

CHAPTER III

GEOLOGY AND GEOMORPHOLOGY

3.1 Regional geology of the study area

The following geologic and stratigraphic subdivisions and their nomenclatures follow those adopted and established by the Department of Mineral Resources that appear in the 1:250,000 scale geologic map of northern Thailand sheet 4 published in 1979 (Figure 3.1) and 1:500,000 scale geologic map of northern sheet Thailand published in 1980.

Changwat Mae Hong Son is underlain by rocks ranging in age from Cambrian to Recent. The geology of the region was described previously by various workers such as Toriyama (1994), Brown et al. (1951), Konishi (1953), Pitakpaiwan (1955), Sithiprasasna (1959), Pitakpaiwan et al. (1964), Phitakpaiwan (1965), Kobayashi and Igo (1966), Stoppel (1966-1969), Baum and Koch (1968), Braun (1969), Wolfat (1969) and Department of Mineral Resources (1979 and 1980). Stratigraphic sequence in the western and eastern parts consists mainly of Paleozoic rocks. The description of stratigraphic of rock units are given from the oldest to the youngest as follows.

3.1.1 Cambrian Rocks

The Cambrian rocks in Changwat Mae Hong Son is called "Pha Bong Quartzite" by Bonopas (1981) which represented by quartzite exposed mainly at Pha Bong Dam. It is characterized by gray to light brown quartzite, consisting of 700m thick thinly to thickly bedding.

3.1.2 Ordovician Rocks

The Ordovician rock in Changwat Mae Hong Son, mainly so-called “Thung Song Group”, is composed of blackish gray to light gray limestone with thin to thick beds. Several Early to Middle Ordovician conodont fossils were found in limestone including *Acontiodus sp. indet* (Stoppel 1967;1982).

3.1.3 Silurian – Devonian Rocks

The Silurian – Devonian Rocks appear mostly in the eastern part of Changwat Mae Hong Son and are mostly called “Mae Hong Son Group” by Bonopas (1981). This group is represented by shale and sandstone with chert beds and limestone lens in shale. Several conodonts in limestone include *Trichonodella sp. Indet*, and *Walliserodus scanticlairi* Cooper that indicate Late Silurian – Early Devonian age (Stoppel 1967, 1982).

3.1.4 Carboniferous Rocks

Carboniferous Rocks in Changwat Mae Hong Son are called “Mae Tha Group” (Piyasin, 1972) with the overall thickness approximately 400 m. They consist of two formations. The Lower formation comprises mainly gray to dark gray coarse grained sandstone, dark gray shale and light green to gray chert which occur locally with limestone interbedded with shale. The upper formation consists of dark gray shale intercalated with gray siltstone and greenish gray sandstone.

3.1.5 Permian Rocks

Permian Rocks in Changwat Mae Hong Son are mainly called “Ngao Group”, herein study area named the Pai Formation. The overall thickness is approximately 200 m. They are composed mostly of thin to medium bed limestone in lower part, massive in upper part. Fossils of fusulinids, corals, gastropods and

conodonts were found. Minor sandstone and shale interbedded are also observed. Limestone in this area is referred to Permian.

3.1.6 Permo – Triassic Rocks

Permo – Triassic Rocks are found in the eastern side of the Nam Mae Yuam River from south of Mae Sariang District. They are composed mainly of sandstone, tuffaceous sandstone, argillaceous limestone, meta-rhyolitic to meta-andesite tuff, shale meta-limestone lenses, chert and shale (Bunopas, 1981).

3.1.7 Triassic Rocks

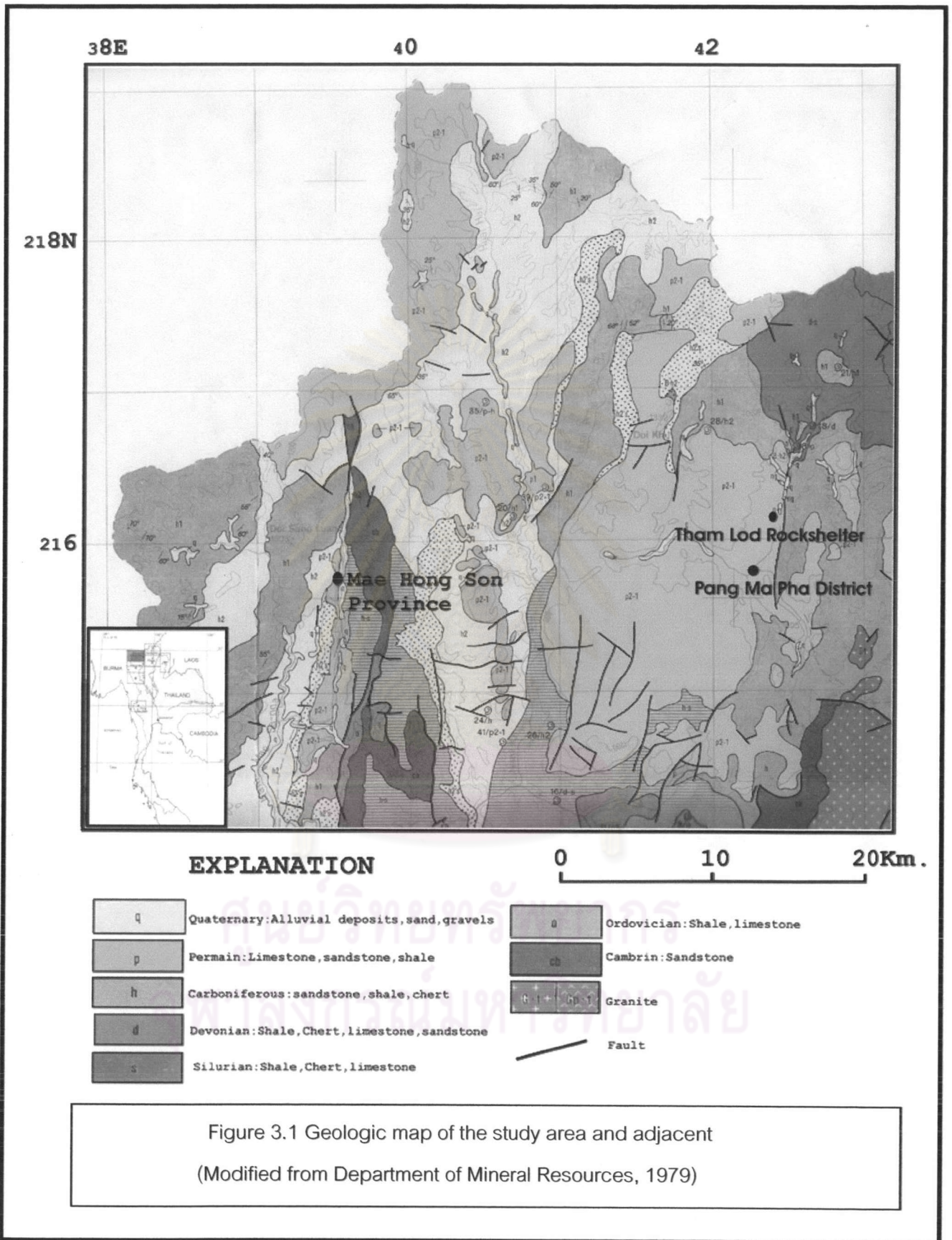
Triassic Rocks are mainly investigated in the eastern side of the Nam Mae Yuam River from south of Mae Sariang District and in the north of Mae Hong Son City. They are composed mainly of sandstone, tuffaceous sandstone, shale and limestone which is called “Mae Sariang Group” by Bunopas (1981).

3.1.8 Jurassic Rocks

Jurassic Rocks are mainly found in the eastern side of the Mae Hong Son City. They are mainly composed of gray mudstone, sandstone and siltstone. Fossiliferous mudstone and siltstone are rich in bivalves and rare in ammonites (Bunopas 1981).

