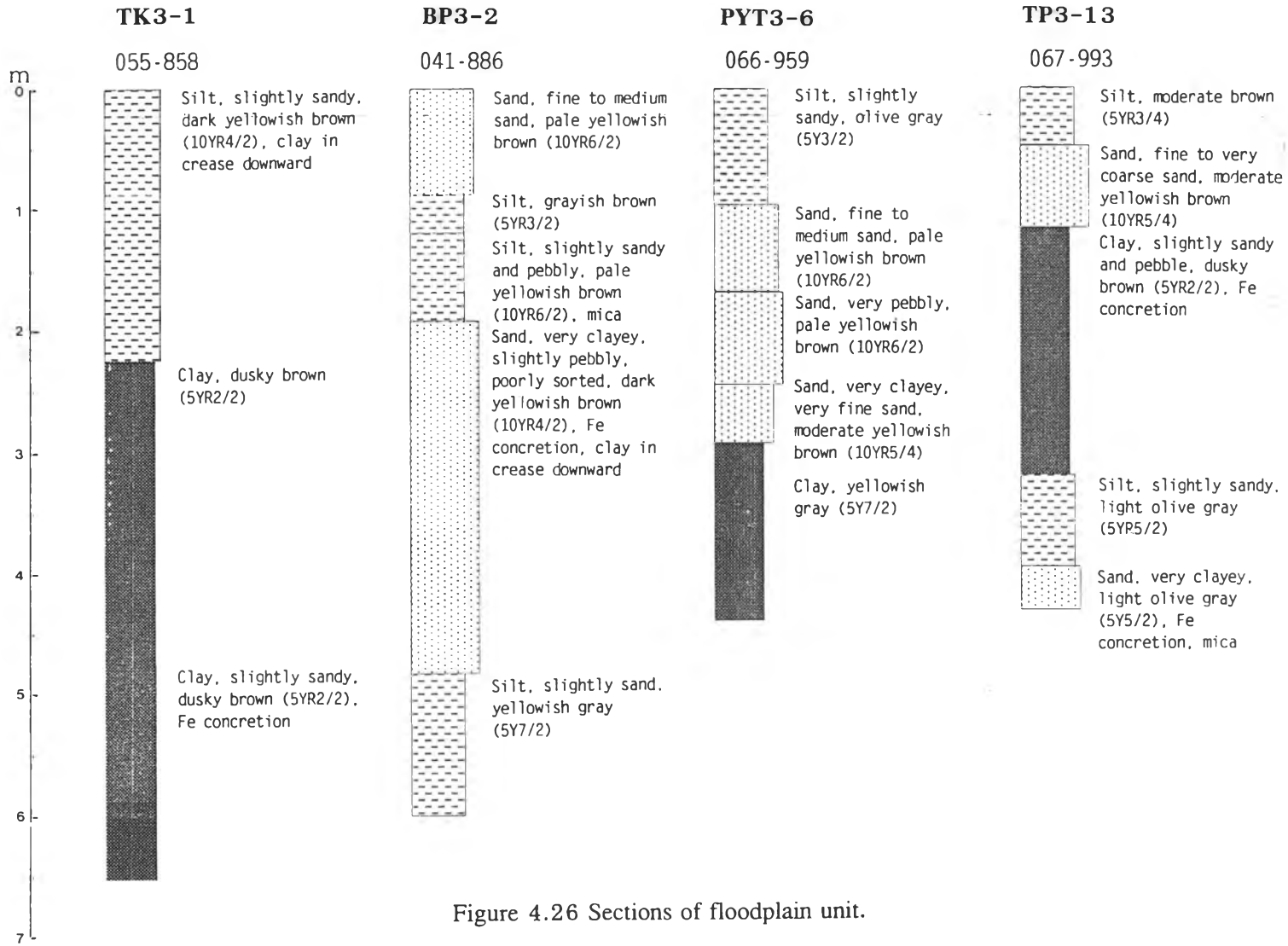

Figure 4.26 Sections of floodplain unit.

Natural Levee

Natural levees are wedge-shaped ridges of sediment bordering stream channels. The levees gently slope from the riverbank in to flood basins away from the channel. They form narrow strips along the rivers and lies about 130 meters above mean sea level or 1-1.5 m above present floodplain. They are formed by depositional of sediment when floodwater of a stream overtop its banks. Coarsest sediment is deposited near the channel and grain size decreases away from the channel. The levee deposits are made up of numerous interfingering and overlapping lenses of sandy material capped by muddy sediments (Figure 4.29). Sand predominates in sections near the channel. In the study area, the levees support much plant growth (Figure 4.27). Thus, much plant debris and organic matter is incorporated into levee sediments. The top of the sequence is mostly a sandy silt layer with dark brown in color and contains small amount of mica flakes (Figure 4.28).

