

CHAPTER II

GEOLOGY



The basics of sediment classification in Thailand are geomorphology, lithology, depositional environments and fossils (Sinsakul, Chaimanee and Tiyaipairach, 2002). The geomorphology of the Khorat Plateau is the result of the collision between Indian and Asian plate in the Late Tertiary, which lead to the Himalayan orogeny and the formation uplift of the Phuphan range in northwest -southeast position. This is also resulted in uplift of the Phuwiang, Phu Khiew, Sisaket, Khon Kaen and decline of the Ubon Ratchathani. When the Himalayan range is prolongation, induced the uplift of nearly parallel to the Kumpawapee syncline in Miocene – Pleistocene (Chuaviroj, 1997).

The Quaternary period is subdivided into two epoches, Pleistocene is the time span from 1.8 m.y. to 10,000 yr. B.P. and Holocene is the time span from 10,000 yr. B.P. to present. Climatic changes, sea-level changes, neo-tectonic and landform transformations are occurred in this period. Sediments are semi-consolidated to unconsolidated (Sinsakul *et. al.*, 2002).

2.1 Previous study of geology

Udomchoke (1988) classified the Quaternary stratigraphy of the Khorat Plateau, and classified into 9 units in ascending order as follow (Fig. 4).

(I) The weathered rocks of the Khorat Group: the character of sedimentation is residual weathering and deposition. This unit lies unconformable under the basalt.

(II) Basalt: the basalt is of Pliocene to Pleistocene age.

(III) Gravel beds: this unit can be classified into two sub-units, the older and the younger gravel beds. The older gravel beds are fine grained semiconsolidated, and inclination. Deposition of the sediment is began in Late Tertiary (Sataragsa, cited in Udomchocke, 1988: 89). The younger gravel bed composed of unconsolidated of coarse graine of pebbles. The bedding plan is slightly undulating. The age of sediment is Middle Pleistocene age according to the absolute age of Tektites.

(IV) Organic sand: the accumulation of sediment occurs in the lowland of Tung Kula Ronghai, during the last glacial maximum (34,000 to 20,000 yr.B.P.) (Tuckson, cited in Udomchocke, 1988: 89).

(V) Red and yellow Loessial soil: these sediments were deposited in the cold and dry climate during the Late Pleistocene – Holocene (Hoang et al., cited in Udomchocke, 1988: 92), when the Mun River was braided (Nutralaya, cited in Udomchocke, 1988: 92). The age of deposition is 18,000 yr.B.P. (Tuckson, cited in Udomchocke, 1988: 92).

(VI) Lake and swamp deposits: the depositional environments of these sediment can be charaterized as a warm and humid climate which prevailed between 7,500 and 3,500 yr.B.P. At that time the area was probably covered by numerous large abandoned channels of the Mun, Chi, Nam Phong and Nam Songkhram Rivers.

(VII) Windblown sand: this sediment unit unconformably overlays the lake and swamp deposits. The environment changed from warm and humid to drier, between 3,500 and 2,000 yr.B.P. Sediments are transported by wind to floodplains and lake.

(VIII) Flood deposits: overlay the windblown sand with very thick bed. The sediments are composed of sand, silt and clay and mixed with sherds, bones, charcoal and shells. The age is 2,100 – 1,850 yr.B.P.

(IX) Alluvium: alluvium sediment is deposited along the present streams and consists of an the alternation of clayey sand, sandy clay and silty sand beds.

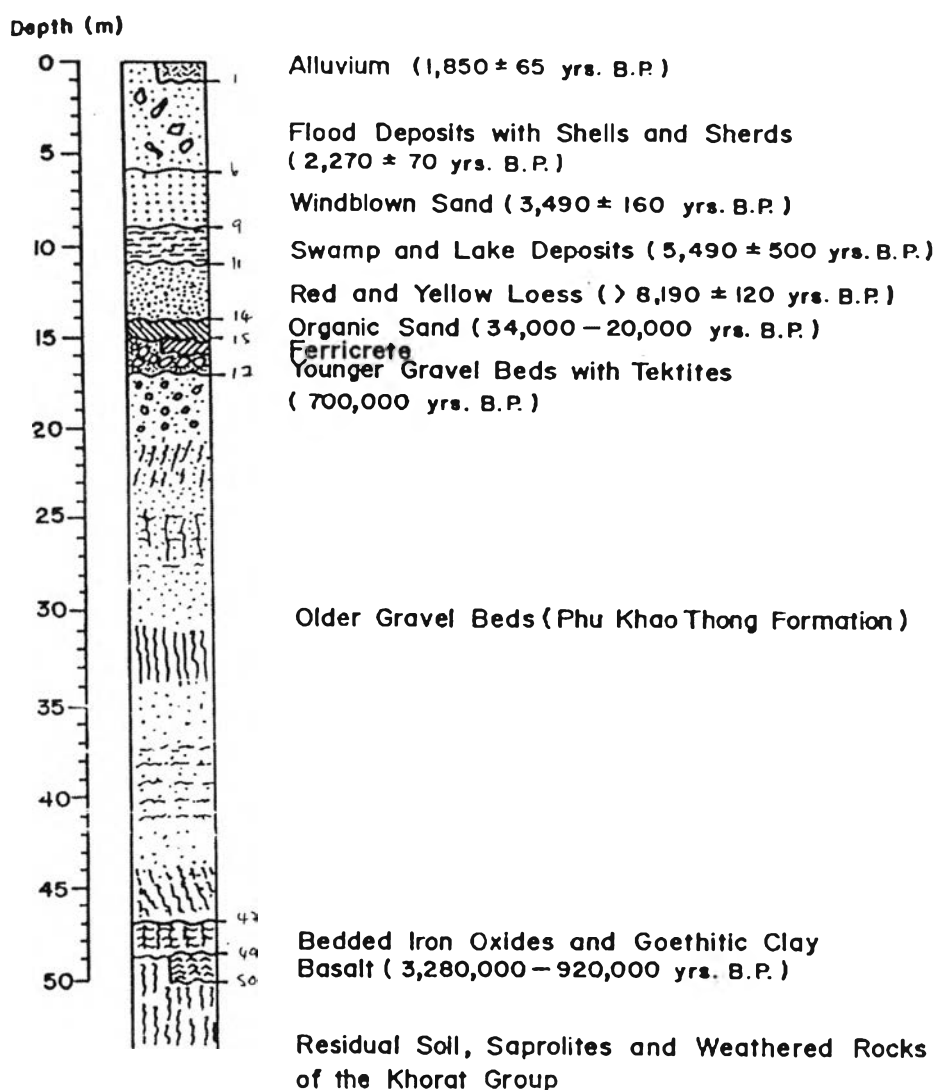


Figure 4 Quaternary stratigraphic section of the Khorat Plateau area (Udomchock, 1988).