3.1.9 Quaternary Sediments

Quaternary sediments are deposited mainly from main river in Changwat Mae Hong Son such as Pai River, Lang River, Mae Nam Yuam River. The deposits consist of high terrace, middle terrace, low terrace and alluvium.



3.1.10 Igneous Rocks

Igneous Rocks of Changwat Mae Hong Son include granite that is widely distributed in the eastern parts of the area and intrude throughout Cambrian rocks in Triassic period (Charusiri et al., 1992). Typically, this rock is medium to coarse grained, porphyritic, biotite granite grading to fine grained, biotite muscovite granite.

3.2 Detail study on geology and geomorphology in the study area

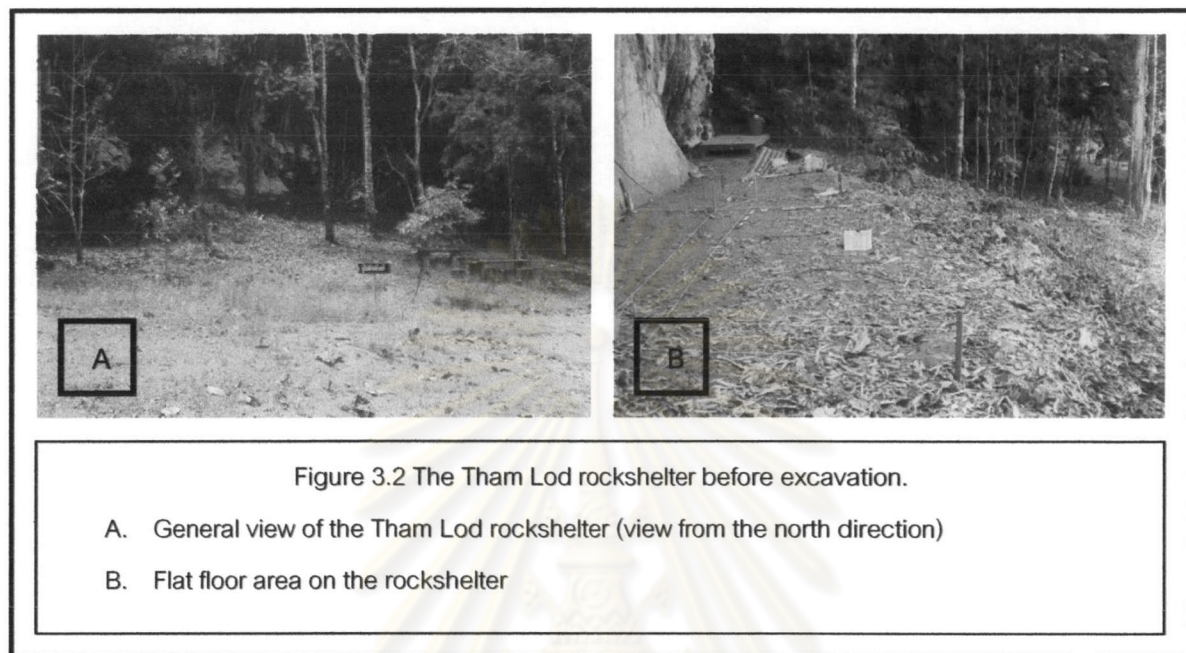
The Tham Lod rockshelter is a stratified archaeological site located in Lang River valley, Pang Mapha district, Mae Hong Son province. It is one of many archaeologically rich in caves and rockshelter in limestone karst region of Pang Mapha district. This section highlights the contributions of the geography, geological setting, geomorphological setting of the study area.

3.2.1 A Geographical Overview

The topography of the area displays mostly as highly mountainous approximately 90 % and other valleys 10 %. The area is characterized by a rugged topography with elevation ranging 600 to 1,170 m. above mean sea level. The highest mountain in this area is at Doi San Kai (named by local people) about 1,170 m. above mean sea level. This area forms part of the mountain ranges that extend along a north-south orientation from the Malaysian peninsular to the Shan States in Burma (Dunkley, 1986).

From a geographical perspective, Tham Lod rockshelter is located at the base of an over-hanging Permian limestone cliff, which is approximately 20 meters high. The floor of the rocks shelter has a flat area that is approximately 10 meters across and extends about 4 meters from the base of the cliff to the drip-line, and is interspersed with large boulders (Figure 3.2). The site is currently less than 100 m. away from the Nam

Lang, and is over 20 m. above the highest water level. A full geomorphological investigation needs to be carried out to establish whether the course of the river, or the relative height of the shelter's floor surface, has changed significantly since prehistory.



The main river in the area is Lang River that following the north to south mountainous orientation, passing the Tham Lod rockshelter site and through the Tham Lod cave and then heading southwest until it flows into a sinkhole just to the west of Ban rai rockshelter (next archaeological site). It re-emerges at Tham Nam Lang roughly 4 km. to the west, which at 8.3 km. is one of the longest active stream caves in Mae Hong Son. From here, it soon joins the Mae Nam Khong, which flows southwards to meet the Pai River. This river then flows westward towards the Mae Hong Son city and eventually joins the Salawin River. Therefore, the Lang River can be described as a component of the greater Salawin River catchment area. Within the study area, Lang River is approximately 5 – 10 m. wide. during the dry season, it contains a little water and flow slowly. On the other hand, during the rainy season, it drains a lot of water and flow swiftly (Figure 3.3).

The numerous of natural resources from Lang River can support a wide range of fish, fresh water shells, reptiles etc. Gravels from Lang Rivers which have been

analysed from five areas (see in appendix) indicate that 42 % of sandstone, 28 % of quartzite and 10 % of volcanic rock were mostly found in the river. Sandstone and quartzite are mostly characterized by high hardness, 74 % of cobble size, sub rounded to rounded, moderately to well sorted (Figure 3.4 and Table 3.1). The characteristic of gravels indicates that they seem to be good quality of raw material for stone tools production. This is possible to confirm the idea that, human in prehistoric period always choose high quality raw material near their habitation sites for producing the tools (Pookajohn et al. 1994; Andrefsky,1994b; Shoocongdej,2000; Khaokhiew and Lertlit, 2002).

