PALEONTOLOGY OF MOLLUSCAN ASSEMBLAGES FROM BANGKOK CLAY IN SAMUT PRAKAN, CENTRAL THAILAND

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บรรพชีวินวิทยาของกลุ่มหอยจากชั้นดินกรุงเทพ บริเวณจังหวัดสมุทรปราการ ภาคกลางประเทศไทย

นางสาววีรัชญาณ์ หันสัง

รายงานฉบับนี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาตรี
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(Dr. Yoshio Sato)

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Contents

Title (English)	:	PALEONTOLOGY OF MOLLUSCAN ASSEMBLAGES FROM BANGKOK CLAY IN SAMUT PRAKAN, CENTRAL THAILAND
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Abstract

In the Holocene, 6.3 ka, shallow marine deposits by the Jyoumonn Transgression are commonly found all over the world. In Thailand, the representative strata i.e. Bangkok clay in the central lowland can be correlated with Jyoumoun Transgression. Ban Phraek Sa Sand Pit in Samut Prakan, the study area yield abundant molluscan fossils were reported. But there were very few data on ecological analysis of molluscan fossils from the upper most past of Bangkok clay. In addition, only one ^{14}C-AMS datum was reported.

Accordingly, seven sample blocks of 25X25x40 cm were cut down perpendicular to the bedding plane. Total number of block is 7. Molluscan assemblage primary consist of Pelecypod. Total number of species is 41 and individuals are 700. At the result of paleoecological analysis of molluscan assemblages, *Veremolpa-Scapharca* Assemblage are recognized.

The results of ^{14}C-AMS analysis for of four molluscan fossils are 1175±28, 1204±28, 1276±29 and 1264±28 years. Whereas two plants yield an age of 3456±30 and 1395±28 years. Reconstructed environment is similar to the first stage of Transgression.

Keywords: Paleoecology, ^{14}C-AMS, Transgression, Assemblages

ชื่อโครงการ : บรรพชีวินวิทยาของกลุ่มหอยจากชั้นดินกรุงเทพ บริเวณจังหวัดสมุทรปราการ ภาคกลางประเทศไทย

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ปีการศึกษา : 2552

บทคัดย่อ

ในสมัยโฮโลซีน เมื่อ 6.3 ล้านปีก่อน มีสภาพแวดล้อมการสะสมตัวแบบทะเลน้ำตื้น ซึ่งการตกสะสมตัวของตะกอนเกิดจากการรุกเข้ามาของทะเล เรียกการรุกเข้ามาของน้ำทะเลในครั้งนี้ว่า Jyoumoun Transgression ซึ่งพบการตกสะสมตัวของตะกอนทั่วโลก สำหรับในประเทศไทยการตกสะสมตัวของชั้นตะกอนที่เกิดจากการรุกเข้ามาของน้ำทะเลนี้ พบการสะสมตัวในบริเวณชั้นดินกรุงเทพ ซึ่ง ณ บริเวณบ้านแพรกษา จังหวัดสมุทรปราการ มีรายงานว่าพบซากบรรพชีวินของกลุ่มหอย แต่รายงานเกี่ยวกับนิเวศวิทยาของกลุ่มหอยจากชั้นบนสุดของชั้นดินกรุงเทพ ยังมีรายงานการศึกษาอยู่น้อย

จากกลุ่มตัวอย่างทั้งหมด 7 กลุ่ม ซึ่งทำการขุดในแนวตั้งฉากกับระนาบพื้นดิน มีขนาด 25X25X40 เซนติเมตร หอยสองฝาเป็นชนิดที่พบมากที่สุด ซึ่งจากกลุ่มตัวอย่างทั้ง 7 กลุ่ม พบหอยจำนวน 41 ชนิด จำนวนหอยที่พบทั้งหมด 700 ตัวอย่าง และจากผลการวิเคราะห์ พบว่า หอย *Veremolpa-Scapharca* สามารถบอกสภาวะแวดล้อมในอดีตของบริเวณพื้นที่ศึกษาได้

จากผลการวิเคราะห์ด้วยวิธี ^{14}C-AMS สามารถหาอายุของซากบรรพชีวิน ได้อายุ 1175±28, 1204±28, 1276±29 and 1264±28 ปี และหาอายุของพืชได้อายุ 3456±30 และ 1395±28 ปี

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Lists of figures

Lists of tables

CHPTER I
INTRODUCTION

1.1 Theoretical Background

At Ban Phraek Sa Pit in Samut Prakan , central low land of Thailand, abandon well meserued molluscan fossils have been collected. But, taxonomical analysis of fauna has not been done yet and “Illustrated catalog” also not been published too. For the evidence of coastal erosion in the low tidal flat area on the west land of Chao Phaya river mouth and adjacent coast, as sedimentological and stratigraphical data (Somboon,1990)

Ban Phraek Sa Pit has been designated as the type locality of Quaternary stratigraphy in Bangkok area (Sinsakul, 2000). Sequence stratigraphical analysis of Quaternary sediment including Bangkok Clay also have been carried out by Saito et al.(2002) and Umitsu et al.(2002) at the stage of Jyoumon Transgression. Bangkok Clay decreases towards the plain margin as a as northern end of Ayutaya.

On the other hand, for the Quaternary Chronostratigraphy ^{14}C-AMS method is the best one and apply this method to the upper horizon of Bangkok Clay. Total samples consist of four kinds of shells containg various life habits and fragment of mangrove plants. And use the ^{14}C-AMS equipments at Nagoya University for determine geological age of upper part of Bangkok clay.

1.2 Literature Review

Robba *et al.* (1993) studied and reconstructed Paleoenvironment of the Holocene Bangkok Clay in the lower Central Plain. The study identified four fossils communities : 1)*Cuma lacera* Community, 2) *Nuculana (Saccella) puellata* Community, 3) *Mactra (Mactra)iliacea* Community, and 4) *Timoclea (Timoclea) scabra* Community. The paleobiological analysis demonstrated that the Bangkok Clay was deposited intertidally or at very shallow depths (not exceeding 8 – 10 m). Some strong influence of occurs in some levels.

Sato *et al.* (2000) studied Pleistocene and Holocene deposits of Bangkok coastal plain in Thailand are well observed in the open pits, that excavated about 50 m under the ground surface. One of these pits in Changwat Samut Prakan, southeaswt Bangkok, yields abundant molluscan fossils. By using block sampling and Paleoecological analysis of the fossil molluscan assemblages revealed that only one cycle of transgression and regression is recognized in the Holocene deposits. The transgression is characterized *by Veremolpa-Moerella* assemblage and the regression is characterized by *Cryptonatica-Paphia* assemblage. By the molluscan assemblages, paleoenvironments in the Late Pleistocene (45,620 yr. B. P.) are presumed as, intertidal, rock shore at the mouth of embayment influenced by fresh water.

Robba *et al.* (2002) studied the bivalves collected from the Holocene Bangkok Clay in the Lower Central Pain of Bangkok. The bivalve assemblages indicate intertidal and shallow infralittoral, predominantly muddy, substrates. Arcoidea, Galeommatoidea, Tellinoidea and Veneroidea are durellers occur abundantly. This paper covers 225 species, 35 species out of them are unidentified and, at least partly, previously undescribed. The species treated are complemented with taxonomic remarks and with informations on respective ecological requirements . Except for a few species represented only by fragmented shells, all are illustrated. A list of references to the mollusk fauna of the Indo-Pacific Region is also given in order to provide facilities to the reader.

1.3 Objective

1. To identify taxonomy of molluscan fossils in the study area
2. To determine geological age of the molluscan fossils using ^{14}C-AMS

1.4 Scope of work

To study taxonomy and paleoecological analysis of molluscan assemblage at Ban Phraek Sa Pit Changwat Samut Prakan Thailand, preparation of illustrated catalog and age determined by ^{14}C-AMS method.

1.5 Output

1. Taxonomy of molluscan fossils
2. Paleoecology of molluscan assemblages
3. Age of upper most of Bangkok clay
4. Catalog Illustrating

1.6 Methodology

1. Literature Review
    - Focused on previous works and relevant researchs on the geology and paleontology of study area such as characteristic of fossils and paleoenvironmental.
    - Collection of important data from literature review leading to research methodology and benefit for the study
2. Preparation of work plan
    - Designed scope of work , methodology, time schedule for preparation of next process such as field work ,collect samples and study in laboratory.
3. Field work and sample collection
    - Collect sample from 7 block samples, size of each block are 25x25x40 cm.
    - Cleanup samples by use water 3 week, separate fossils get out from soil and drying.
    - After drying process separate fossils and form into groups, identify the name of each species.
    - Collect 5 samples for determine geological age of upper part of Bangkok clay by used ^{14}C-AMS method at Nagoya University, samples consist four kinds of shells containg various life habits and fragment of mangrove plants 10 g., that which takes 10 days.

- Prepare a illustrated catalog

4. Discussion and conclusion

- When all processes complete gives results of taxonomy of molluscan fossils, paleoecological analysis of molluscan assemblages, geological age of upper part of Bangkok clay and illustrated catalog.
- Conclusion of all results for leading to presentation

5. Report writing and presentation

- In the final step the report is written and submitted to the Department.
- Prepared presentation seminar on senior projects of the department.