Charusiri *et al.* (2002) used Thermoluminescence dating (TL-dating) to study tektites and sandy samples from the sandy pit at Ban Tachang, Amphoe Chaloe Pra Kiat, Changwat Nakhon Ratchasima. The thickness about 7-7.77 meter, and subdivided into six sediment units. The dating results of sand sediments from the uppermost to the lowermost layers range from ca. 0.623 to 4.338 Ma. The dates of tektites from the 3rd unit were estimated about 0.69 ± 0.24 , 0.69 ± 0.17 and 0.80 ± 0.18 Ma for teardrop, dumbbell and circular shaped tektites respectively.

Nakchaiya (2002) classified the high gravel beds of the sand quarry at Ban Nong Bua Ri, Amphoe Chakkarat, Changwat Nakorn Ratchasima into five units according to lithology, stratigraphy, sedimentary structure and fossils. The five units are subdivided. The upper most unit was interpreted to a fluvialite deposit of Pleistocene age, the 2nd and 3rd units were interpreted as alluvial fan deposits of Pliocene age, and the 4th and 5th were interpreted as alluvial fan deposits of the Miocene (Fig. 5).

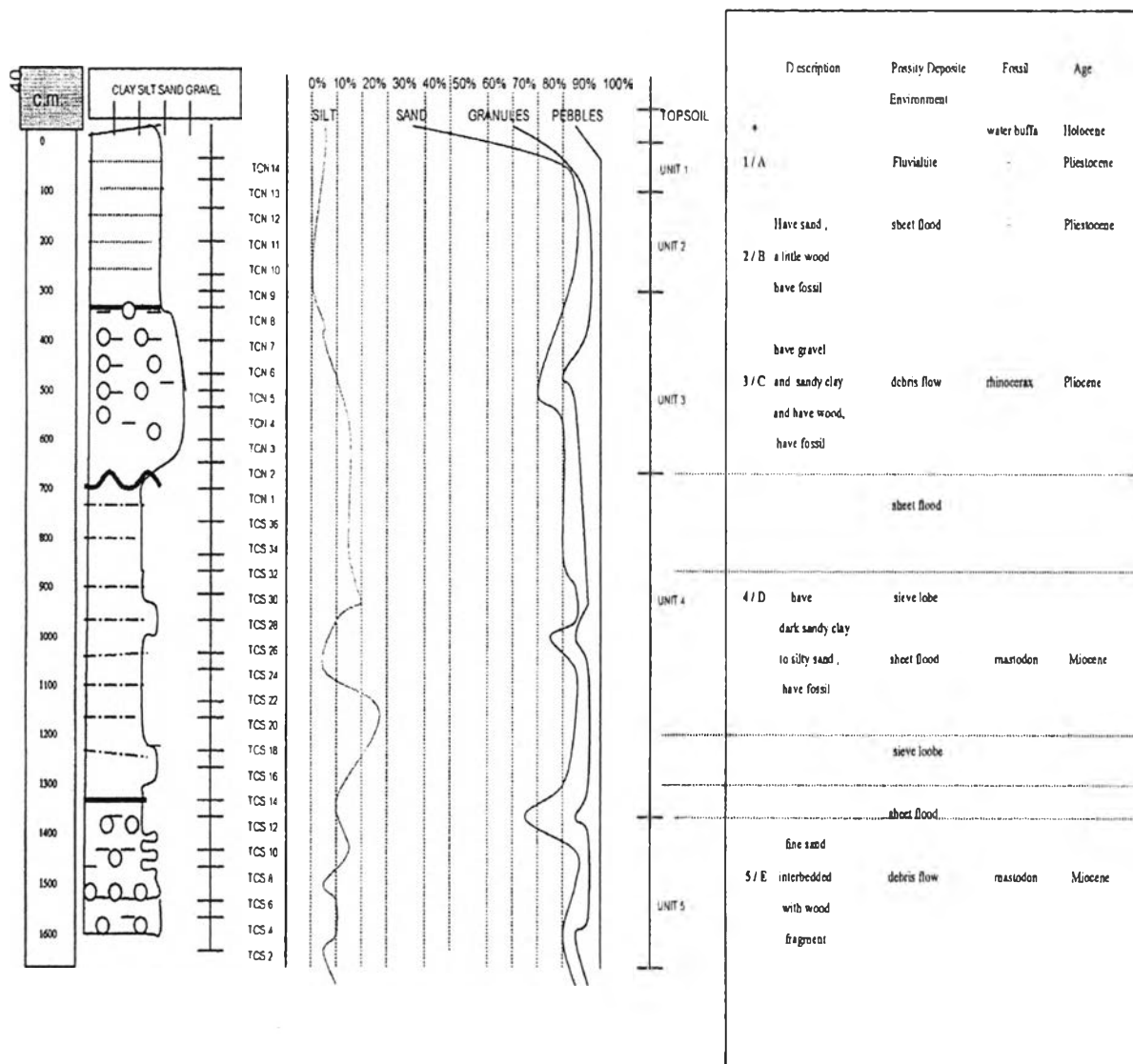


Figure 5 Stratigraphic section of the high gravel beds of the sand quarry at Ban Nong Bua Ri, Chakkarat District, Nakhon Ratchasima Province (Nakchaiya, 2002).

Sato (2002) studied a fluvial deposit at a new sand pit in Ban Non Man Thet, Amphoe Non Sung, Changwat Nakhon Ratchasima. The columnar section has a thickness of about 16 meter and is subdivided into five horizons by distinct unconformities (Fig. 6).