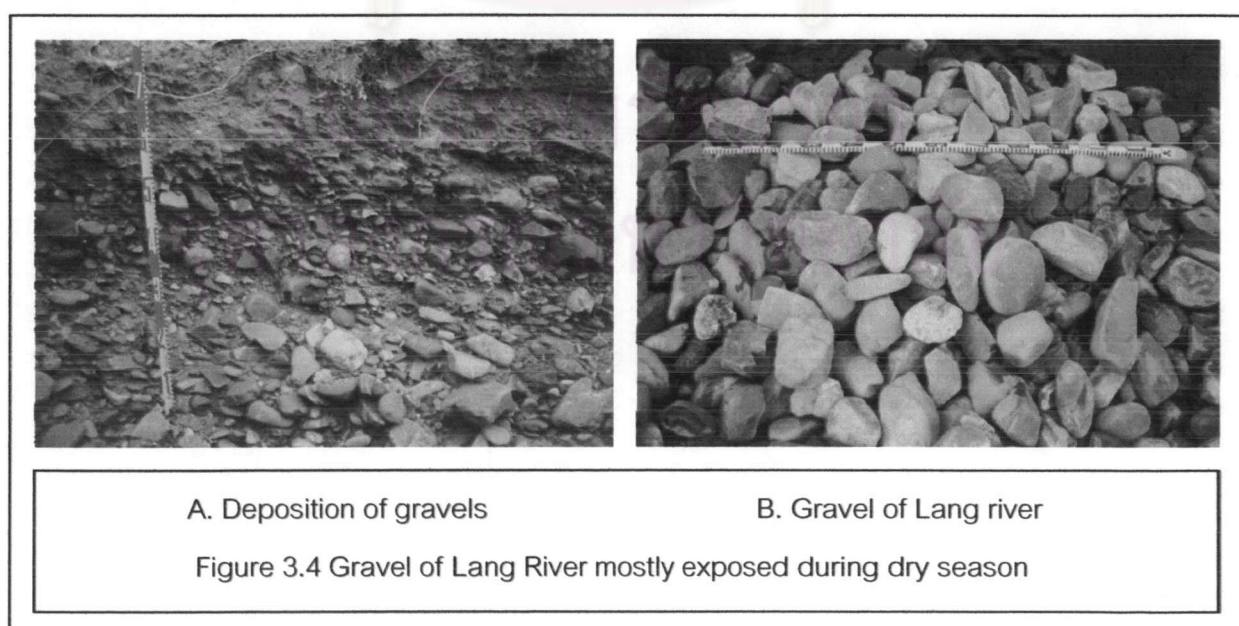
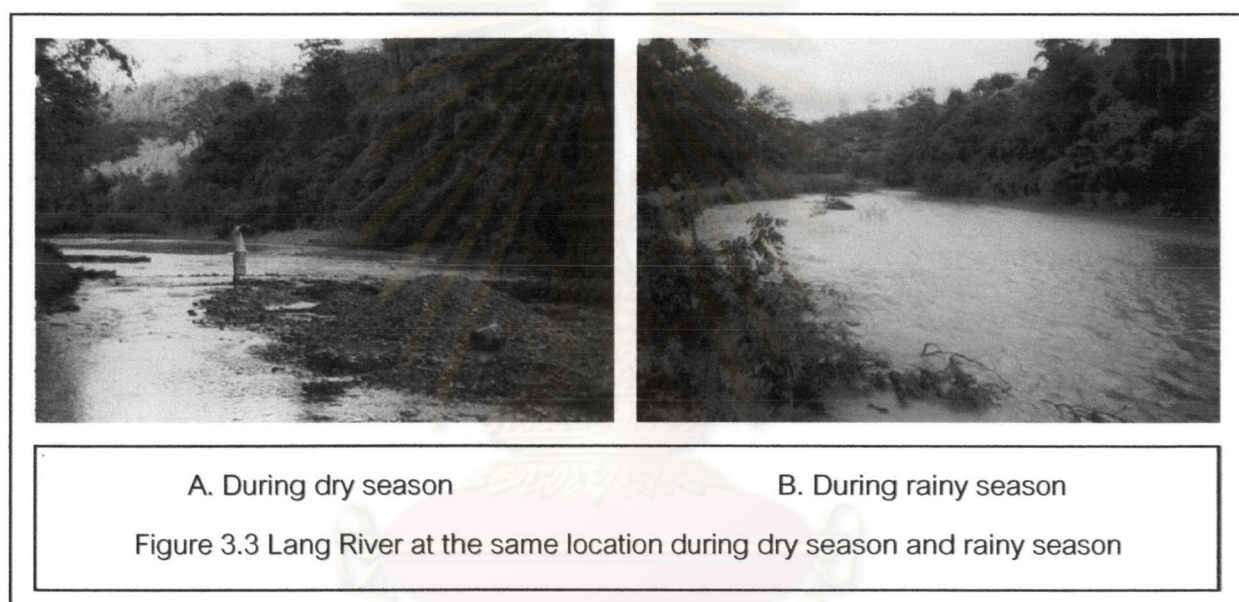


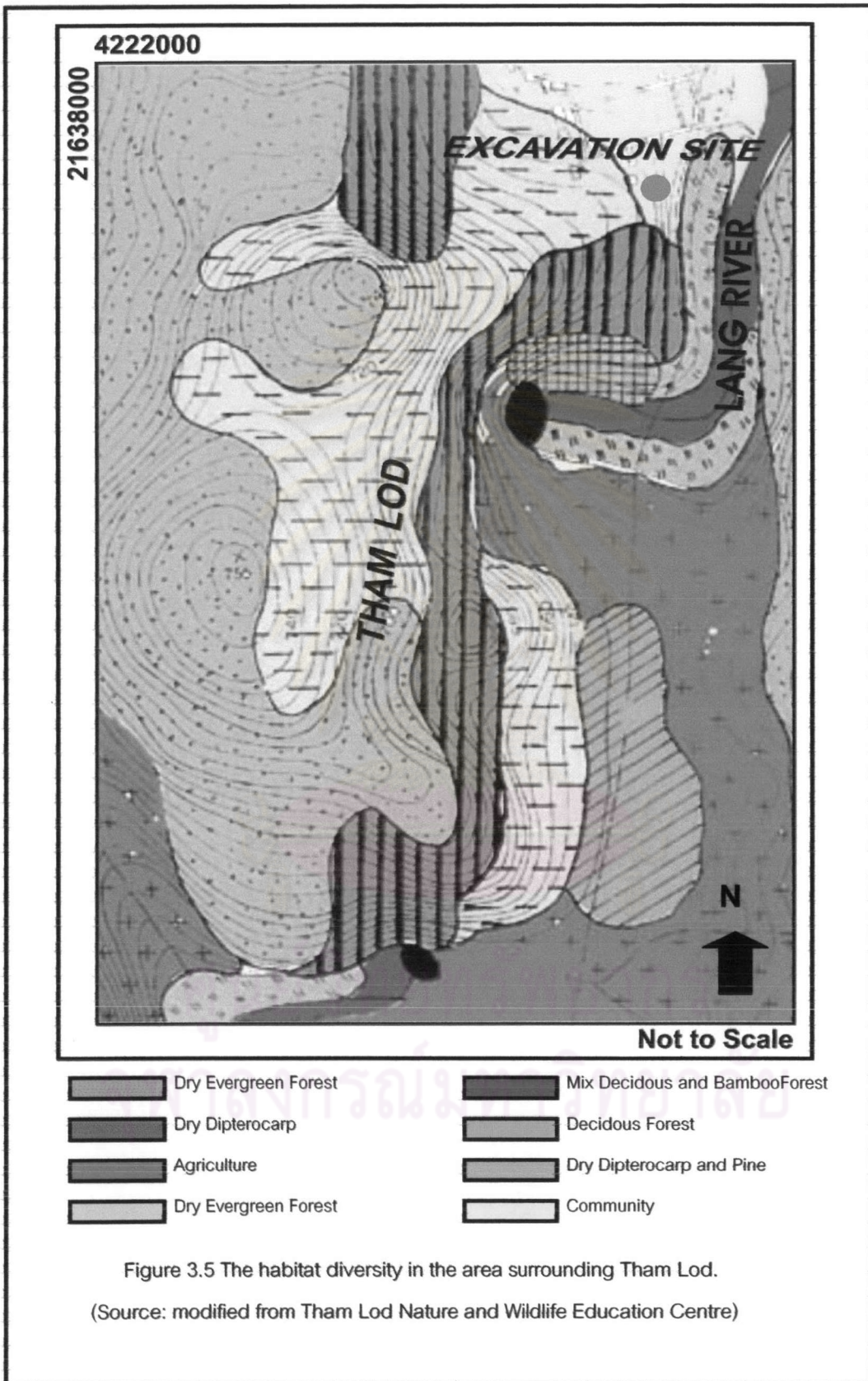
Table 3.1 Result of gravel analysis from 5 sampling areas of Lang River

A. Rock type

B. Particles size distribution

Rock types	Total (%)	Size (mm.)	Total (%)
Sandstone	42	Boulder (> 256)	5
Quartzite	28	Cobble (64 – 256)	74
Volcanic rock	10	Pebble (4 – 64)	12
Plutonic rock	6	Granule (2 – 4)	7
Other	4		