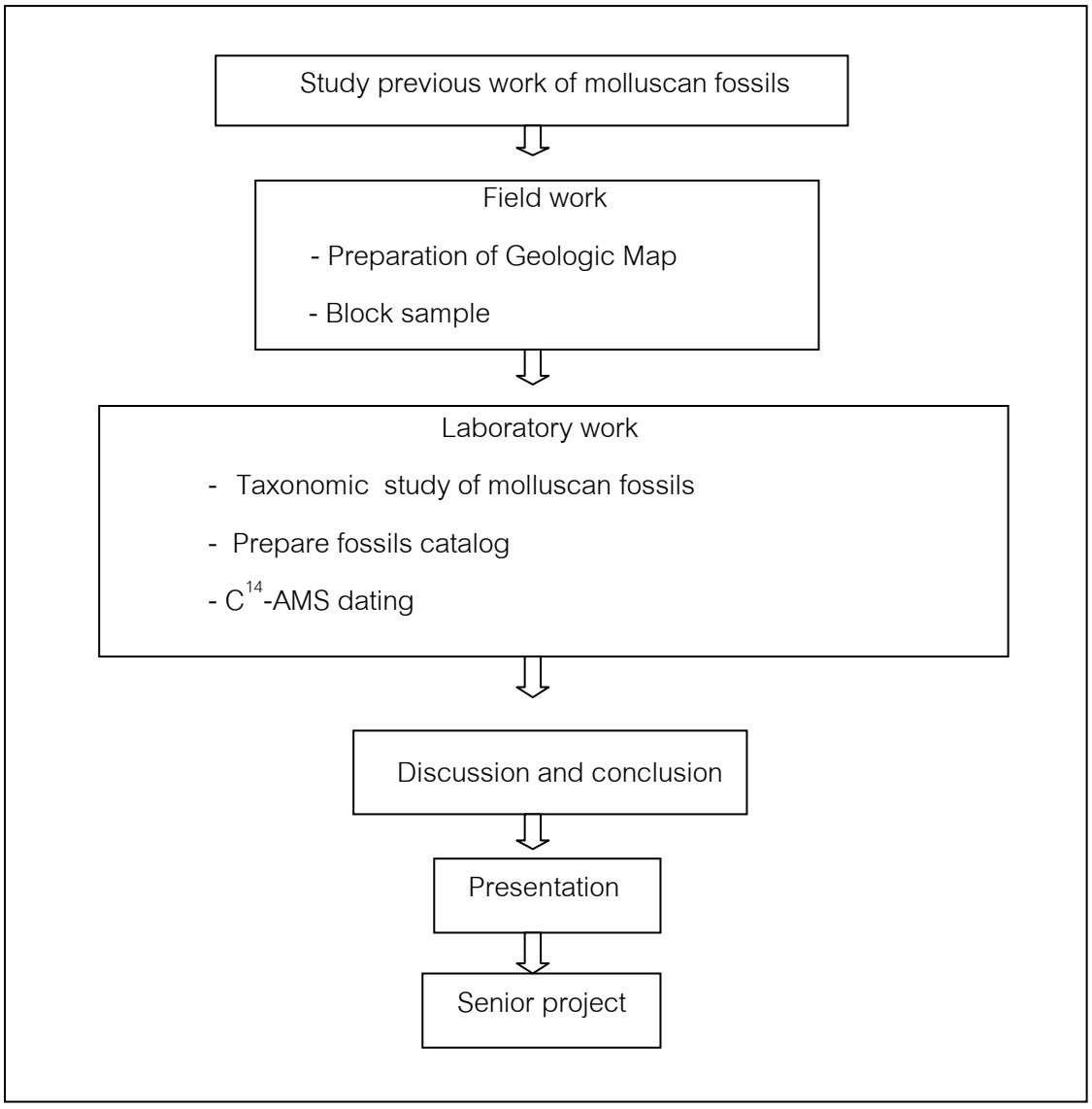


Figure 1.1 Flow chart showing the methods of the study

1.7 Study area

The study area is located around Ban Phraek Sa Pit, Changwat Samut Prakan, Central Thailand. (Figure 1.2 and 1.3) The locality is shown in the topographic map scale 1:50,000 of CHANGWAT SAMUT PRAKAN Series L7018 Sheet 5136 II. (Figure 1.3)

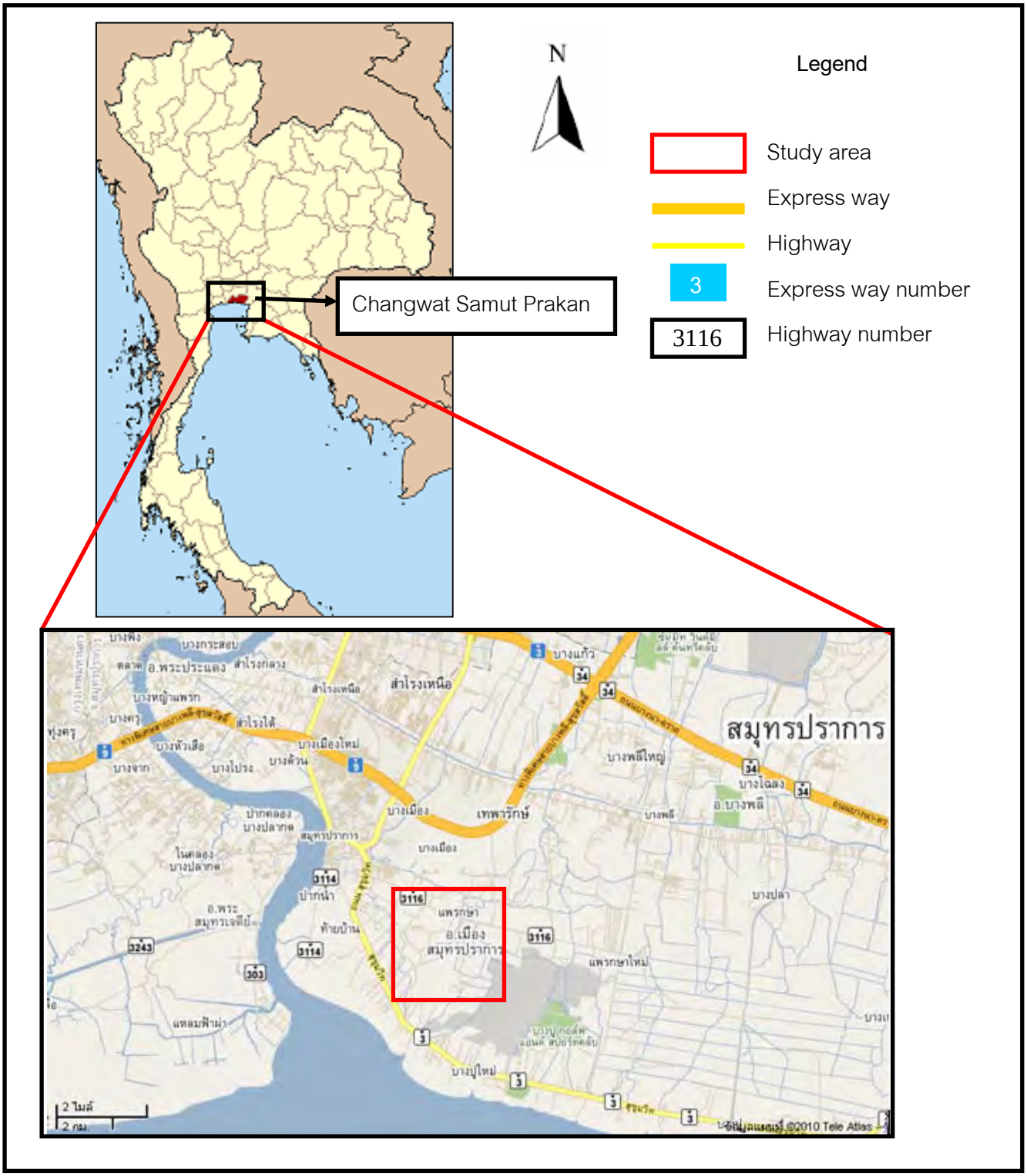


Figure 1.2 Location of study area in Ban Phraek Sa area, Amphoe Bang Pu, Changwat Samut Prakan (http://www.thailand-map-guide.com date of search 03/03/2010)

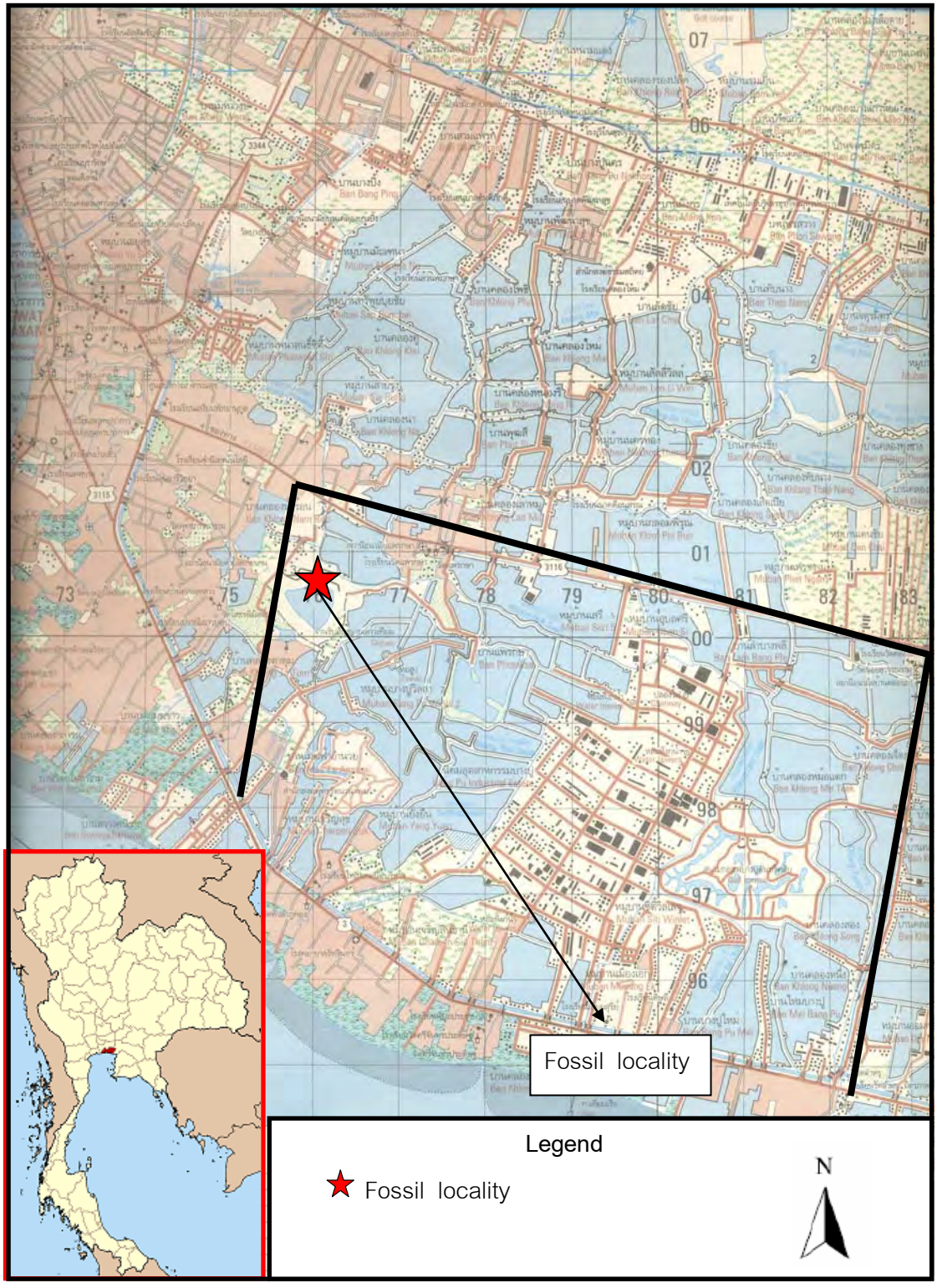


Figure 1.3 Location of study area in Ban Phraek Sa Pit, Changwat Samut Prakan.

Map 1:50,000 CHANGWAT SAMUT PRAKAN Series L7018 Sheet 5136 III

Accessibility

The investigated area can be accessed by the highway 3 (Thanon Sukumvit) from Bangkok to Samut Prakan and from Samut Prakan to Ban Phraek Sa about 3 kilometer by highway 3116

Figure 1.4 Accessibility of study area in Ban Phraek Sa Pit, Changwat Samut Prakan. Map 1:50,000 CHANGWAT SAMUT PRAKAN Series L7018 Sheet 5136 III

CHAPTER II

GEOLOGY AND BASIC KNOWLEDGE OF MOLLUSCAN

2.1 Quaternary geology of Central Thailand

2.2 Geology of study area

2.3 Basic knowledge of molluscan

Ban Phraek Sa area, Amphoe Bang Pu, Changwat Samut Prakan located at central of Thailand near Chao Phraya river. The study area in Ban Phraek Sa area about 42 km^2.

2.1 Quaternary geology of Central Thailand

The Quaternary period is the second out of two periods of the Cenozoic era in the geologic time scale of the International Commission on Stratigraphy. It follows after the Neogene period, spanning 2.588 +/- 0.005 million years ago to the present. The Quaternary includes two geologic epochs: the Pleistocene epochs (1.8 m. yr.B.P. – 10,000 yr.B.P.) and the Holocene epochs (10,000 yr.B.P.-present). The sediments are mainly semi-consolidated to unconsolidated. Basalt is only single volcanic rock that occurred in this period (Sinsakul *et al.,* 2002).