The first horizon is composed of sand and granule to pebble beds. Bones of *Elephas maximus* Linnaeus, polished stone tools and fragments of ceramic are found in this horizon. This occurrence indicates a historical age.

The second horizon is composed of laminated fine sands with scars of roots and a alternation of sand and clay.

The third horizon is composed of cross bedding of coarse grained sandstone and a granule pebble conglomerate. Tektite deposits are rare.

The fourth horizon is composed of a granule to pebble conglomerate, lenticular beds of clay with granule conglomeratic sandstone and laminated pebble conglomerate and cross lamination of conglomeratic coarse grained sandstone. Mammal fossils and logs (5 by 0.3 m dimension) are abundant in the horizon.

The fifth horizon is composed of clay and laminated fine sandstone. Plant fragments and mammal fossils are found frequently.

The poor sorting of the sediment and the dominance of conglomerates indicate fluvial deposition. Lenticular structures of the fourth unit are indicates a lake of the waste-filled valley deposits.

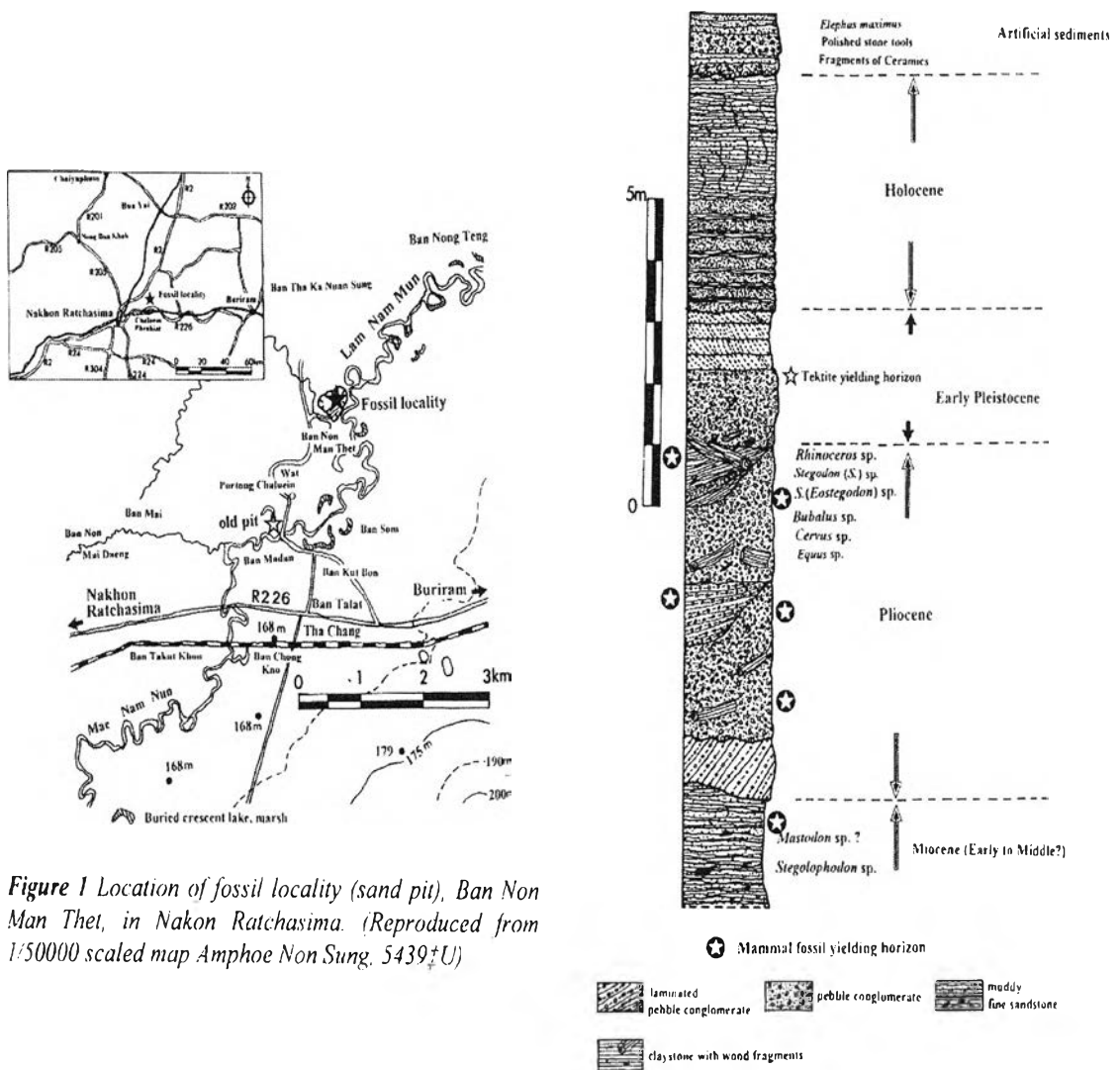


Figure 1 Location of fossil locality (sand pit), Ban Non Man Thet, in Nakhon Ratchasima. (Reproduced from 1/50000 scaled map Amphoe Non Sung, 5439±U)

Figure 6 Stratigraphic section of a new sand pit in Ban Non Man Thet, Non Sun District, Nakhon Ratchasima Province. (Sato, 2002).

Sinsakul *et al.* (2002) pointed out that the Cenozoic depositional processes and sedimentary sequences of the Khorat basin derive from the tectonic evolution, existing geomorphology, climatic changes, weathering and erosion during the Tertiary and Quaternary period. The geomorphological development of Khorat basin from older to younger units happened are as follows.

(I) The residual deposit consisting sand and clayey sand derives from weathered rocks of the Khorat group. The basalt of about 920,000 yr.B.P. overlays on

this unit. It that indicates to the age of residual deposit is older than the basalt, and the unit is associate to Lower Pleistocene age.

(II) Terrace deposits can be divided into high and low terraces. The high terrace consists of semiconsolidated sand and gravel, and fragments of petrified wood. This unit is overlain unconformably by bed rock. The low terrace consists of gravel with a sand and silt matrix. Tektites which are accumulated in the bed, give an age of about 700,000 yr.B.P. for the deposition. Lateritic layer covers the top.