In relevance of flora and fauna, generally, dry dipterocarp and mixed deciduous forest were found in the lower lying areas and on the lower hill slopes. Within this habitat, the co-dominant species of Teak (*Tectona grandis*) were found, as well as frequent patches of different species of bamboo forest. At higher elevation the mixed deciduous and dry dipterocarp forest blends into lower montane and pine forest. Patches of evergreen forest, occur around the depressions and outcrops of limestone. Evergreen forests also occur at lower elevations, usually in cooler and wetter areas that are shaded from the along stream valleys and found around the exit of Tham Lod. Pine and chestnut forests, with very sparse ground vegetation, are located along the high ridges (Figure 3.5). The high degree of habitat diversity is also reflected the variety of fauna species. The data base record of Tham Lod Nature and Wild Life Education Center indicate that in the past, around the area, a lot of variety of fauna species were found such as deer, wild pig, bear, tiger, rhinoceros, elephants etc. Eventhrough, in the present, some of fauna species has decreased rapidly but some still also appear in the area. Mixed Deciduous Forest appears to be the suitable place for wild pig, wild fowl, deer etc. In Dry evergreen forests appears to suit for goat antelope, deer, gibbon etc.



3.2.2 Geological Setting

The detail geological setting was studied by interpretation of aerial photos and field checked.

1. Geological Lineament : The lineaments are traced from aerial photo (PCD. Project) on the scale of 1:50,000. Three major groups of them are distinguished in the area (Figure 3.6). The first group shows clearly in direction of N – S, particularly the fault zone of N – S direction. It passes the study area where Lang river follows along a fault line, contact boundary between clastic and non-clastic rock. The second direction of the lineaments is in northwest and southeast. Lineaments are observed dominantly in the southern part of the study area particularly in Amphoe Pang Mapha and along the road number 1095. The third zone of lineaments was recognised from drainage pattern and line of sink hole. They are observed dominantly in the eastern part of the study area. This feature indicates the group of sink hole, doline or subterranean stream.

2. Geological setting: The interpretation from aerial photos helps to classify the rock unit in the study area into three units. Fault line in north – south direction was interpreted as contacts boundary of different rock units. Lang River follows along this fault line, that represents contact boundary between clastic rock mountain and non-clastic rock mountain (Figure 3.7).

Permain limestone occurs in the western part of Lang River. Permain limestone are normally found in this area. There are in various geomorphological features such as mountain range, cave, sink hole, doline etc. The drainage pattern shows mostly no pattern because most of them were internal drainage system within closed depressions. Underground drainage and the subsequent lack of surface water add to the inhospitability of karst areas. Generally, the limestone is easily eroded and weathered by water, making the karst topography in the limestone area with cave, rockshelter or doline. The cave and the rockshelter are among the good landscapes for the prehistoric people used as habitation site as found around the Tham Lod cave and

rockshelter. It is confirmed by the occurrence of other archaeological sites as rockshelter in Permain limestone around Amphoe Pang Mapha area and nearby such as Ban Rai rockshelter (Shoochongdej, 2002).

In the east of Lang River, there are clastic rock mountain composing of sandstone, mudstone, shale, chert and are referred to Permain – Carboniferous in age. High mountain range appears as local people called “Doi San Kai”. The drainage pattern shows mostly dendritic pattern. From the geological investigation on this unit, a lot of stone tools were found on the top of mountain (most of them are utilized core and flake). Figure 3.8 shows the number of open lithic site and rockshelter site around the area indicating that prehistoric people not preferred to use the only rockshelter but they also chosen the open air site for habitation.

The Quaternary sediments which are the last geologic period in this area, appear as small area along Lang river. The sediments are semi – consolidated and unconsolidated such as sand, silt, clay, gravel etc. Sediment formed as terrace and flood plain deposits.



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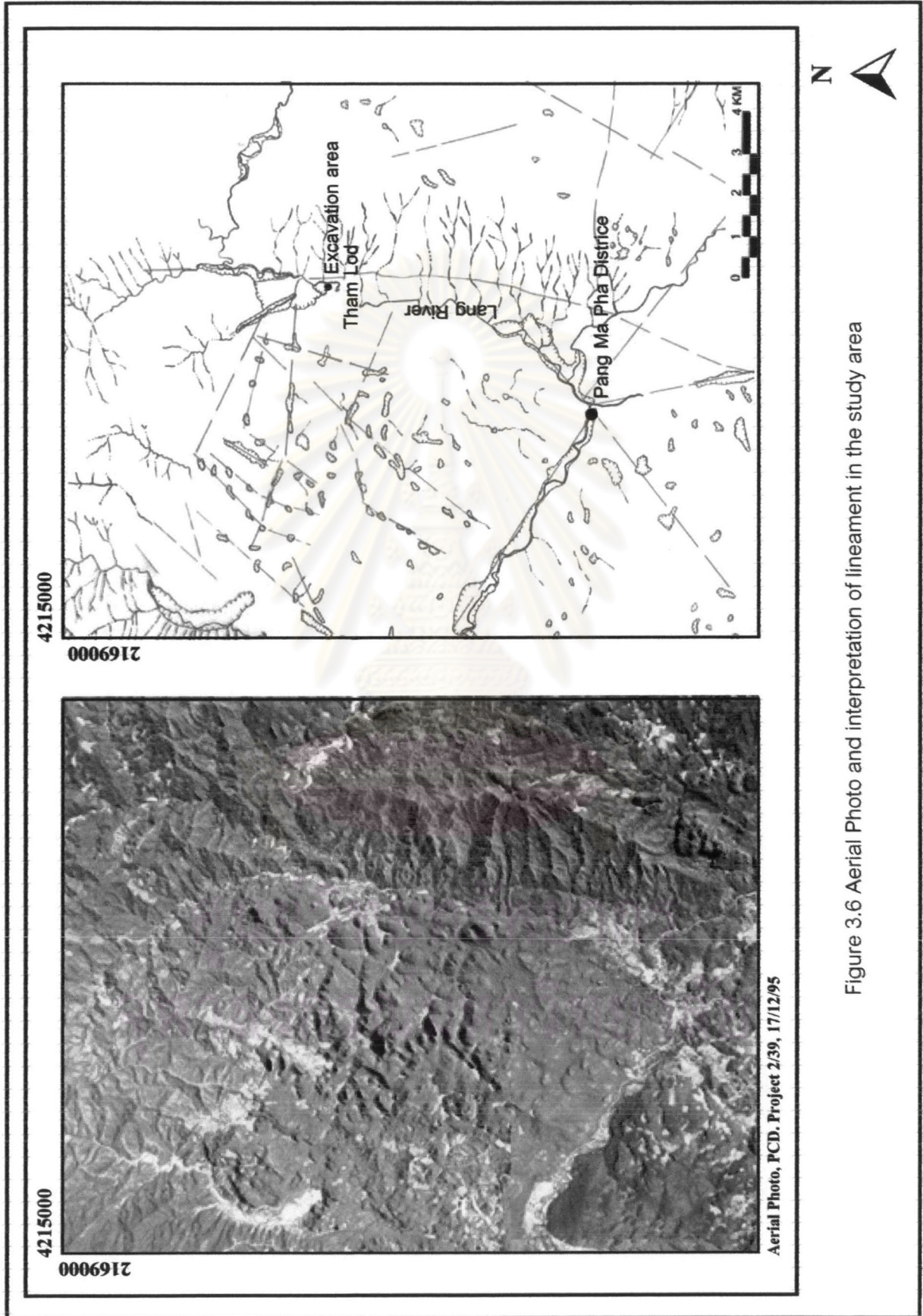