Sinsakul *et al.* (2002) studied the classification of Quaternary sediments in Thailand based on geomorphology, lithology, depositional environment and fossils. Quaternary sediments are both marine and non marine origins, that are usually found in the lowland areas, intermountain basins, broad valleys, flat top terrains, and coastal zone (Sinsakul et al. 2002).

Quaternary geologic sequences of the Central plain occurred on both rims and the plain itself. The rim of Central plain are the areas between mountain range and the plain. The central plain of Thailand is sloping southward and divided into Upper and Lower Central Plains. Sediments in the Upper Central plain are mainly alluvium and fluvial deposited resting on the bed rock. They composed of gravels, coarse sand, and clay. Usually these sediments are intercalated in layer, and some are in lenses. They are found as exposure and underlay the younger sediments that slope to the deep basin of Lower Central plain. The bed rock in upper Central plain is shallow, therefore the Quaternary sediment is thinner than the Lower Central plain sediments. The Lower Central Plain or Chao Phraya Basin begins at Chainat, where the Chao Phraya River folws southward through a flat and featureless plain, until it reaches the Gulf of Thailand at Samut Prakan province with the distance of about 200 kilometer. The Quaternary sediments are classified into Pleistocene and Holocene deposits.

Pleistocene deposit are mainly alluvium and fluvial, they are intercalation of gravels, sand, silt, and clay layer. The upper sequence is stiff clay with orange and red mottles. Iron and manganese concretions are also found scattered in clay matrix. In some area, there is laterite and lateritic soil occurred as upper sequence . These sediment indicate the oxidizing environment, and the barren to surface of the Pleistocene deposit, within the depth of 10-20 meters from the present ground surface.

Holocene sediments of the Lower Central plain was related with the sea-level change after the ice age of Late Pleistocene. The flat top terrain of the plain was affected by the transgression and regression of Holocene sea. Rapid sedimentary accumulation occurred in the area where the Chao Phraya River interacted with sea water causing deceleration of river flow and resulted in the deposition of sediment load which gave rise to the huge deltaic area so called Chao Phraya delta.

2.2 Geology of study area

The study area is located in Ban Phraek Sa area, Amphoe Bang Pu, Changwat Samut Prakan.

Morphology of study area including Artificial canal sediment, Artificial burial sediment, Artificial lake, Mangrove forest sediment, Samut Prakan beach sand sediment, Bangkok clay and Bangkok stiff clay.

Mainly locality of study area are Artificial burial sediment and Artificial lake. In locality of Artificial burial sediment now are factory area (Bang Pu Industrial Estate) and Artificial lake use for shrimp farm and fish farm. Bangkok stiff clay including fluvial sandstone and Samut Prakan beach sediment includind muddy sand.

Sato (2000) studied stratigraphy of the Chao Phaya delta consists of thick Pleistocene, thin Holocene and recent fluvial deposits (Satio *et al*. in 2002 and Umitsu *et al*. in 2002). The thickness of Holocene deposits, Bangkok Clay, decreases towards the plain margins as far as northern end of Ayutaya. General paleontological studies of Bangkok Clay had been done by Somboon (1990). But synecological analysis of fossils molluscan assemblages by the correct taxonomy has just begun (Sato, Saito and Suzuki in 2000). Holocene sediments dominate with marine clay which named Bangkok Clay in the Lower Central Plain. The sequence consist of clay, peaty clay and fine sand. The thickness of Bangkok Clay is about 14 meter.

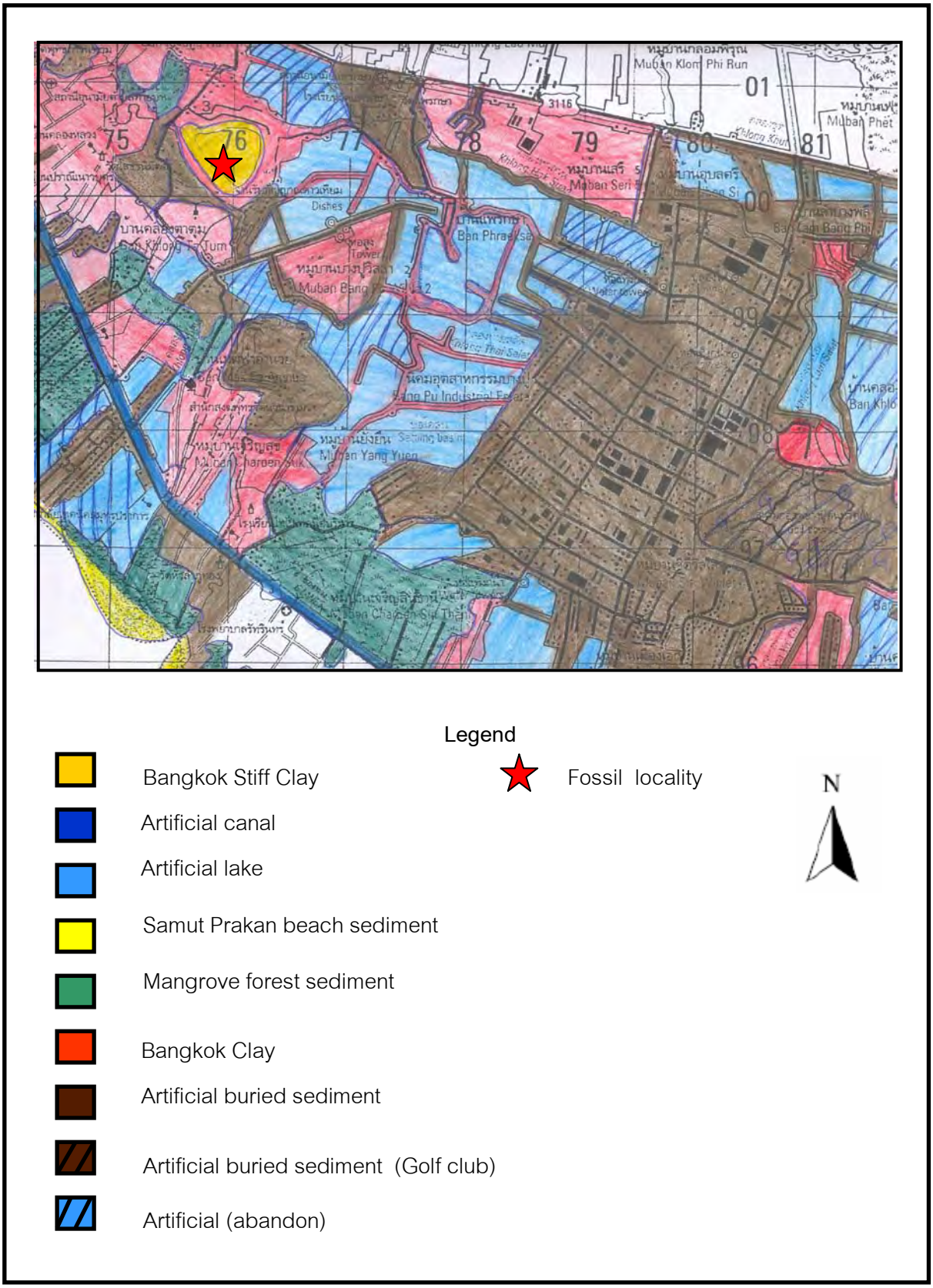
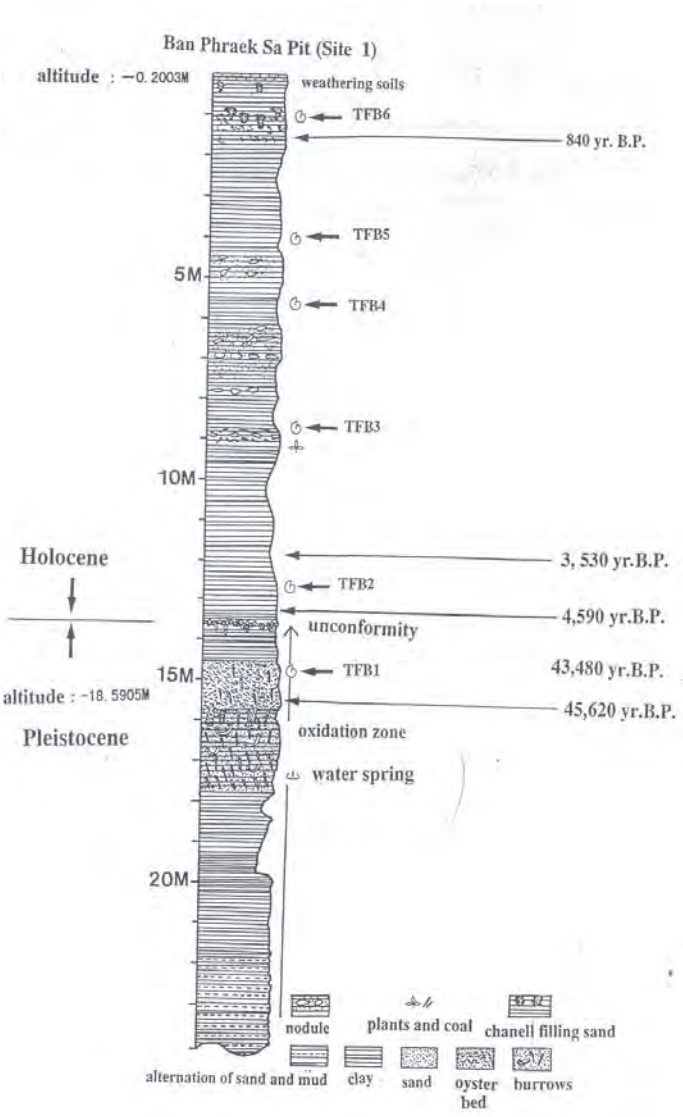


Figure 2.1 Geologic Map of Study area

map scale 1:50,000 of CHANGWAT SAMUT PRAKAN Series L7018 Sheet 5136 II



Sato, et al., (2000)

Figure 2.2 **Stratigraphy of Study area**

2.3 Basic knowledge of molluscan

Molluscs belong to the animal phylum Mollusca. There are around 93,000 recognized extant species, making it the largest marine phylum as it contains about 23% of named marine organisms. Representatives live in marine, freshwater, and terrestrial habitats. Molluscs are highly diverse in size, in anatomical structure, in behaviour and in habitat.

The phylum is typically divided into nine or ten taxonomic classes, of which two are extinct. The gastropods (snails and slugs) include by far the most classified species, accounting for 80% of the total. Cephalopod molluscs such as squid, cuttlefish and octopus are among the most neurologically advanced invertebrates. Either the giant squid or the colossal squid is the largest known invertebrate species. Molluscs have diverse body structures. The two most universal characteristics are a mantle with a significant cavity used for breathing and excretion, and the structure of the nervous system. As a result, many textbooks base their descriptions on a hypothetical "generalized mollusc", with features common to many, but not all species.