(III) The organic sand unit is composed of fine sand. Abundant organic matter and peat were found in the lowland of Thung Kula Ronghai. The ^{14}C - dating of this unit shows an age of 34,000-20,000 yr.B.P. organic clay is deposit in swamp, associated of 5,400-5,200 yr.B.P. Loess and sand dune deposits are still suspicion.

2.2 Methodology of geology

The Mong Korn sand pit. It is closely located in Ban Som, Tambol Ban Tha Chang, Amphoe Chaloe Pra Kiet, Changwat Nakhon Ratchasima, by $15^{\circ} 02' 01.4''$ N latitude and $102^{\circ} 17' 33.5''$ E longitude. This lithostratigraphic study is started with literature reviews. Then, field observation and collecting data are operated in the private sand pit. The lithostratigraphic column and samples collecting together with some soil profile are carried out.

2.3 Result of geological study

The stratigraphic column of the site is constructed from a sediments of about 25.4 meter thick. It can be divided into six units and three subunits from the evidence of

hiatus, sedimentary components, sedimentary structures, depositional environments and logs. The result is shown in figure 7 and 8 and summarize, in descending order.

The unit 1 and top unit is 5.4 meters thick. This massive clay unit is structureless and homogenous, and interbedded by a layer of silt to very fine sand. Reddish brown mottles and rootlets are scattered in the unit. The depositional environment is vertical accretion in floodplain. This soil unit is overlain by the second unit by erosional contact hiatus.

The unit 2 is 8.80 meters in thick. It was formed by repeated channel deposition, which allows that subdivide this zone into sixth subunits. The boundaries between the subunits are marked by sharp, erosional and irregular contact hiatus.

Subunit 2.1 is 2.97 meters thick. The main sediment component is sand grain. The size varies from medium sand to pebble. The dominant structures in the massive sand bed is cross lamination, while the gravel bed is structureless. This indicates an alternation of strong and poor currents in the lateral accretion. Logs and wood fragments are embedded in the gravel bed at the lowest unit. The depositional environment is channel deposition. This subunit covers the subunit 2.2 by erosional contact hiatus.

Subunit 2.2 is 1.17 meter thick. The unit is composed of fine sand to granules. The accretion of this unit is normal graded bedding of granule, medium sand, fine sand and very fine sand from the bottom to the top, respectively. The dominant structure is cross lamination of very fine to fine sand. Logs are embed at the lowest subunit of the gravel bed. The environment of deposition is channel deposit. This subunit covers the subunit 2.3 by erosional contact hiatus.

Subunit 2.3 is 4.66 meters thick. The main sediment component is sand. The grain size are varies from fine sand to pebble. The dominant structures are cross lamination on top, parallel lamination in middle and parallel bedding and trough cross bedding close to the bottom, respectively, but some part of the subunit are interbedded by clay layers and poorly sorted, very coarse sand to granule. Therefore, the

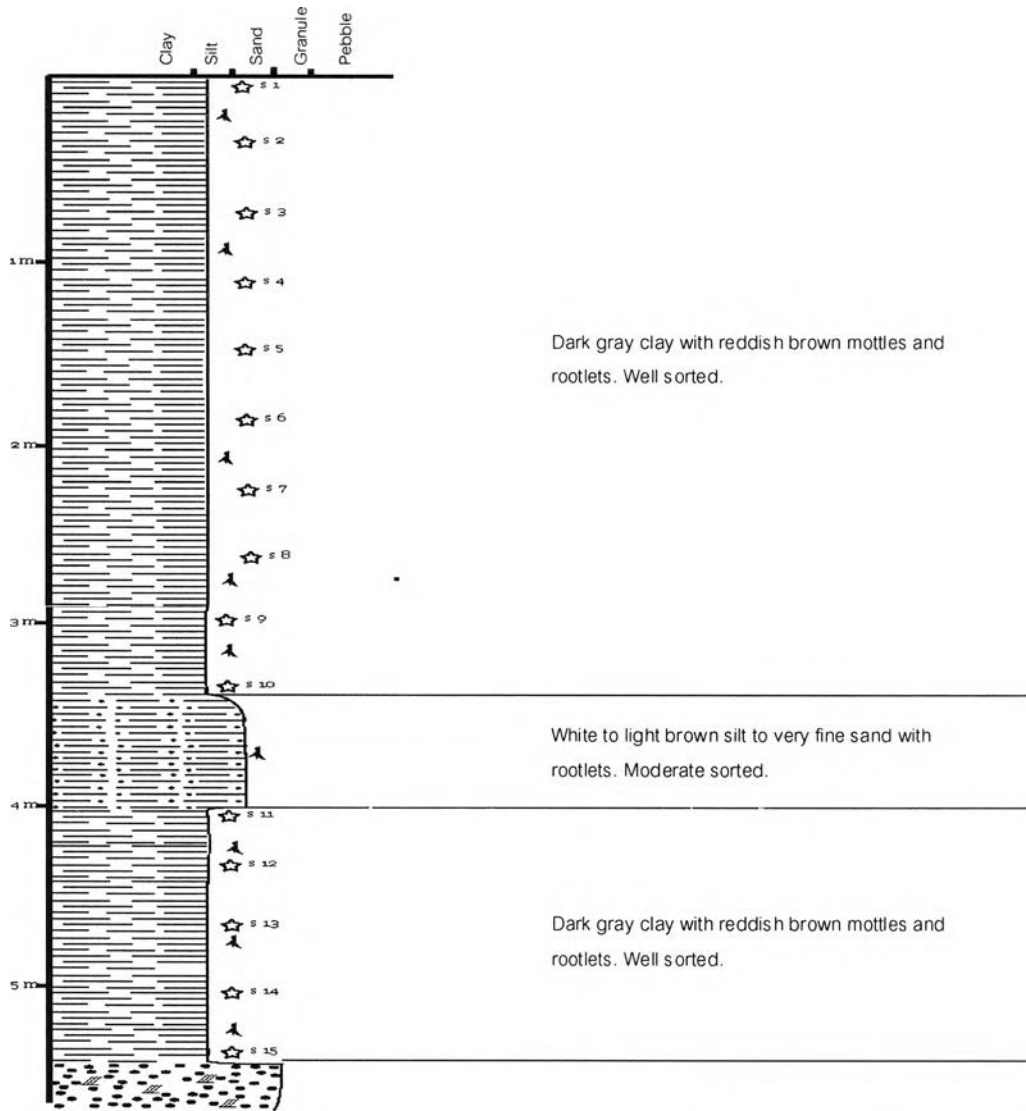
appearances are indicated to channel deposition. This subunit covers the subunit 2.4 by erosional contact hiatus.