Figure 3.6 Aerial Photo and interpretation of lineament in the study area

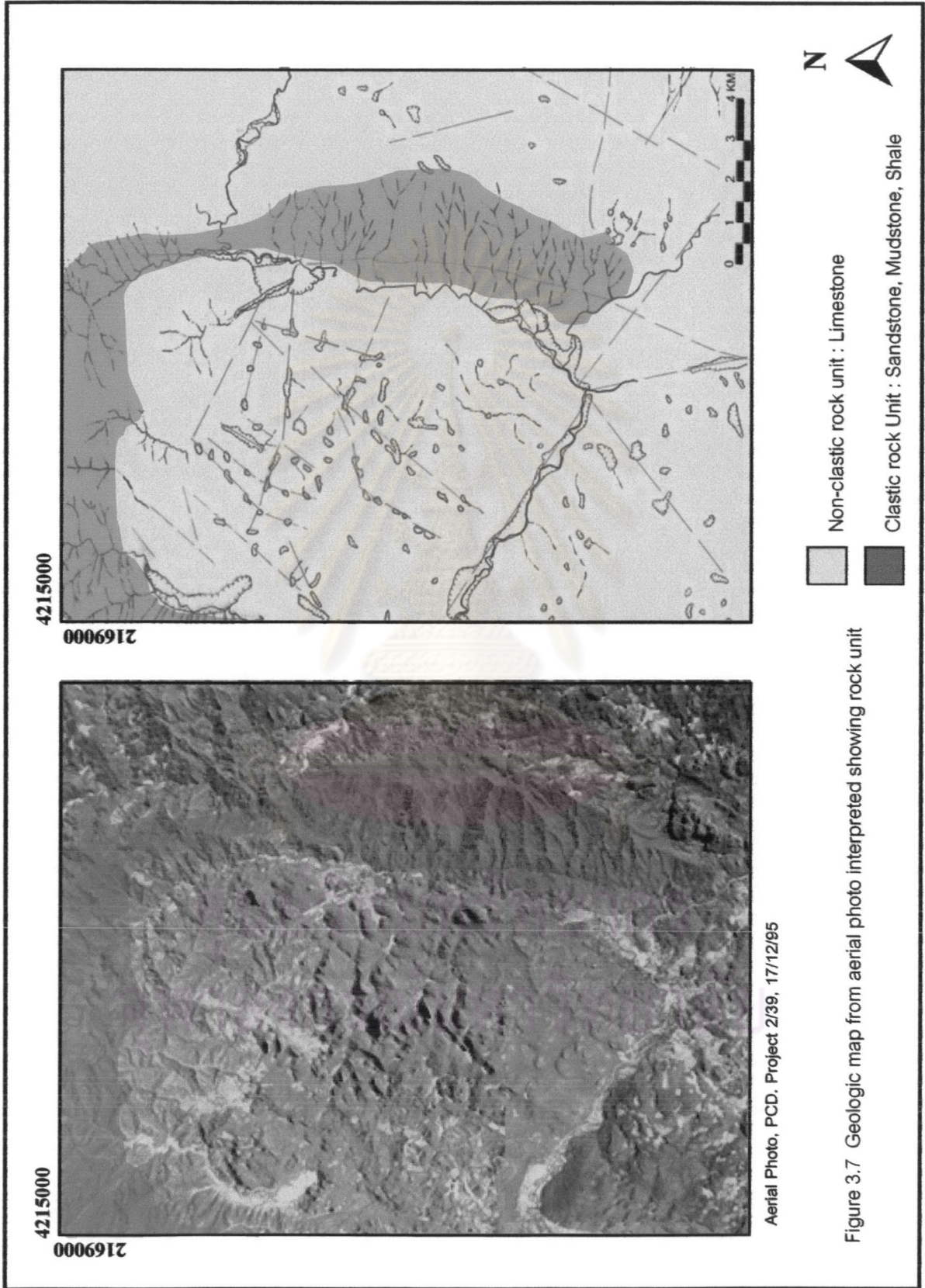


Figure 3.7 Geologic map from aerial photo interpreted showing rock unit

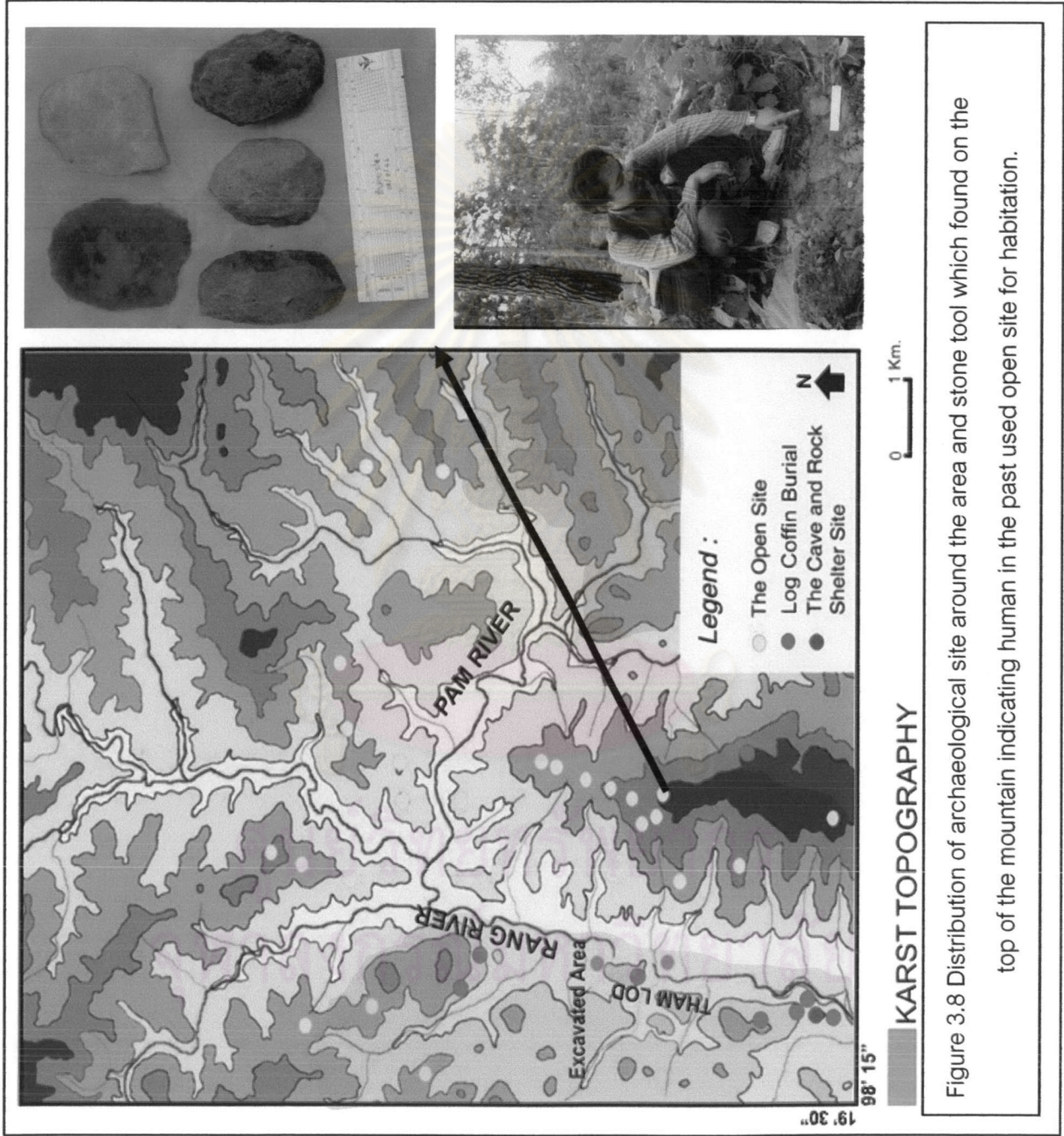


Figure 3.8 Distribution of archaeological site around the area and stone tool which found on the top of the mountain indicating human in the past used open site for habitation.