Diversity

About 80% of all known mollusc species are gastropods. There are about 93,000 named mollusc species, which include 23% of all named marine organisms. Molluscs are second only to arthropods in numbers of living animal species – far behind the arthropods' 1,113,000 but well ahead of chordates' 52,000. It has been estimated that there are about 200,000 living species in total, and 70,000 fossil species, although the total number of mollusc species that ever existed, whether or not preserved, must be many times greater than the number alive today.
(http://en.wikipedia.org/wiki/Mollusca date of search 03/03/2010)

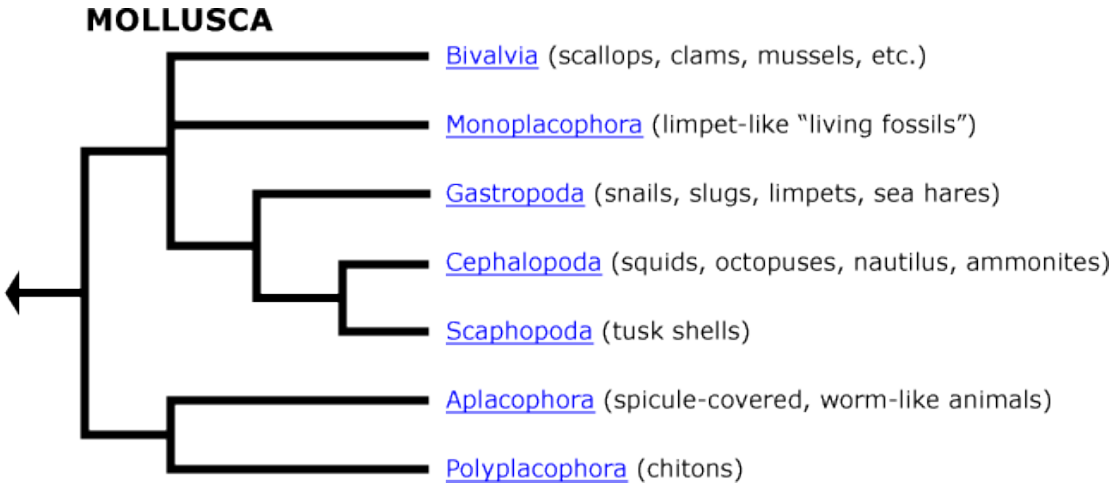


Figure 2.3 Mollusca systematic

(http://www.ucmp.berkeley.edu/taxa/inverts/mollusca/mollusca.php date of search 03/03/2010)

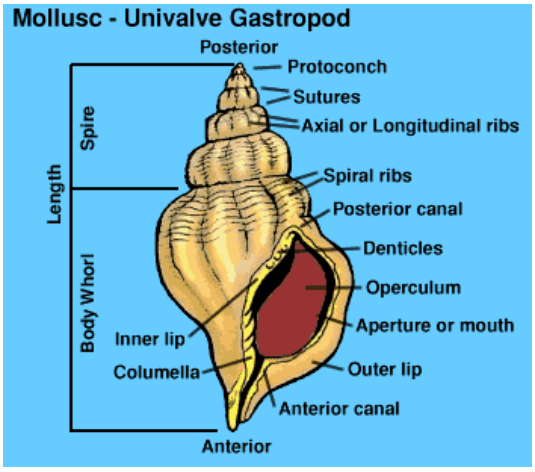


Figure 2.4 Content of Gastropod (www.jimwashkau.com date of search 03/03/2010)

CHAPTER III
METHODOLOGY, DATA ACQUISITION AND ANALYSIS

3.1 Field investigation and Sample collection

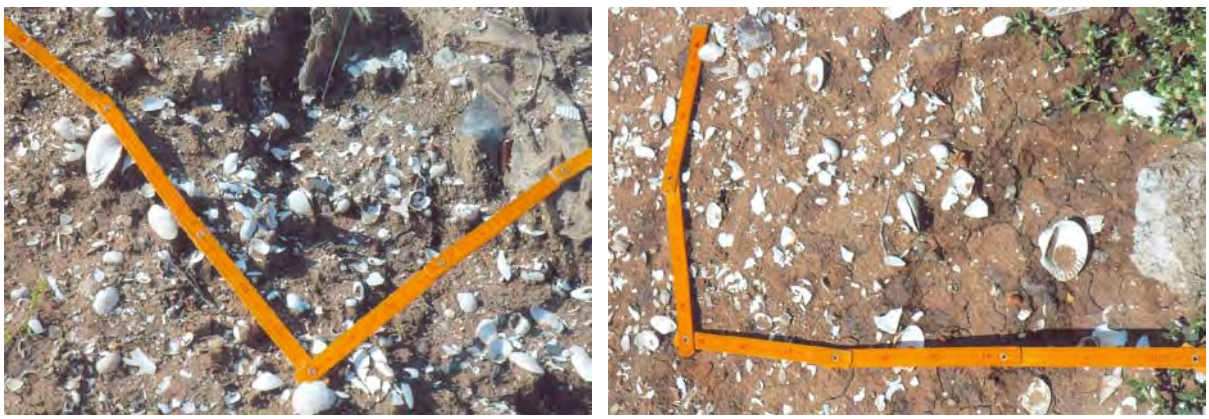
3.2 Geochemical preparation ^{14}C-AMS analysis

3.1 Field investigation and Sample collection

1. At Ban Ban Phraek Sa Pit, Changwat Samut Prakan, general geological data, and Samples were collected and Photograph.

Figure 3.1 Occurrence of molluscan fossils

Figure 3.2 Characteristics of study area



a b

Figure 3.3 a and b Characteristics of molluscan fossils in study area

2. Collect sample from 7 block samples, size of each block are 25x25x40 cm.

Figure 3.4 Sample block

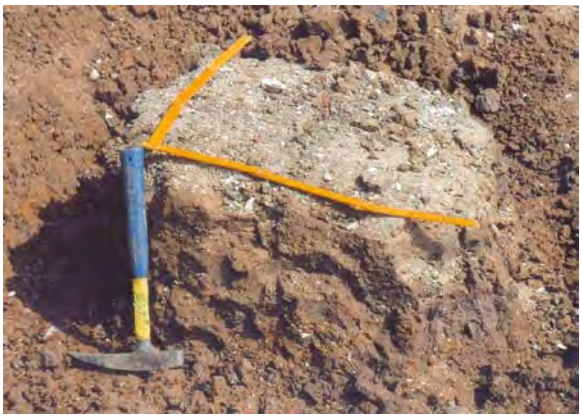


Figure3.5 Size of sample block are 25x25x40 cm

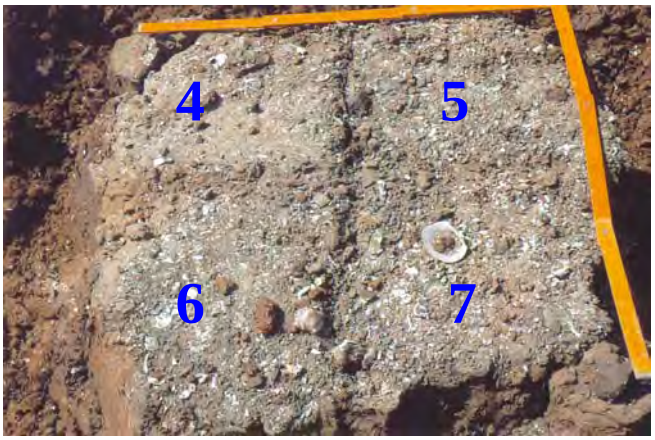


Figure 3.6 Sample block (4 block)

3. Cleanup samples by use water 3 week, separate fossils get out from soil and drying. After drying process separate fossils and form into groups, identify the name of each species.

Figure 3.7 After drying process, separate

Figure 3.8 Molluscan fossils in sample block 1

Figure 3.9 Molluscan fossils in sample block 2

Figure 3.10 Molluscan fossils in sample block 3

Figure 3.11 Molluscan fossils in sample block 4

Figure 3.12 Molluscan fossils in sample block 5

Figure 3.13 Molluscan fossils in sample block 6

Figure 3.14 Molluscan fossils in sample block 7

Figure 3.15 Identification molluscan fossils based on the Catalog in Japan

Figure 3.16 Books used for reference information (writer in Japanese)

3.2 Geochemical preparation ^{14}C-AMS analysis

In process of Geochemical preparation ^{14}C-AMS analysis including

3.2.1 Methodology of cleaning shells and plant samples

3.2.2 Methodology of standard sample preparation for shells and plant samples

3.2.3 Methodology of evacuated grass line process for shells samples

3.2.4 Methodology of evacuated grass line process for plants samples

3.2.5 Methodology for reduction of Iron process

3.2.6 Methodology of graphitization process

3.2.7 Methodology of target preparation for ^{14}C-AMS machine

First step collect 5 samples for determine geological age of upper part of Bangkok clay by used ^{14}C-AMS method at Tandetron Accelerator Laboratory Dating and materials Research Center, Nagoya University, Japan. Samples consist four kinds of shells containg various life habits and fragment of mangrove plants 10 g.

Material No.	Sample No.	Name	Site	Material
1	Block 1-1	*Balanus*	Ban Phraek Sa Pit	Shell
2	Block 1-2	*Euspira fortunei* (Reeve)	Ban Phraek Sa Pit	Shell
3	Block 3-1	*Siliqua pulehella* (Dunber)	Ban Phraek Sa Pit	Shell
4	Block 4	Plant (Mangrove)	Ban Phraek Sa Pit	Plant
5	Block 6-1	*Mya (Arenomya) arenaria oonogai* (Makiyama)	Ban Phraek Sa Pit	Shell

Table 3.1 List of samples that consist four kinds of shells and one fragment of mangrove

Figure 3.17 Samples that were selected for geochemical preparation ^{14}C-AMS analysis

3.2.1 Methodology of cleaning shells and plant samples

Shells samples

1. Broke shells samples and selected a part of sample for cleaning

Figure 3.18 Broke shell sample

Figure 3.19 Characteristics of shell sample after broke it

2. Cleaning shells samples with distilled water 100 ml. and wash them by ultrasonic cleaner wait 5 minutes 5 times and after that cleaning shells sample with Hydrochloric acid concentration 1.2 N wait 5 minutes

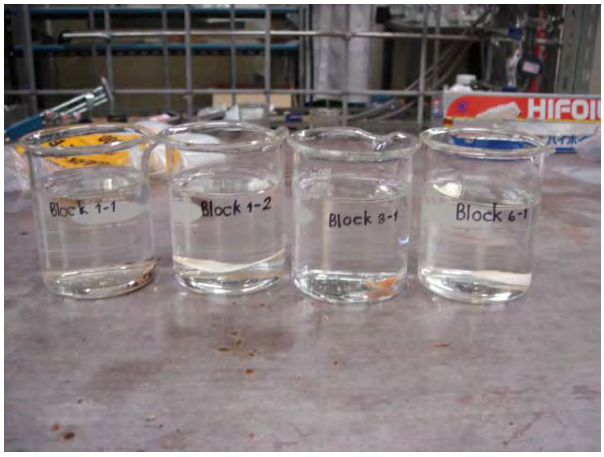


Figure 3.20 Put distilled water 100 ml. into breaker

Figure 3.21 After put distilled water wash them by ultrasonic cleaner

Figure 3.22 Change distilled water until distilled water did not change color (around 5 times)

Figure 3.23 After cleaning by ultrasonic cleaner put Hydrochloric acid concentration 1.2 N 100 ml into each breaker wait 5 minutes

3. After waiting 5 minutes remove Hydrochloric acid and cleaning shells samples with distilled water 10 times. After that put distilled water 100 ml. into breaker wait 1-2 minutes and then remove distilled water. Finally cover loosely top of breaker with Aluminum paper and bring shells samples into electric drying oven 1-2 hours.