Subunit 2.4 is 2.22 meters thick. The main sediment component is structureless gray clayey silt, with homogenous texture. The depositional environment is vertical accretion in floodplain. Bamboo trunks are scattered in the subunit. These evidences are suggested to floodbasin deposition which is occur beside the river. This unit covers the sununit 2.5 by irregular contact hiatus.

Subunit 2.5 is 3.83 meter thick. The structures are complexity. The main sediment components are sand and gravel. The grain size varies from fine sand to pebble. The dominant structures are cross lamination in white fine sand, cross bedding in medium to very coarse sand, grade bedding from pebble to very coarse sand. Gravel beds are structureless. Logs are accumulated in the gravel bed. These depositional structures indicate a point bar deposition. This subunit overlay on the subunit 2.6 by irregular contact hiatus.

Subunit 2.6 is 2.90 meter thick. The main component is gravel, at granule to pebble size. This zone is structureless. The gravel bed is deposited in the middle to lower part, and logs are accumulated inside. This evidence suggests a channel deposition. The upper part consists of structureless, very fine sand, rootlets and plant fragments, which indicate a floodbasin deposition. This subunit overlay on the thrid unit by shape contact hiatus.

The unit 3 is 2.25 meters thick. The sediment is a lamination of gray silt and very fine sand. Clay nodules occur in the upper part of the unit, and bioturbation is found in the lower part. This evidence suggest a deposited in floodbasin deposits.

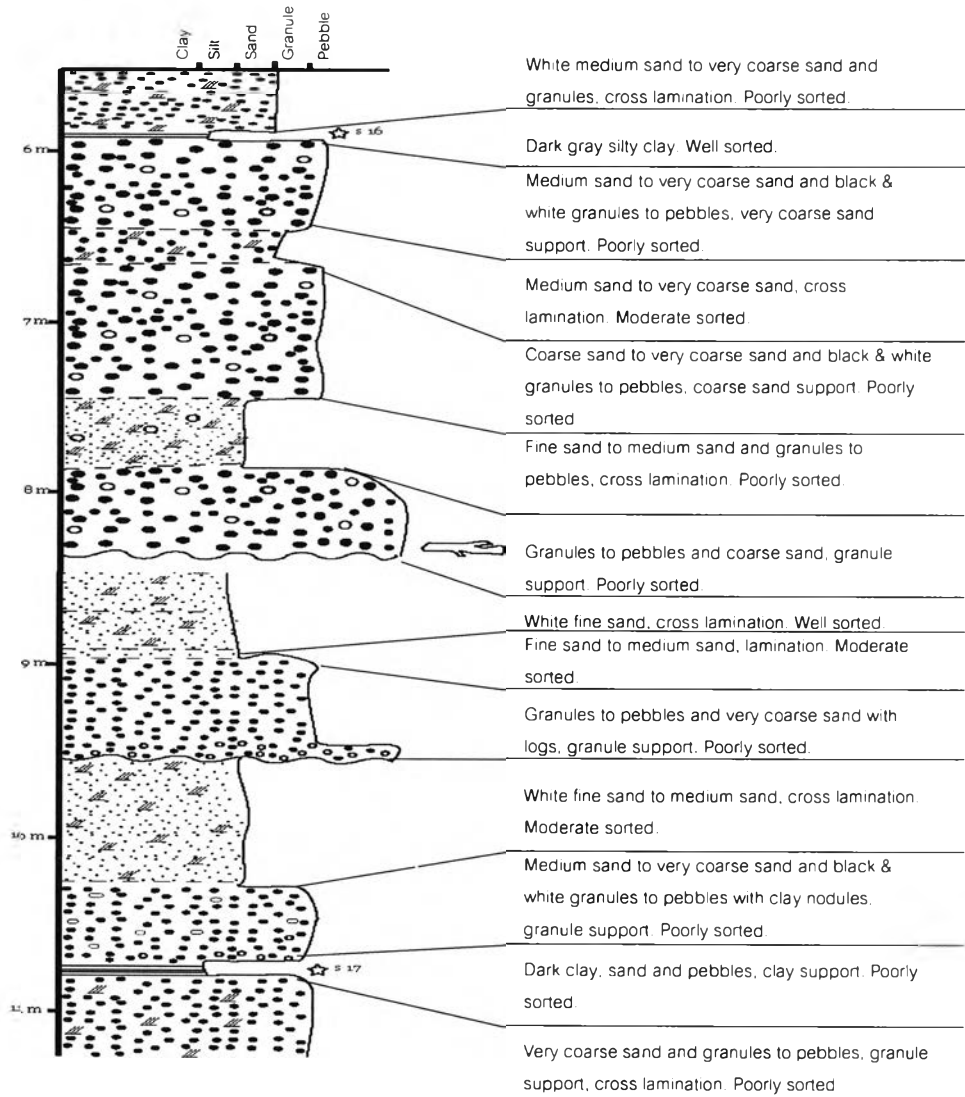


Legend



Figure 7.1 Stratigraphic column of Mong Korn sand pit in Ban Som, Tambol Tha

Chang, Chaloam Prakiet District, Nakhon Ratchasima Province.