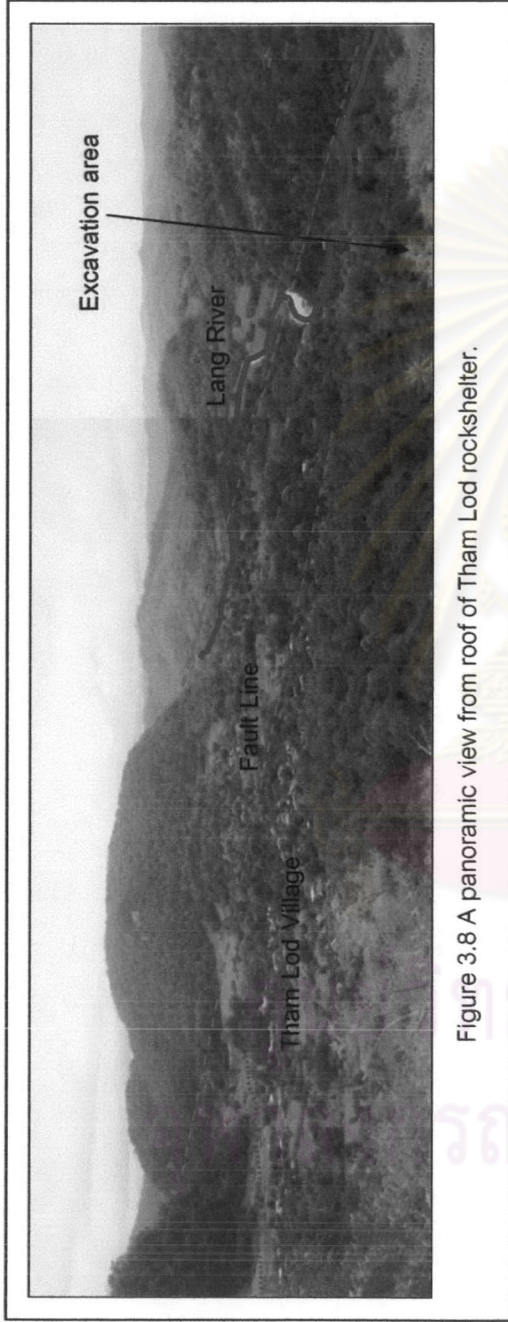


Figure 3.8 A panoramic view from roof of Tham Lod rockshelter.

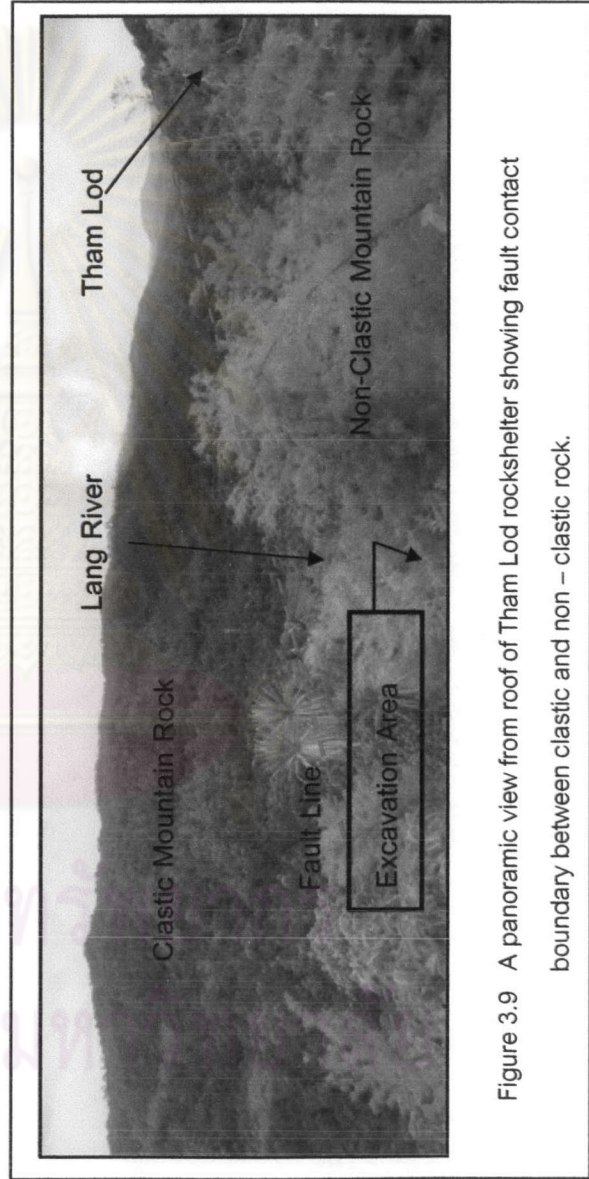


Figure 3.9 A panoramic view from roof of Tham Lod rockshelter showing fault contact boundary between clastic and non – clastic rock.

3.2.3 Geomorphology

The geomorphological study in this area was based primarily on the interpretation of aerial photos. Various patterns of landforms can be obtained clearly from aerial photos. The origin of geomorphic landforms in the study area is associated with geological origins. The geomorphological units can be classified mainly into three units as unit of clastic rock mountain (non – karst), unit of non -clastic rock mountain (karst) and unit of fluvial deposited (Figures 3.11 and 3.12).

3.2.3.1 Units of clastic rock mountain

This unit mainly appears in the eastern part of Lang River that is characterized by the high mountain ranges with north to south trending. The elevation of mountain ranges from 600 -1070 m. above mean sea level, and is called from local people "Doi San Kai". The rock is composed of sandstone and metamorphose mudstone, indicated the Permian – Carboniferous in age.

3.2.3.2 Unit of non-clastic rock mountain (Karst topography)

Permian limestone is the main rock formed as dominated mountain in this unit as karst topography. Karst topography appears in the western part of Lang river with particular geological features such as cave, rockshelter, doline, sinkholes, blind valleys and subterranean stream. The excavation area is situated in a collapse open doline (not closed depressions), nearly circular shape (about 100 m. of diameter) with the elevation ranging from 600 – 640 m. above present mean sea level (Figure 3.14). The sediment was deposited in doline which formed in nonsoluble rock, caused by solution of a buried karst mixed with a thick of high terrace deposit of Lang river valley.

3.2.3.3 Unit of Fluvial Deposition

The fluvial deposit in the area was formed by the Lang river valley. The terrace deposit and small floodplain were found in the western part along Lang river.

A. Terrace Deposit : terrace deposits are characterized and displayed as “unpaired terrace” (Figure 3.14)

High terraces deposit formed as the high flat plain mixing with doline sediment deposit.

The middle terraces are clearly seen as its gentle slope with low relief amplitudes, mainly comprised clayey, silty and sandy from top to bottom , respectively.

The low terrace is physiographically similar to middle terrace but its lies in lower elevation. It is formed gentle slope with low relief amplitudes, comprising clayey, silty and sandy from top to bottom, respectively.

B. Floodplain : floodplain appears as a small area of deposition along Lang River. In the area under investigation, floodplain deposits are composed of gravel, sand and sandy silt (Figure 3.15).