Figure 3.24 Cover loosely top of breaker with aluminum paper

Figure 3.25 Bring shells samples into Electric drying oven wait 1-2 hours

Plant sample

Plant sample from block 4 can be divide 2 sample

Block 4-1 Plant sample from wood and Block 4-2 Plant sample from seed

Figure 3.26 Plant samples that divide into 2 breaker

1. Put distilled water 100 ml. into breaker of block 4-1 and block 4-2 wash them by ultrasonic cleaner and then cut plant sample from block 4-1 for made it easy when reaction process is happen

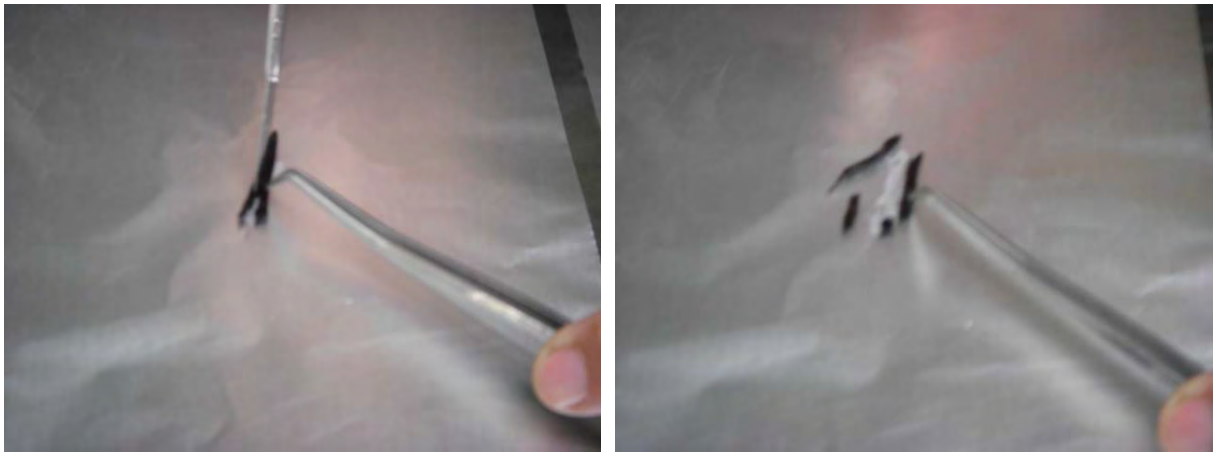


Figure 3.27 Cutting plant sample from block 4-1

2. Put Hydrochloric acid concentration 1.2 N 100 ml. into breaker of block 4-1 and 4-2. Finally bring them into heater machine temperature 70-80º c waiting this process 1-2 hours.

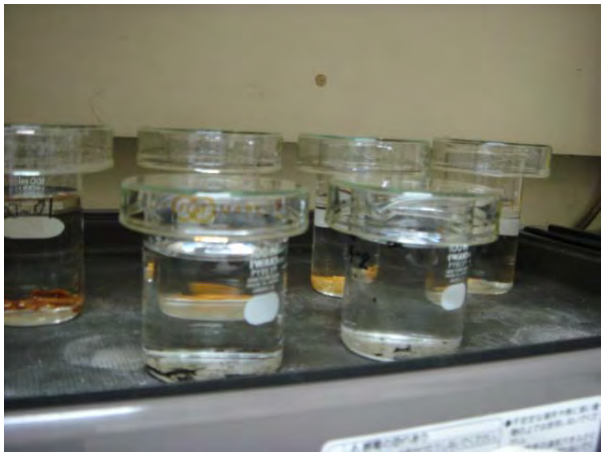


Figure 3.28 Plant samples from block 4-1 and 4-2 at heater machine

3. After waiting the color of Hydrochloric acid did not change color remove Hydrochloric acid and put Sodium Hydroxide solution concentration 1.2 N 100 ml. into breaker 4-1 and 4-2 and then bring them into heater machine 1-2 hours

4. After waiting the color of Sodium Hydroxide did not change color remove Sodium Hydroxide solution and then put distilled water into breaker of 4-1 and 4-2.

5. Check removing Hydrochloric acid from plant sample by using indicator. If put distilled water from breaker into indicator paper and indicator paper did not change color that can indicate removing of Hydrochloric acid are complete.

6.Remove distilled water and bring them into Electric drying oven temperature 90º c wait 3 hours.

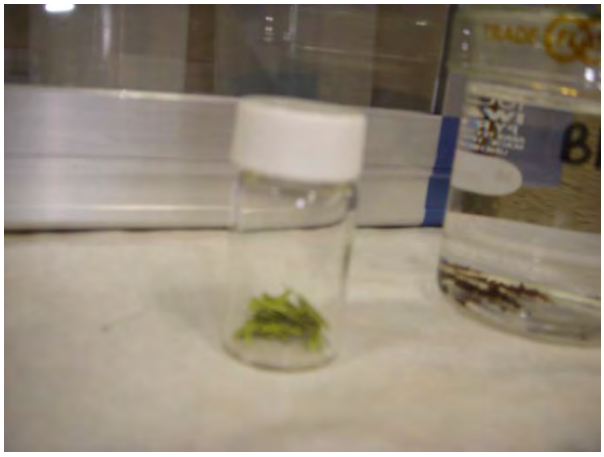


Figure 3.29 Indicator paper for test removing of Hydrochloric acid in plant sample

Figure3.30 After test can be indicate the removing of Hydrochloric acid is complete

Figure 3.31 Bring them into Electric drying oven temperature 90° c wait 3 hours.

3.2.2 Methodology of standard sample preparation for shells and plant samples

Shells samples

Make 4 standard sample preparation for shells samples

1. Clean equipments by Acetone acid and dry them by blower.
2. Weigh Copper Oxide around 500 mg. into weighing machine
3. Weigh Oxalic acid around 15 mg. into weighing machine
4. Put Oxalic acid into tube and then put Copper Oxide into tube together and cover bottom of tube by Aluminum paper
5. Melt a part of tubes by fire for made shape of tubes are curved.
6. Before cutting put Nitrogen fluid into Rotary Vacuum Pump and wait 3 hours for remove another gas within Rotary Vacuum Pump
7. After waiting 3 hours cut each tube by fire

8. After cutting write a number by diamond pen on surface of each tube and then bring tubes into heater machine temperature 400ºc wait 3 hours

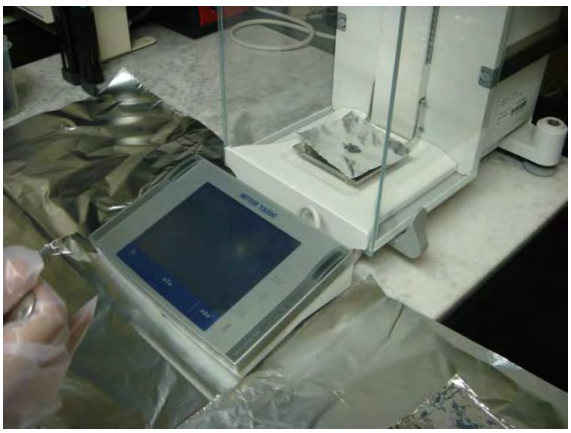


Figure 3.32 Weigh Copper Oxide around 500 mg.

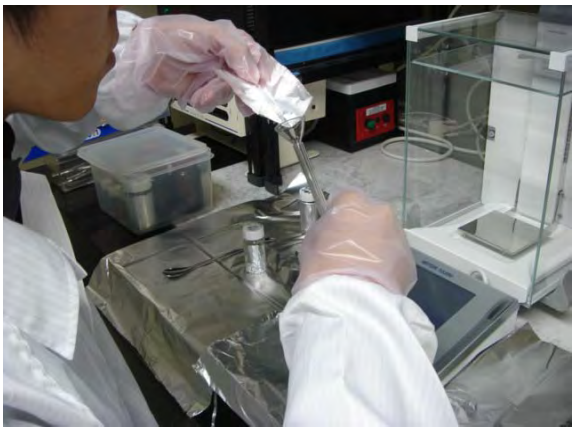


Figure 3.33 Put Copper Oxide and Oxalic acid into tube together

Figure 3.34 Melt tube for make it look like curved

Figure 3.35 Cutting by fire

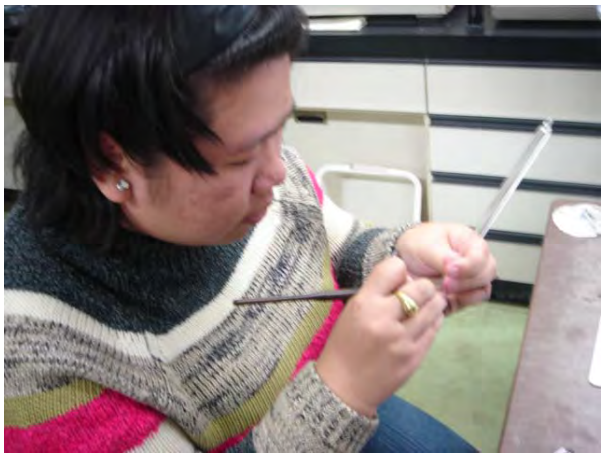


Figure 3.36 Write a number on surface of tube

Figure 3.37 Bring tubes into heater machine

No.	Standard sample No.	Weight of Copper Oxide	Weight of Oxalic acid
1	STD-1	512.22 mg.	14.86 mg.
2	STD-2	500.59 mg.	15.26 mg.
3	STD-3	502.74 mg.	16.08 mg.
4	STD-4	508.32 mg.	15.13 mg.

Table 3.2 Shows weight of Copper Oxide and Oxalic acid that using in standard sample preparation for shells samples

plant samples

Make 2 standard sample preparation for plant samples

1. Clean equipment by Acetone acid and dry it by blower before using
2. Weigh Copper Oxide around 500 mg. into weighing machine
3. Weigh plant samples around 6 mg. into weighing machine
4. Put both of Copper Oxide and plant samples into tube together and then cover bottom of tube by Aluminum paper
5. Melt a part of tubes by fire for made shape of tubes are curved.
6. Before cutting put Nitrogen fluid into Rotary Vacuum Pump and wait 3 hours for remove another gas within Rotary Vacuum Pump
7. After waiting 3 hours cut each tube by fire
8. After cutting write a number by diamond pen on surface of each tube and then bring tubes into heater machine temperature 850°c wait 3 hours

No.	Standard sample No.	Weight of Copper Oxide	Weight of Plant samples
1	STD 4-1	511.02 mg.	6.36 mg.
2	STD 4-2	500.27 mg.	6.21 mg.