Legend

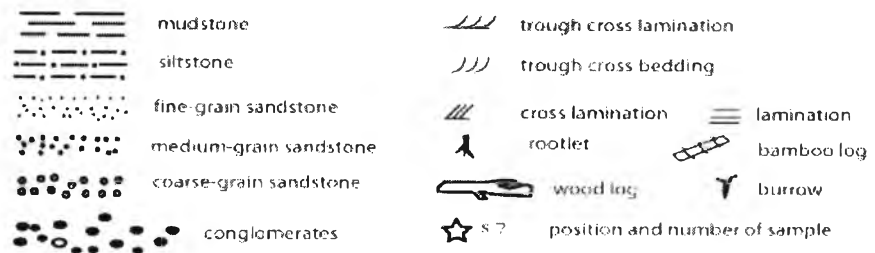
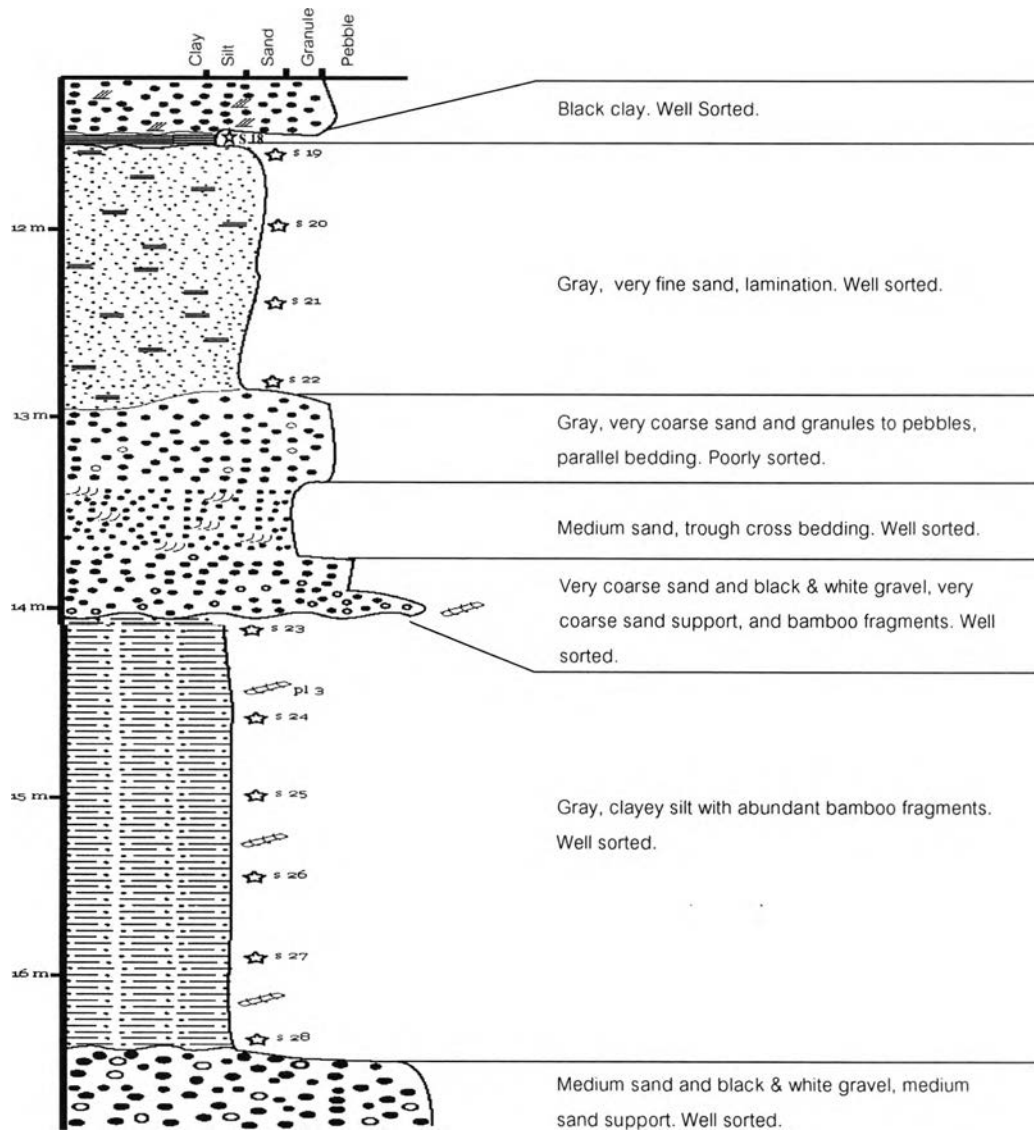


Figure 7.2 Stratigraphic column of Mong Korn sand pit in Ban Som, Tambol Tha

Chang, Chaloam Prakiet District, Nakhon Ratchasima Province (cont.).