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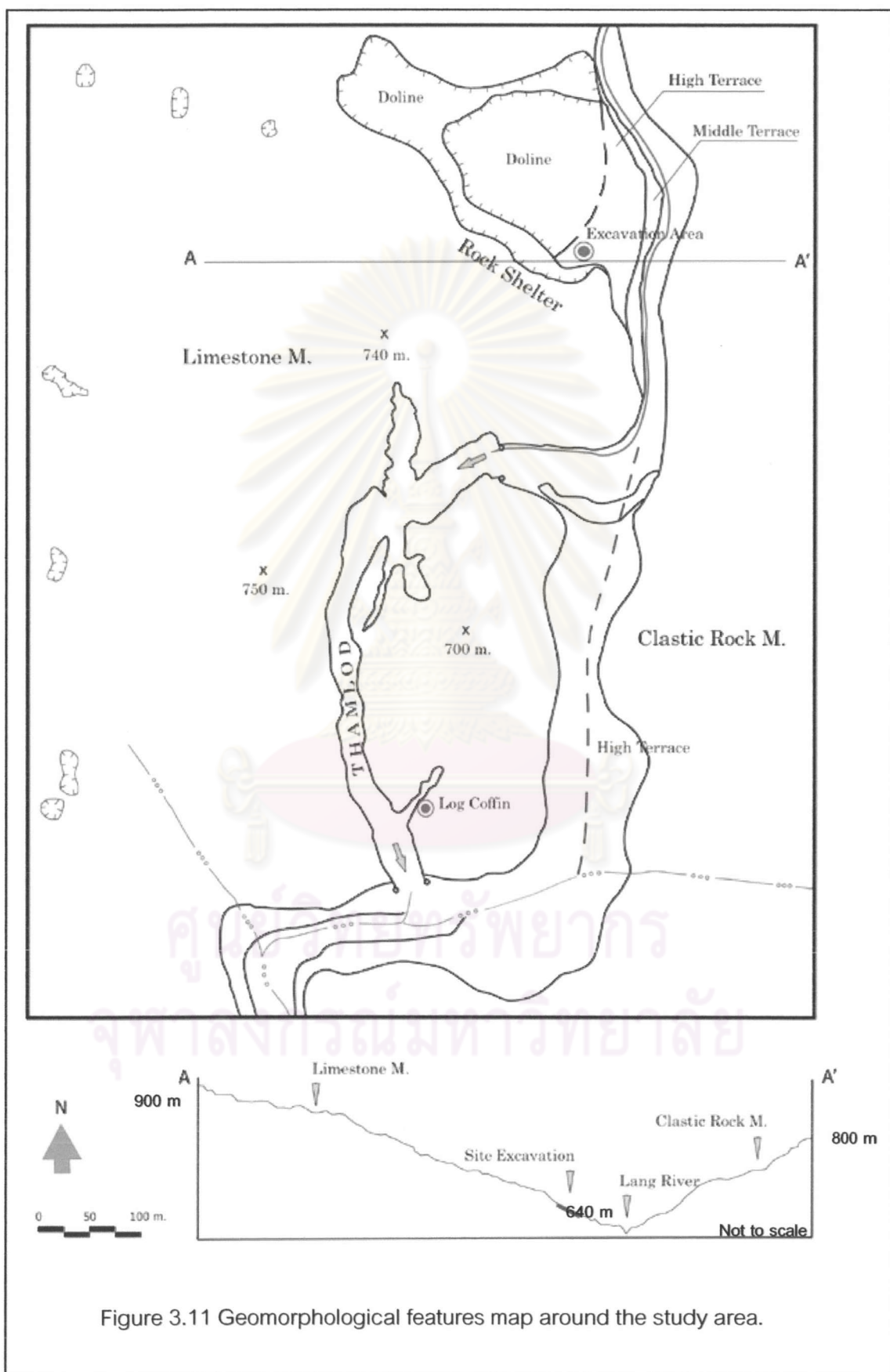
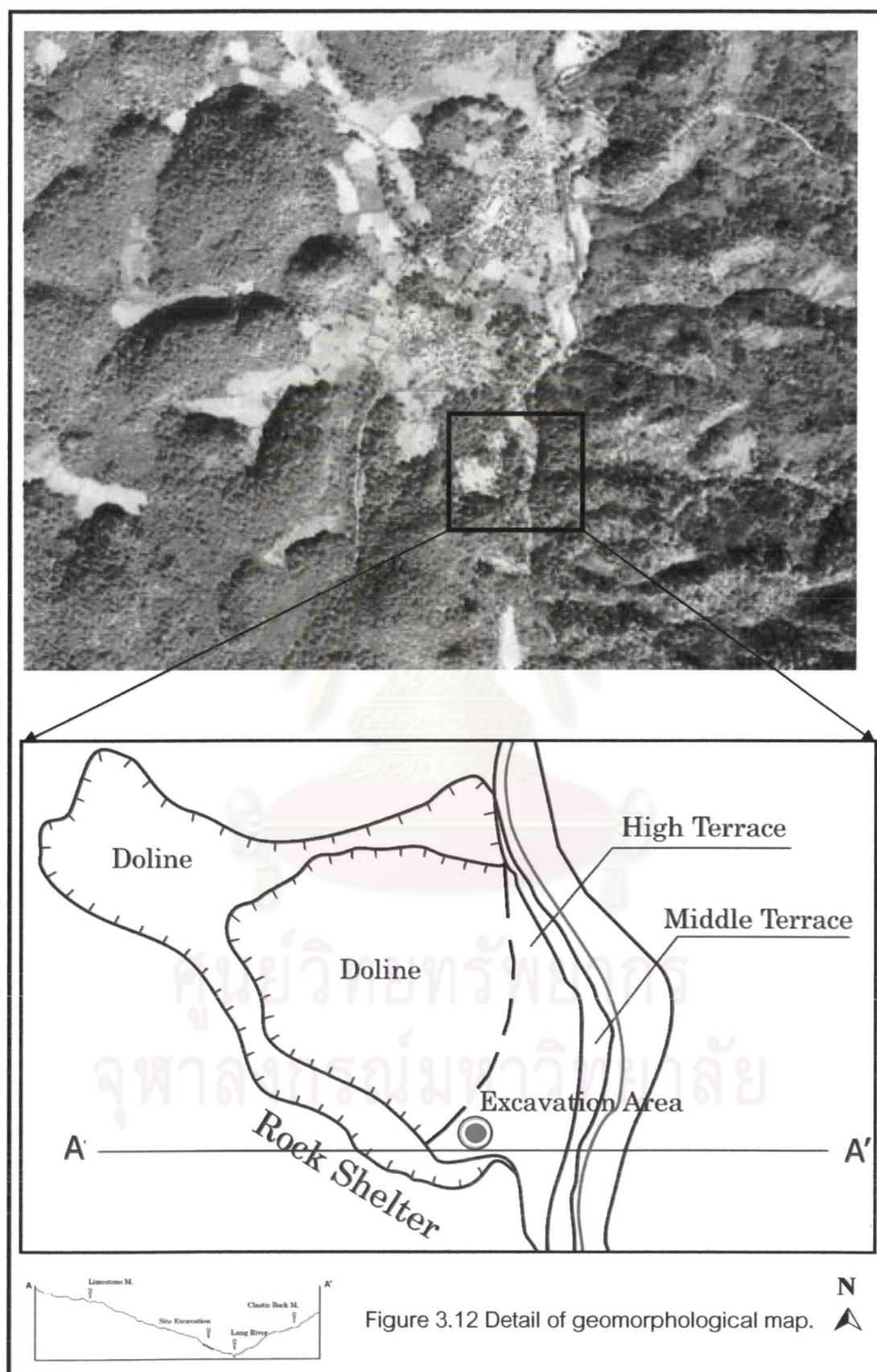
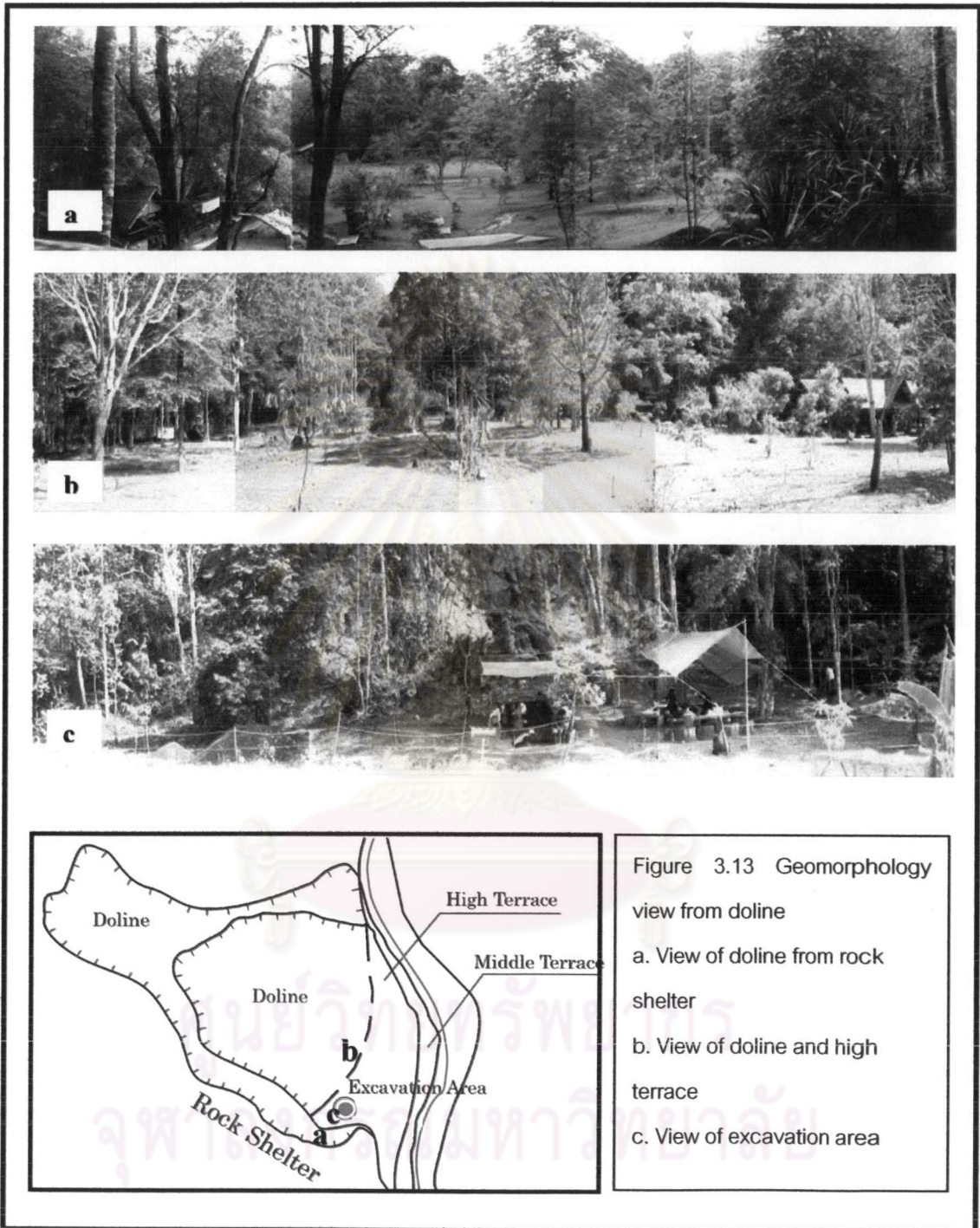