Table 3.3 Shows weight of Copper Oxide and Plant samples that using in standard sample preparation for plant samples

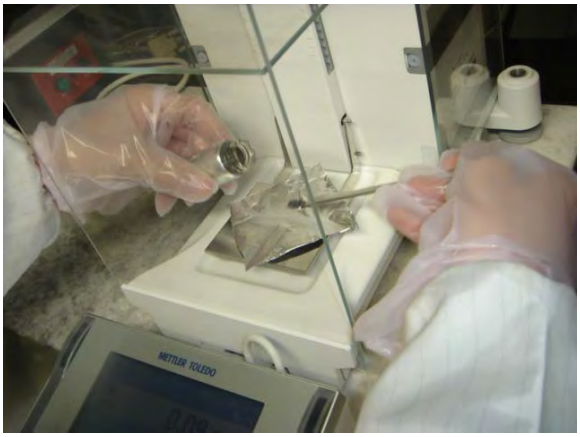


Figure 3.38 Weigh Copper Oxide

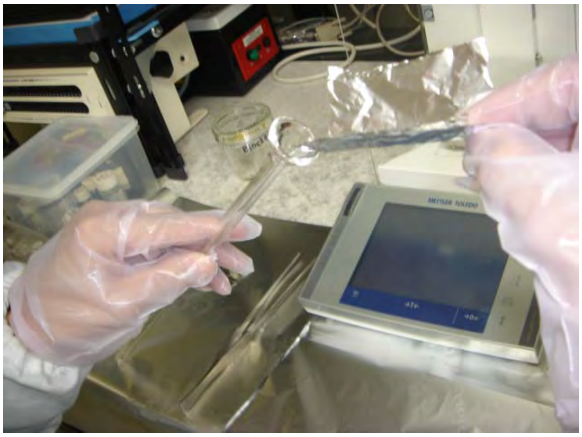


Figure 3.39 Put both of Copper Oxide and Plant sample into tube together

Figure 3.40 Connect tubes into Rotary Vacuum Pump and put Nitrogen fluid

Figure 3.41 After wait 3 hours cut tubes and bring tube into heater machine

3.2.3 Methodology of evacuated grass line process for shells samples

Make 4 shells samples preparation for evacuated grass line

1. Clean equipments by Acetone acid and dry them with blower
2. Broke shells sample by mortar, put them into breaker and cover top of breaker by Aluminum paper
3. Weigh shell sample around 30 mg. into weighing machine, put into tube and then cover bottom of tube by Aluminum paper
4. Use pipette for move Phosphoric acid 2 ml. and put it into tube
5. Using grease around area bottom of tube

6. Connect tubes into evacuated grass line and put Nitrogen fluid into evacuated grass line too after that open all button for remove another gas and air within evacuated grass line, finally wait 3 hours

Figure 3.42 Broke shells samples by mortar until particle is fine grains

Figure 3.43 After weight shells sample put them into tube

Figure 3.44 Use pipette for move Phosphoric acid 2 ml. and put it into tube

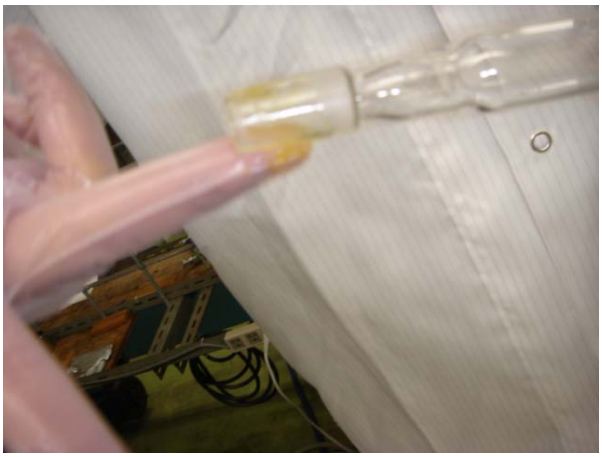


Figure 3.45 Using grease around area bottom of tube

Figure 3.46 Connect tubes into evacuated grass line

Shells samples No.	Weight of shells samples
Block 1-1	29.15 mg.
Block 1-2	30.90 mg.
Block 3-1	30.93 mg.
Block 6-1	29.29 mg.

Table 3.4 Shows weight of shells samples in shells samples preparation for evacuated grass line process

After remove another gas in evacuated grass line. Close button that connect with tube of shells and then rotate slowly tube of shell for mix shell sample and phosphoric acid together ,finally start process of evacuated grass line

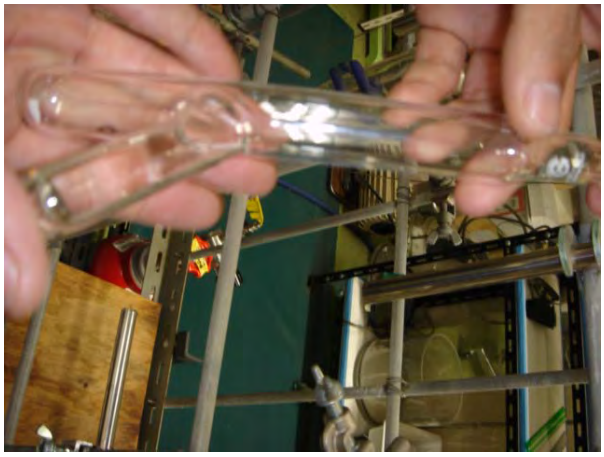


Figure 3.47 Rotate slowly tube of shell for mix

Figure 3.48 After mix it has reaction happen

Figure 3.49 Evacuated grass line

Equation for calculate amount of carbon in evacuated grass line

In evacuated grass line they have two part for using. They divide in left site and right site

Left site equation of evacuated grass line

$$C[mg] = 501.05 \times \frac{V_1 - V_0}{(273.2+T)}$$

Ratio of content of carbon in each tube 0.94 : 1

Right site equation of evacuated grass line

$$C[mg] = 850.76 \times \frac{V_1 - V_0}{(273.2+T)}$$

Ratio of content of carbon in each tube 1: 0.92

Calculate amount of total carbon in evacuated grass line from shell sample block 1-1

use evacuated grass line in left site

Shell sample block 1-1 (left site)

$$C[mg] = 501.05 \times \frac{V_1 - V_0}{(273.2+T)}$$

$$C[mg] = 501.05 \times \frac{(1.739 - 0.038)}{(273.2+17^{o}c)}$$

$$= 2.937$$

In process of evacuated grass line from shell sample block 1-1 can be divide content of carbon into 2 tubes and then will be calculate ratio of content of carbon in each tube

Ratio of content of carbon in each tube is 0.94 : 1

$$\frac{2.937}{1.94} = 1.514$$

$$2.937 - 1.514 = 1.423$$

Ratio of content of carbon in each tube is 1.423 : 1.514

Shell sample in block 1-1 has amount 29.15 mg.

Shell content	Ca	C	O_3
	40	12	16

Calculate amount of carbon atom from shell

$$\frac{12 \text{ X } 29.15}{100} = 3.498$$

Calculate percent of total carbon atom from block 1-1

$$\frac{2.937}{3.498} = 0.84$$

percent of total carbon atom from block 1-1 is 84%

(rate of good percent of total carbon atom around 90%)

Serial No.	Sample No.	Site	Material	Carbon content
1	Block1-1-1	Ban Phraek Sa Pit	Shell	1.51
2	Block1-1-2	Ban Phraek Sa Pit	Shell	1.42
3	Block 1-2-1	Ban Phraek Sa Pit	Shell	1.69
4	Block 1-2-2	Ban Phraek Sa Pit	Shell	1.55
5	Block 3-1-1	Ban Phraek Sa Pit	Shell	1.68
6	Block 3-1-2	Ban Phraek Sa Pit	Shell	1.55
7	Block 6-1-1	Ban Phraek Sa Pit	Shell	1.56
8	Block 6-1-2	Ban Phraek Sa Pit	Shell	1.46

Table 3.5 Shows value of carbon content from evacuated grass line process for shells samples

3.2.4 Methodology of evacuated grass line process for plants samples

Equation for calculate amount of carbon in evacuated grass line

In evacuated grass line they have two part for using. They divide in left site and right site

Left site equation of evacuated grass line

$$C[mg] = 501.05 \times \frac{V_1 - V_0}{(273.2+T)}$$

Ratio of content of carbon in each tube 0.94 : 1

Right site equation of evacuated grass line

$$C[mg] = 850.76 \times \frac{V_1 - V_0}{(273.2+T)}$$

Ratio of content of carbon in each tube 1: 0.92

Calculate amount of total carbon in evacuated grass line from plant sample block 4-1

use evacuated grass line in left site

Plant sample block 4-1 (left site)

$$C[mg] = 501.05 \times \frac{V_1 - V_0}{(273.2+T)}$$

$$C[mg] = 501.05 \times \frac{(2.037 - 0.042)}{(273.2+18.5^{o}c)}$$

$$= 3.427$$

In process of evacuated grass line from plant sample block 4-1 can be divide content of carbon into 2 tubes and then will be calculate ratio of content of carbon in each tube

Ratio of content of carbon in each tube is 0.94 : 1

$$\frac{3.427}{1.94} = 1.767$$

$$3.427 - 1.767 = 1.66$$

Ratio of content of carbon in each tube is 1.660 : 1.767

Calculate amount of total carbon in evacuated grass line from plant sample block 4-2

use evacuated grass line in right site

Plant sample block 4-2 (right site)

$$C[mg] = 850.76 \times \frac{V_1 - V_0}{(273.2+T)}$$

$$C[mg] = 850.76 \times \frac{(1.238 - 0.013)}{(273.2+18.5^{o}c)}$$

$$= 3.573$$

In process of evacuated grass line from plant sample block 4-2 can be divide content of carbon into 2 tubes and then will be calculate ratio of content of carbon in each tube

Ratio of content of carbon in each tube is 1 : 0.92

$$\frac{3.573}{1.92} = 1.861$$

$$3.573 - 1.861 = 1.712$$

Ratio of content of carbon in each tube is 1.861 : 1.712

Serial No.	Sample No.	Site	Material	Carbon content
1	Block 4-1-1	Ban Phraek Sa Pit	Plant	1.77
2	Block 4-1-2	Ban Phraek Sa Pit	Plant	1.66
3	Block 4-2-1	Ban Phraek Sa Pit	Plant	1.86
4	Block 4-2-2	Ban Phraek Sa Pit	Plant	1.71

Table 3. 6 Shows value of carbon content from evacuated grass line process for plants samples

Methodology of evacuated grass line process for standard samples

Equation for calculate amount of carbon in evacuated grass line

In evacuated grass line they have two part for using. They divide in left site and right site

Left site equation of evacuated grass line

$$C[mg] = 501.05 \times \frac{V_1 - V_0}{(273.2+T)}$$

Ratio of content of carbon in each tube 0.94 : 1

Right site equation of evacuated grass line

$$C[mg] = 850.76 \times \frac{V_1 - V_0}{(273.2+T)}$$

Ratio of content of carbon in each tube 1: 0.92

No.	Sample No.	Carbon content
1	STD 1-1	1.563
2	STD 1-2	1.437
3	STD 2-1	1.34
4	STD 2-2	1.45

Table 3.7 Shows value of carbon content from evacuated grass line process for standard samples

3.2.5 Methodology of sample preparation for reduction of Iron process

1. Put glass capsule at weighing machine and adapt weight of glass capsule in zero
2. Weigh Iron powder around 2 mg. at weighing machine and put them into glass capsule and weigh it
3. Put glass capsule into tube and then cover top of tube with Aluminum paper
4. Make sample preparation for reduction of Iron process in 8 sample

No.	Sample Name	Weight of Iron powder
1	Fe-1	2.08
2	Fe-2	2.14
3	Fe-3	1.92
4	Fe-4	1.93
5	Fe-5	2.15
6	Fe-6	2.12
7	Fe-7	2.03
8	Fe-8	1.92

Table 3.8 Shows weight of Iron powder in reduction of Iron process

Figure 3.50 Weigh glass capsule in weighing machine

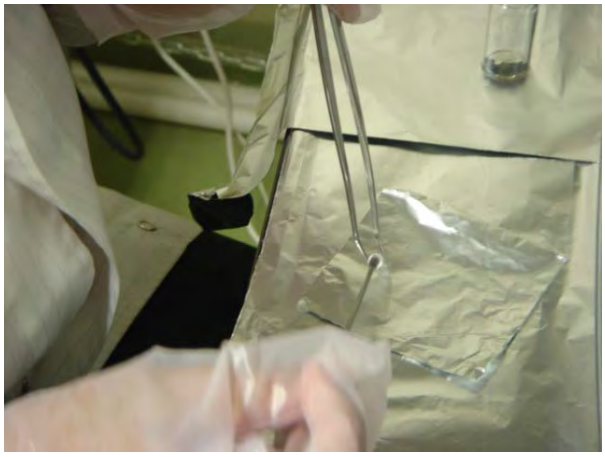


Figure 3.51 Put Iron powder into glass capsule around 2 mg.