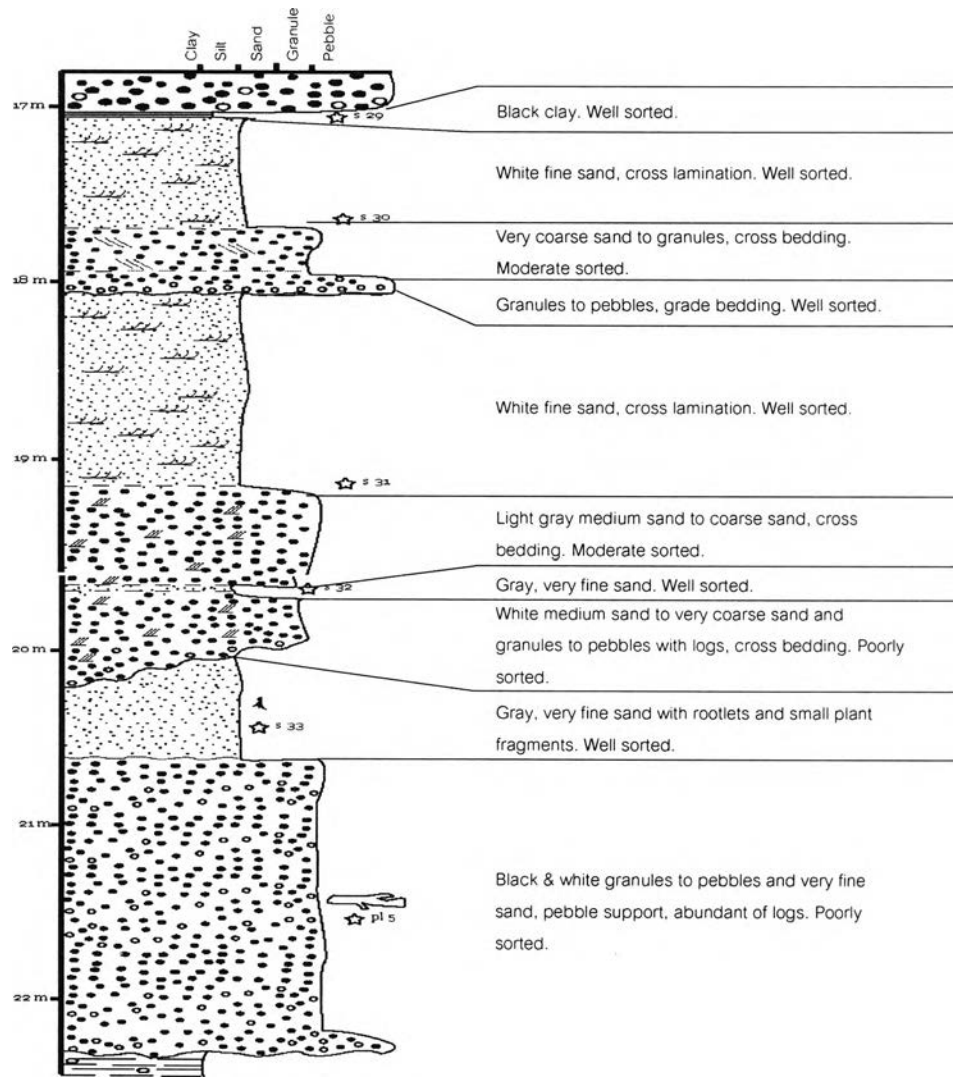


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Figure 7.3 Stratigraphic column of Mong Korn sand pit in Ban Som, Tambol Tha

Chang, Chaloom Prakiet District, Nakhon Ratchasima Province (cont.).

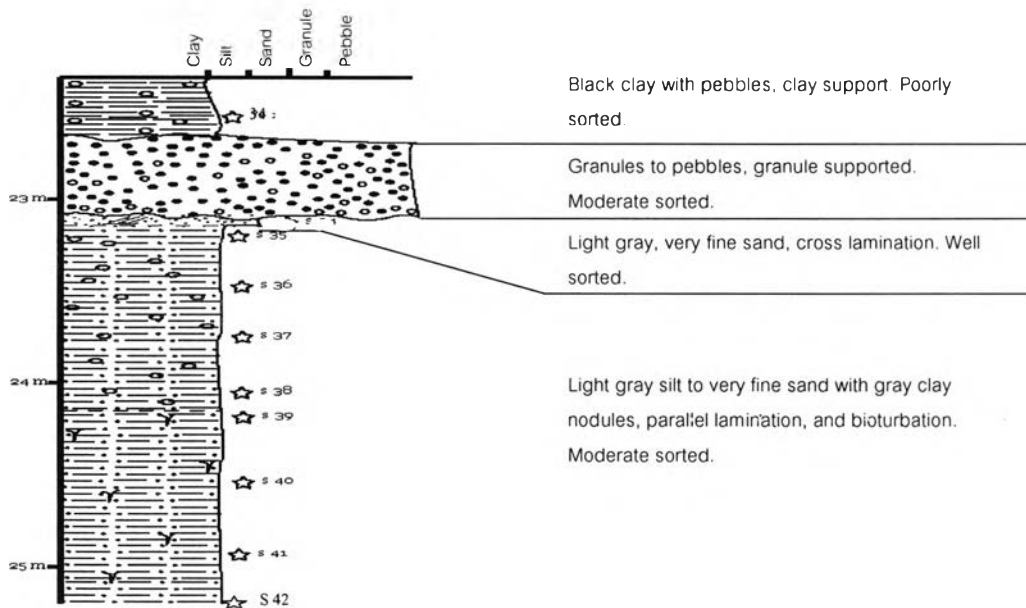


Legend

- | | | | |
|--|------------------------|--|-------------------------------|
| | mudstone | | trough cross lamination |
| | siltstone | | trough cross bedding |
| | fine-grain sandstone | | cross lamination |
| | medium-grain sandstone | | rootlet |
| | coarse-grain sandstone | | bamboo log |
| | conglomerates | | wood log |
| | | | burrow |
| | | | position and number of sample |

Figure 7.4 Stratigraphic column of Mong Korn sand pit in Ban Som, Tambol Tha

Chang, Chaloom Prakiet District, Nakhon Ratchasima Province (cont.).



Legend

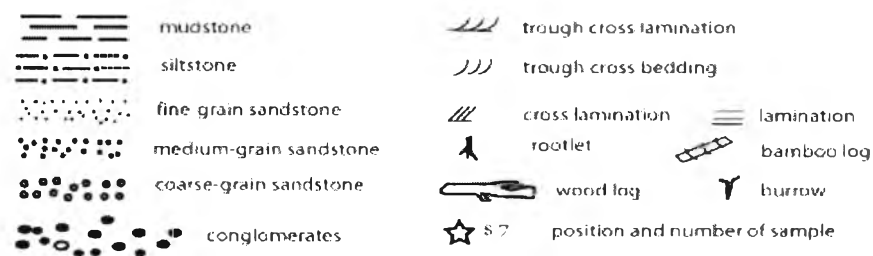


Figure 7.5 Stratigraphic column of Mong Korn sand pit in Ban Som, Tambol Tha

Chang, Chaloom Prakiet District, Nakhon Ratchasima Province.

2.4 Conclusion and discussion of geology

The lithostratigraphical study of fluvial system of Mong Korn sand pit can be classified into three units and six subunits, based on the evidences of hiatus, sedimentary components, sedimentary structures, depositional environments and logs. Accordingly, the depositional environment of this site can be determined as a meandering river system as outlined below (Fig.8).

Unit 1: Floodplain deposits, with structureless, and homogenous of clay.