Point bar

Point bars are the most conspicuous geomorphic features of a meandering stream. They occur on the convex sides of the meanders dipping gently toward the channel. The main rivers, the Ping and the Wang, are up to 400 m and 70 m wide respectively, typically braided and meandering. Point bars are present in both rivers and their main tributaries such as Huai Mae Bon. Point bar deposits are composed mainly of bed load sediments. Coarse rock fragments consist of pebbles and cobbles of quartz, quartzite, sandstone, etc. where as fine grained sediment are sand. They are formed as a result of lateral migration of a meandering river during flooding, which are usually poorly to moderately sorted. Cross bedding of current ripple origin are the major bedding types in the point bar deposit.

Sand bar

Sand bars, braided bars and channel bars are characteristic features of braided rivers. They are also known as channel islands. The Ping is up to 400 m wide, typically braided with steep bank up to 2 m high. Sand bars are traversed by the channel or braids of the Ping River, and by numerous minor flood channels. It occurs as channel island in the Ping River (Figures 4.30a and 4.30b). The slope of a channel bar in the upstream direction is steep and downstream slope is rather gentle. Generally, channel bars are covered with ripple mark (Figures 4.30c and 4.30d) and cross bedding are the main features of the unit. The sand

Figure 4.27 Section in natural levee show the deposits of dark brown sand and silt deposits.

Figure 4.28 Sample from hand auger is mostly a very poorly sorted sandy silt layer and contains small amount of mica flakes and plant remains. (grid reference 038043)

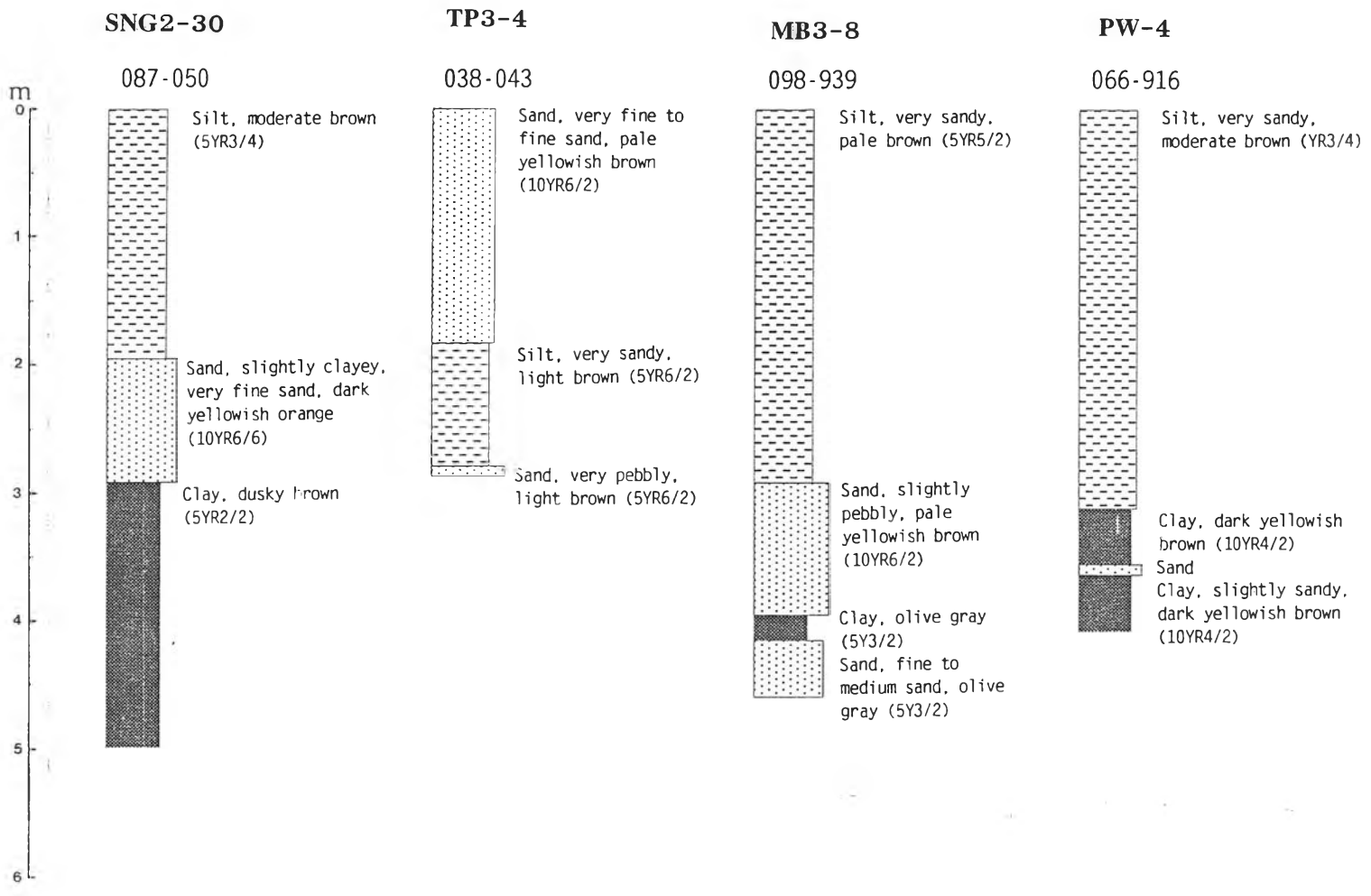

Figure 4.29 Sections of natural levee unit.