Connect tubes that has Iron powder into Hydrogen grass line and then put Hydrogen gas into tubes then, finally bring tube to heat with machine temperature 450º c wait this process 1 hour

Figure 3.52 Connect tubes that has Iron powder into Hydrogen grass line

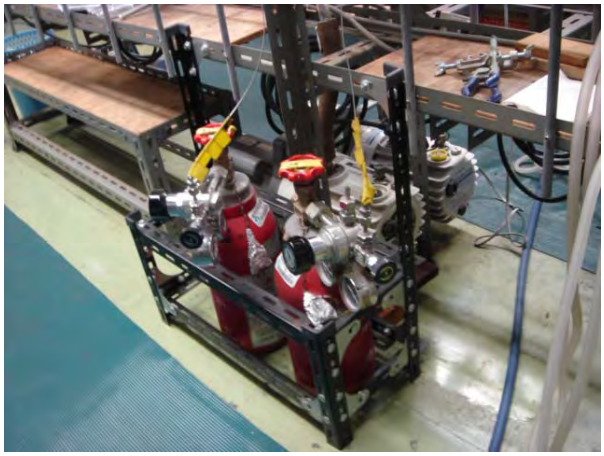


Figure 3.53 Put Hydrogen gas into tubes

Figure3.54 Heating machine for remove Oxygen gas

3.2.6 Methodology of graphitization process

1. Scrape on surface of sample tube with file and clean it by Acetone acid and then make it dry with blower
2. Connect samples tubes into graphitization grass line and check leaking
3. Put a glass of Nitrogen fluid at for trap carbon dioxide gas
4. Close button and then broke sample tube around joint wait 1 minute
5. Remove another gas without graphitization grass line
6. Remove a glass of Nitrogen fluid and then melt tube with heat
7. Close button and add Hydrogen gas into a tube
8. Use table of graphitization grass line for find a suitable position of tube for cutting
9. Cut a tube
10. Bring tubes that have content Iron powder, carbon dioxide and hydrogen gas within tubes to heat by heating machine with temperature 650º c wait 6 hours and then after wait 6 hours. Bring tubes to heat by machine for remove water wait 3 hours
11. Broke tubes and dry them by Electric drying oven temperature 90º c wait 24 hours.

Serial No.	Sample No.	Site	Material	Carbon content	Position of cutting	Presser (Pa)	Fe No.
1	Block1-1-1	Ban Phraek Sa Pit	Shell	1.51	25 cm.	4647.1	Fe-5
2	Block1-1-2	Ban Phraek Sa Pit	Shell	1.42			
3	Block 1-2-1	Ban Phraek Sa Pit	Shell	1.69	25 cm.	5111.8	Fe-6
4	Block 1-2-2	Ban Phraek Sa Pit	Shell	1.55			
5	Block 3-1-1	Ban Phraek Sa Pit	Shell	1.68	25 cm.	5111.8	Fe-7
6	Block 3-1-2	Ban Phraek Sa Pit	Shell	1.55			
7	Block 4-1-1	Ban Phraek Sa Pit	Plant	1.77	25 cm.	5731.5	Fe-2
8	Block 4-1-2	Ban Phraek Sa Pit	Plant	1.66			
9	Block 4-2-1	Ban Phraek Sa Pit	Plant	1.86	28 cm.	5117.4	Fe-1
10	Block 4-2-2	Ban Phraek Sa Pit	Plant	1.71			
11	Block 6-1-1	Ban Phraek Sa Pit	Shell	1.56	25 cm.	4802.0	Fe-8
12	Block 6-1-2	Ban Phraek Sa Pit	Shell	1.46			

Table 3.9 Shows position of cutting ,Presser and Fe No. from graphitization process

Figure 3.55 Graphitization grass line

Figure 3.56 Connect sample tube into graphitization grass line

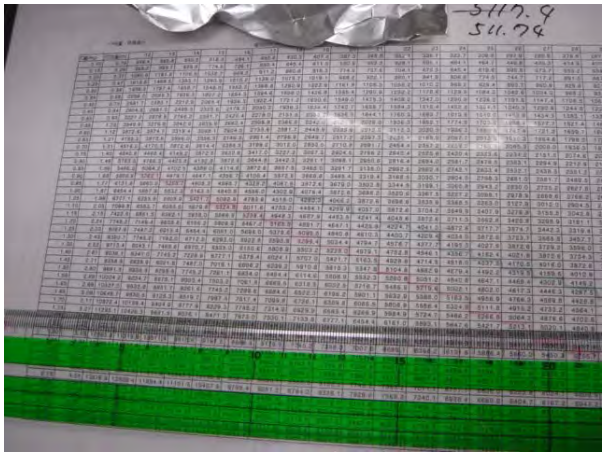


Figure 3.57 Table of graphitization grass line. Use it for find suitable position for cutting tube

Figure 3.58 After cutting bring tube to heat with temperature 650º c wait 6 hours

3.2.7 Methodology of target preparation for ^{14}C-AMS machine

1. Cleaning all equipment

a

b

Figure 3.59 a. Put all equipment into a glass of Acetone acid

b. Bring a glass to washing by ultrasonic cleaner

2. After washing dry them by blower and then put Aluminum on equipment

Figure 3.60 Equipment after cleaning

Figure 3.61 Put Aluminum on equipment

3. Put target on Aluminum, cover target and lock them with screw

Figure 3.62 Put target on Aluminum

Figure 3.63 Cover target and lock with screw

4. Put a cone in equipment and then cover them with Aluminum paper

Figure 3.64 Put a cone in equipment

Figure 3.65 Cover them with Aluminum paper

5. Bring grass capsule from graphitization tube of graphitization process and put them on Aluminum paper and then destroy them

Figure 3.66 Grass capsule from graphitization tube

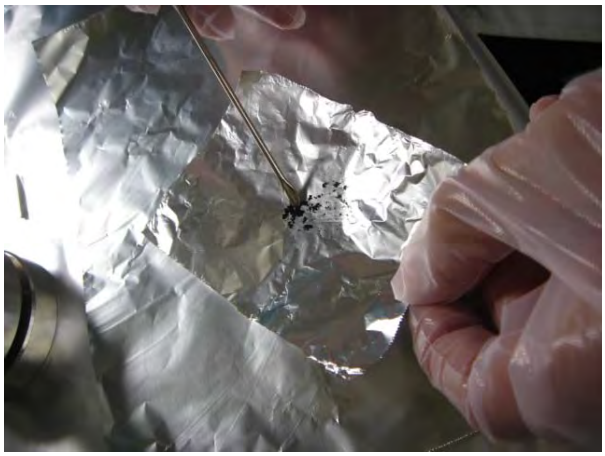


Figure 3.67 Put them on Aluminum paper and then destroy them

6. After destroy put them into equipment and put steel bars into equipment

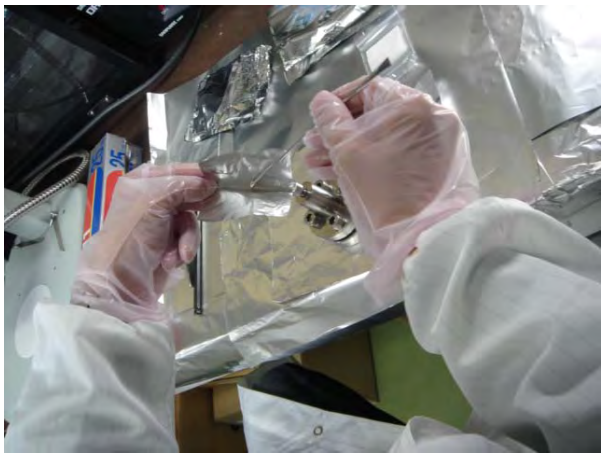


Figure 3.68 After destroy put them into equipment

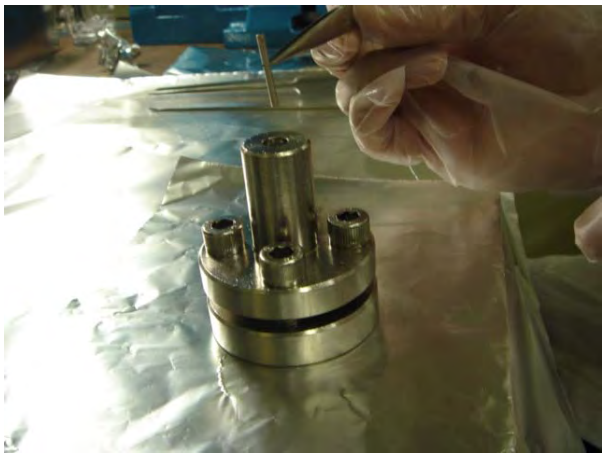


Figure 3.69 Put steel bars into equipment

7. bring them to press number machine after that shake of controlling handle until press number is value around 2

Figure 3.70 Shake of controlling handle until press number is value around 2

8. Separate equipment for bring target and then write a name on surface of target

Figure 3.71 Separate equipment

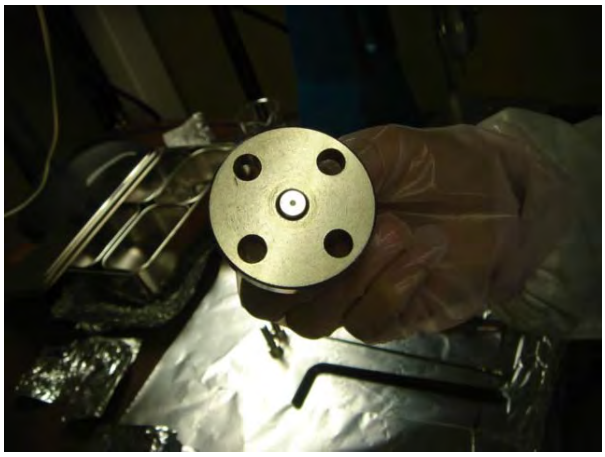


Figure3.72 Target after use press number machine

9. Bring target into dry keeper machine and wait after that bring target samples into ^{14}C-AMS machine for dating. After that wait this process in 3 days