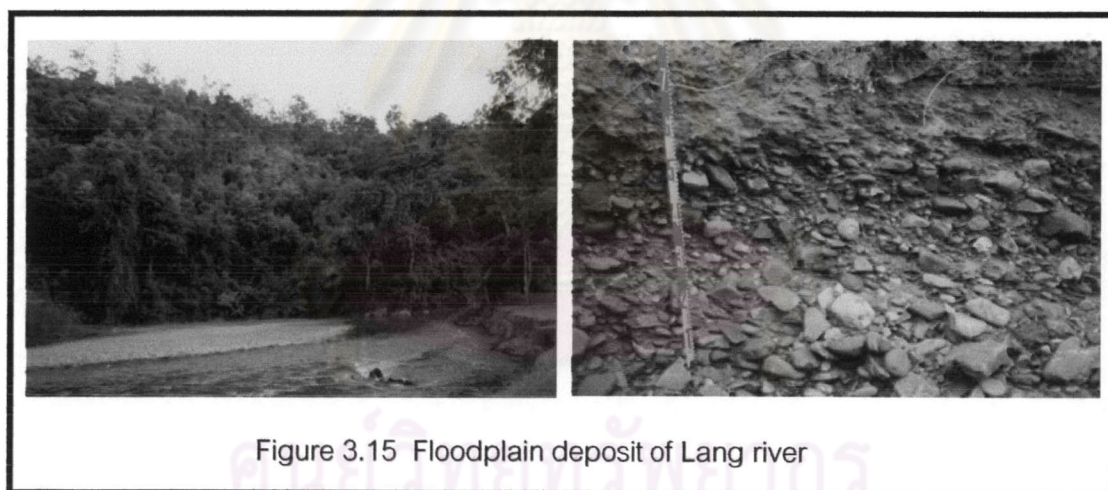
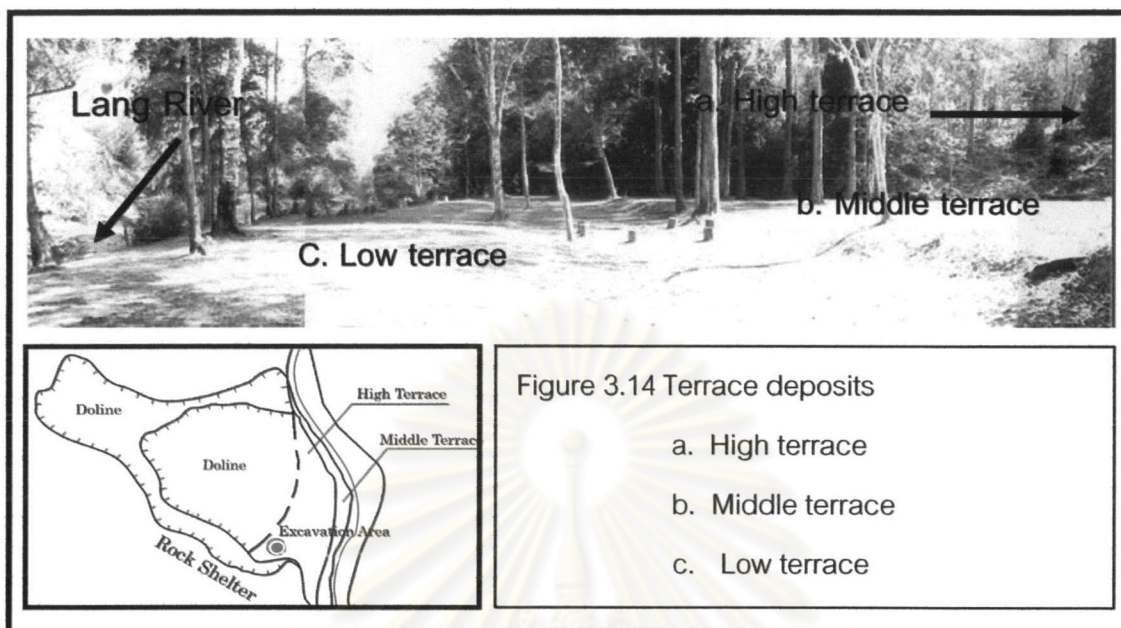


Figure 3.11 Geomorphological features map around the study area.







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