Unit 2: Channel deposits, with gravelly component and logs.

Unit 3: Floodbasin deposits, with parallel lamination in very fine sand, clay nodules and bioturbation.

When comparing the stratigraphic column of this study with Sato's (2002) results, the following age of the sediment can be concluded (Fig. 9).

The unit 1 is cover the first and second horizons of Sato (2002), and he estimated the age of the second horizon as Holocene.

The unit 2 is correlate to the third, fourth and fifth horizon of Sato, and Sato estimate the age of the third horizon into early Pleistocene, and the fourth horizon into Pliocene and the fifth horizon into Miocene.

The unit 3 is deeper than the stratigraphic column of Sato.

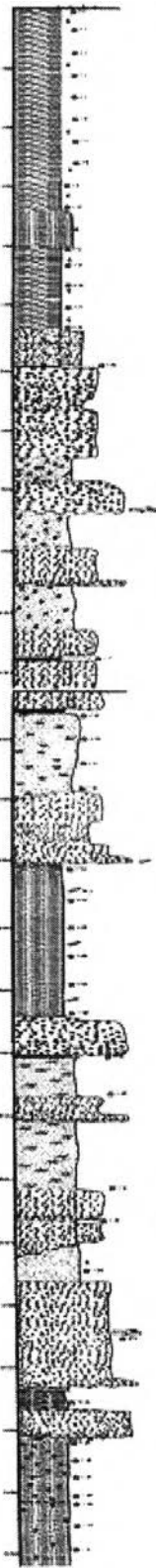
Depth (m)	Lithostratigraphic column	Contact boundary (hiatus)	Palaeoenvironment	
0			Unit 1. Floodplain deposits	
5		Sharp contact	Subunit 2.1	Unit 2. Channel deposits
		Erosional contact	Subunit 2.2	
10		Erosional contact	Subunit 2.3	
		Erosional contact	Subunit 2.4	
15		Irregular contact	Subunit 2.5	
		Irregular contact	Subunit 2.6	
20	Irregular contact	Subunit 2.6		
	Sharp contact		Unit 3. Floodbasin deposits	
25				

Figure 8 Lithostratigraphic column of Mong Korn sand pit.

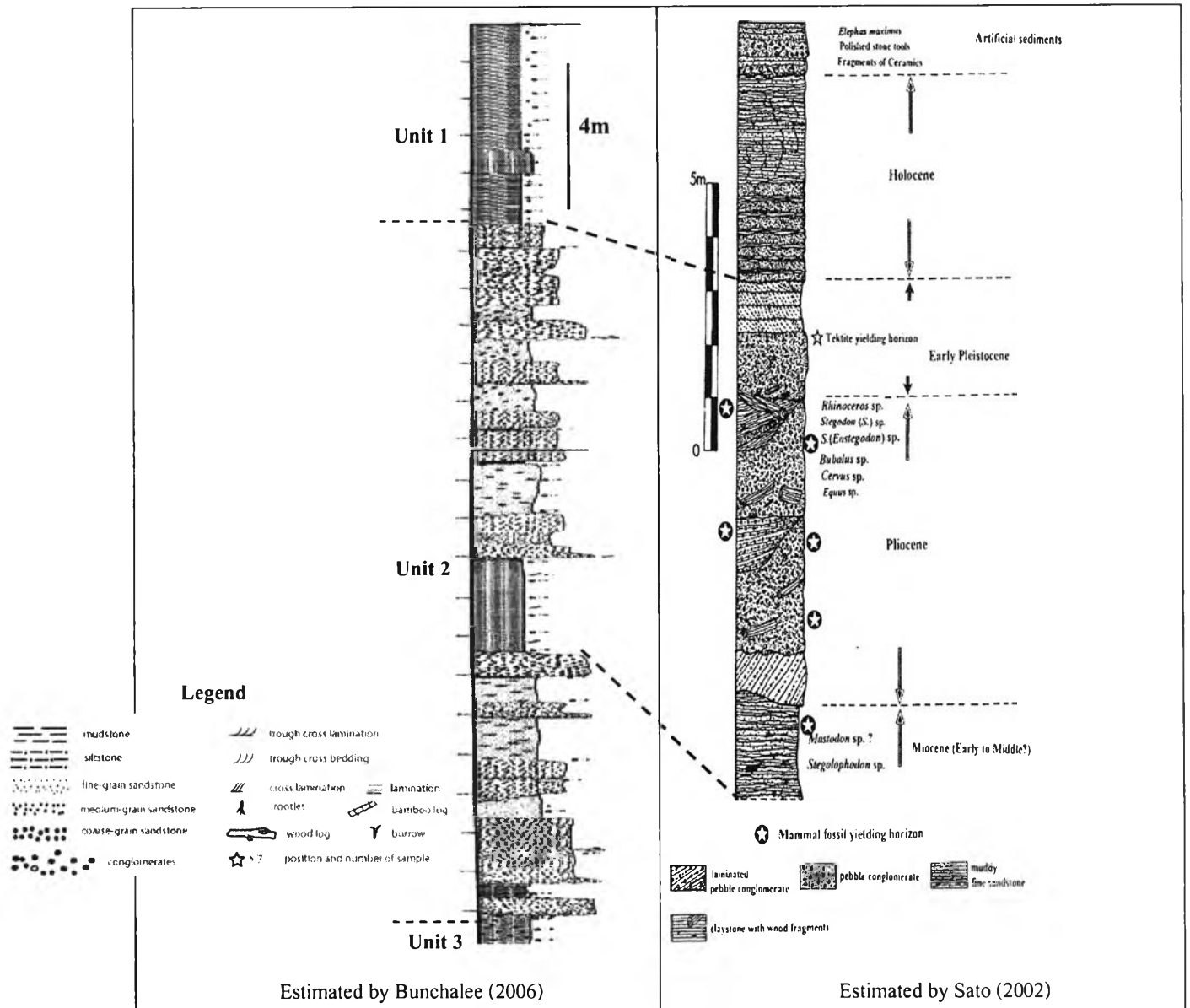


Figure 9 Lithostratigraphic correlation of Bunchalee (2006) and Sato (2002).