bar deposits consist mainly of sands and gavels in pebble size. They are subangular to subrounded and usually poorly to moderately sorting.

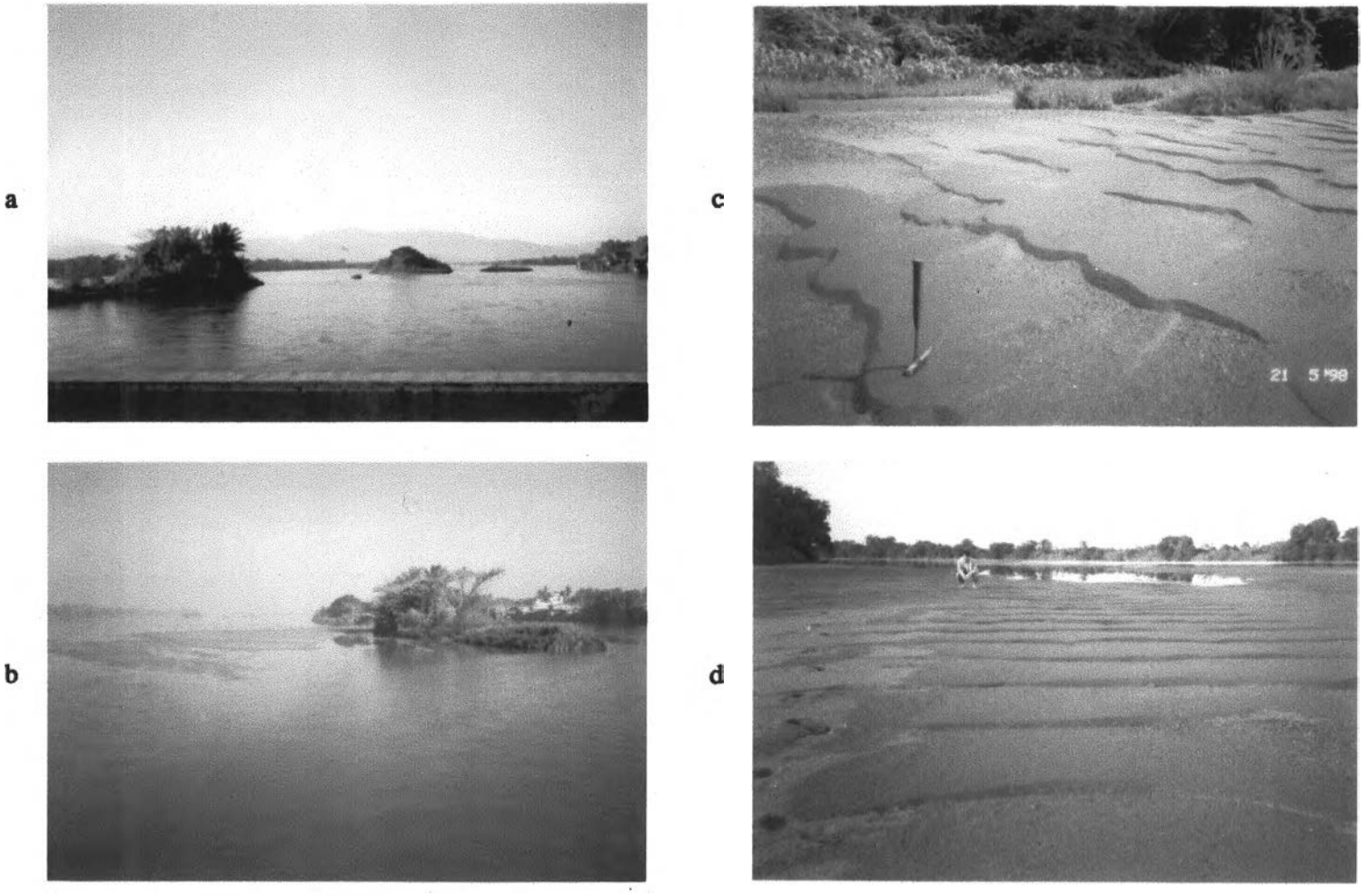

Figure 4.30 a), b) Sand bar generally occurs as island bar in the Ping river. c), d)Ripple mark is the main features make up its surface.