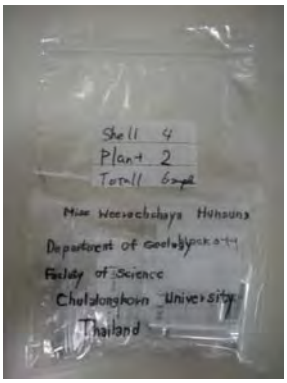


Figure 3.73 Bring target into dry keeper machine

a b c

Figure 3.74 a, b is ^{14}C-AMS machine and c is principle of ^{14}C-AMS machine

Serial No.	Sample No.	Site	Material	Carbon content	Fe weight	Press
1	Block1-1-1	Ban Phraek Sa Pit	Shell	1.51	2.15	2.152
2	Block1-1-2	Ban Phraek Sa Pit	Shell	1.42		
3	Block 1-2-1	Ban Phraek Sa Pit	Shell	1.69	2.12	2.012
4	Block 1-2-2	Ban Phraek Sa Pit	Shell	1.55		
5	Block 3-1-1	Ban Phraek Sa Pit	Shell	1.68	2.03	2.039
6	Block 3-1-2	Ban Phraek Sa Pit	Shell	1.55		
7	Block 4-1-1	Ban Phraek Sa Pit	Plant	1.77	2.14	2.081
8	Block 4-1-2	Ban Phraek Sa Pit	Plant	1.66		
9	Block 4-2-1	Ban Phraek Sa Pit	Plant	1.86	2.08	2.121
10	Block 4-2-2	Ban Phraek Sa Pit	Plant	1.71		
11	Block 6-1-1	Ban Phraek Sa Pit	Shell	1.56	1.92	2.072
12	Block 6-1-2	Ban Phraek Sa Pit	Shell	1.46		

Table 3.10 Shows value of Fe weight and press from target preparation for ^{14}C-AMS machine

CHAPTER IV
RESULT AND INTERPRETATION

4.1 Result

4.2 Interpretation

4.1 Result

The study area is located Ban Phraek Sa area, Amphoe Bang Pu, Changwat Samut Prakan. In the fieldwork seven sample blocks of 25X25x40 cm. were cut down perpendicular to the bedding plane.

In laboratory samples can separate and identify into 41 species and total samples are 700 sample. Geological age of the molluscan fossils by using ^{14}C-AMS method are 1175±28, 1204±28, 1276±29 and 1264±28 years. Whereas two plants yield an age of 3456±30 and 1395±28 years.

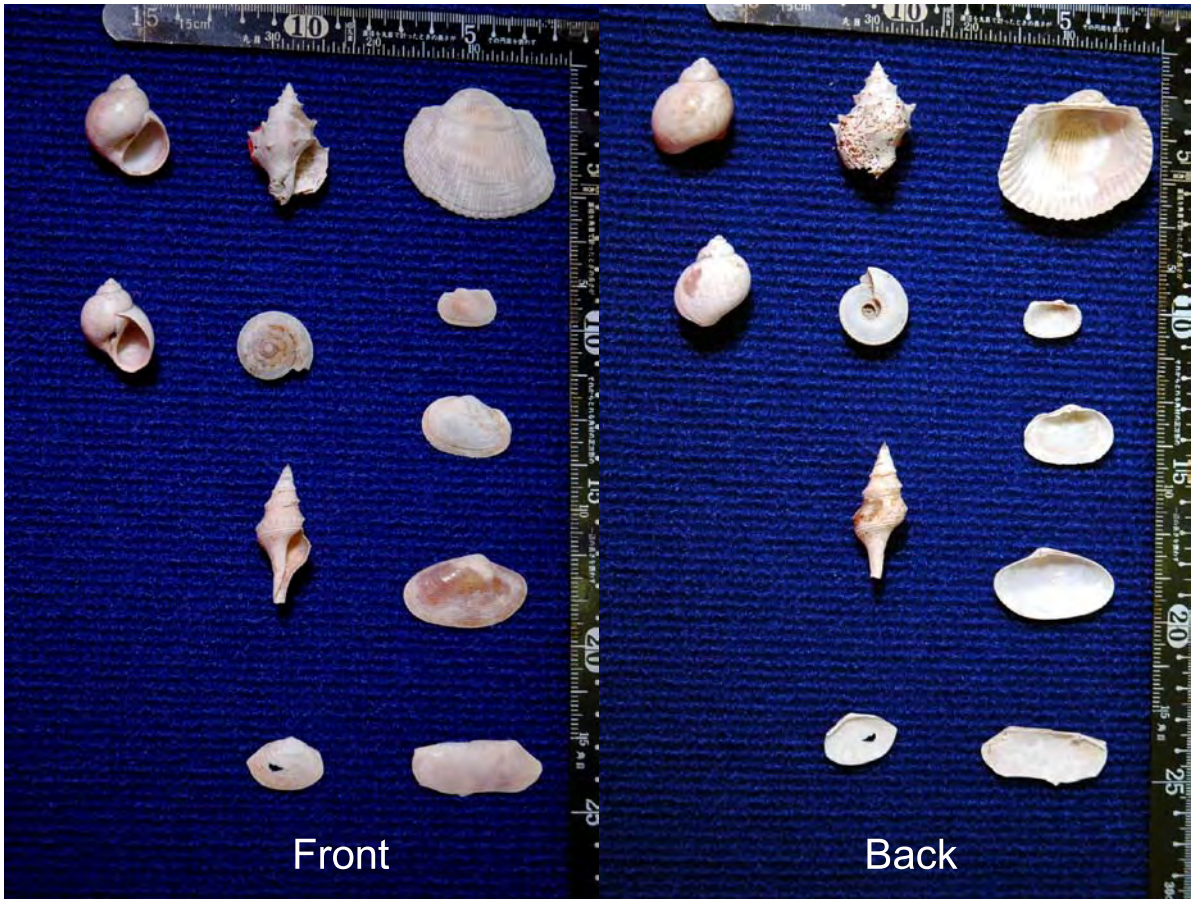


Figure 4.1 Characteristic of molluscan fossils in Ban Phraek Sa area

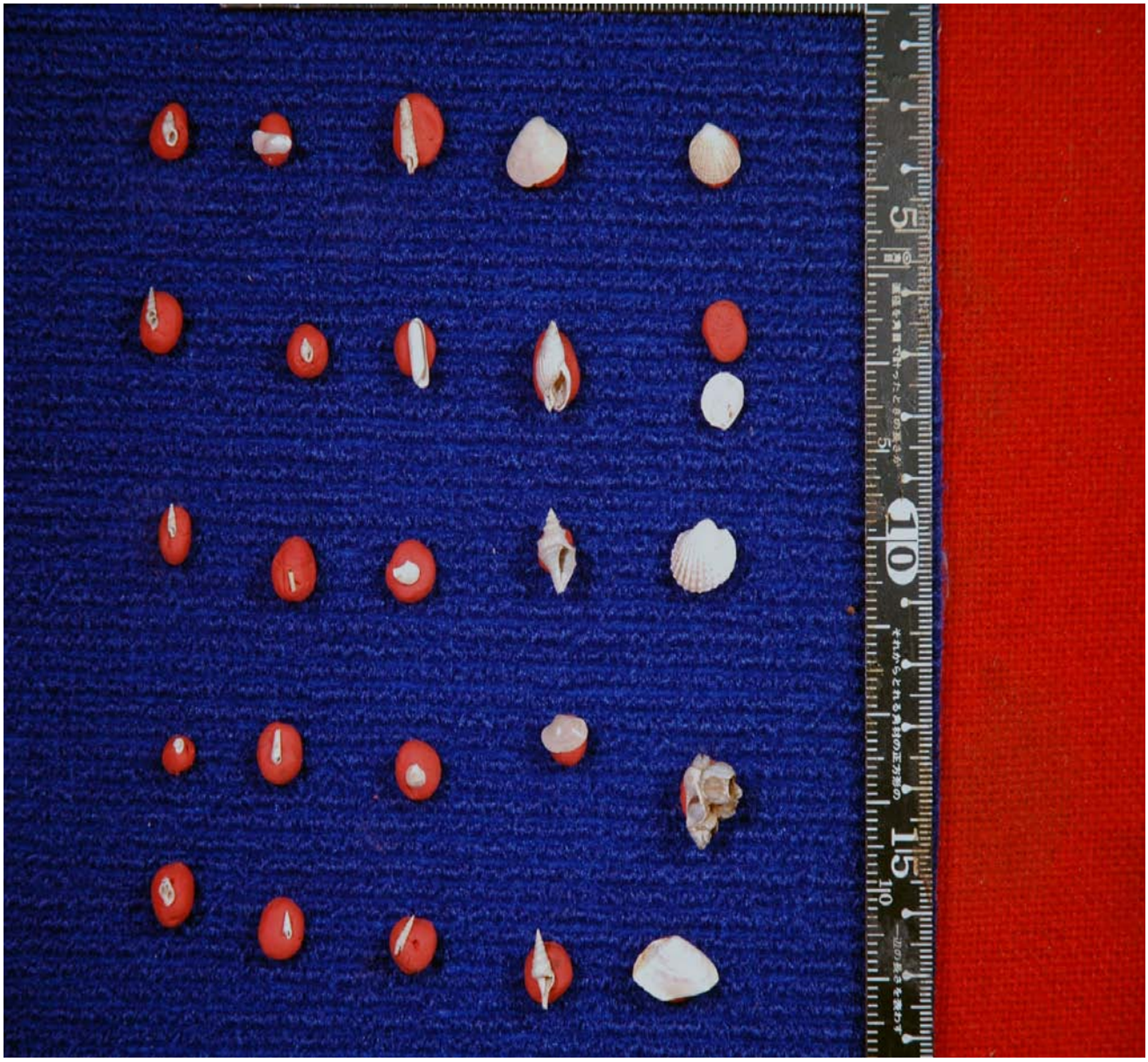


Figure 4.2Characteristic of molluscan fossils in Ban Phraek Sa area

Name	Table summary							
	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Total
1.Rapana spaff R. Wnosa (Valenciennes)	1	1	2	2	1			7
2.Veremolpa micra (Pilsbry)	39	6	12	39	20	25	6	147
3.Diluvarca ferruginca (Reeve)	11	6	31	33	15	12	7	115
4.Scapharca gloliosa ursus (Talnaka)	6	5	9			2	3	25
5.Cinguloterebra serptina (Adamb et Reue)	7	2	12	2	8	10	3	4
6. Mya (Arenomya) arenaria oonogai (Makiyama)	10	6	9	25	5	29	6	90
7.Siliqua pulehella (Dunber)	1	1	1	1		1	2	7
8.Ringicula (Ringicuella) *doliaris Gould*	7	1	3		4	9	2	26
9.Euspira fortunei (Reeve)	7	4	2		12	7	1	33
10.Melanoides tuberculata (Muller)	18	4		4		3		29
11.Hastula matheroniana (Deshayes)	9	3		5		5		22
12.Nuculana mauritiana (Sowerby)	9			18	2	10		39
13.Turricula javana (Linnaeus)	9			6		3		18
14.Tegillarca granosa (Linnaeus)	1		1		1			3
15.Zeuxis concinnus (Powys)	1		3	3	3	2	1	13
16.Amaea acuminate (Sowerby II)	1			2		1		4
17.Tellina inflate (Gmelin)	1							1
18.Mactra cumingii (Dunker)	1							1
19.Architectonica perspective (Linnaeus)	1							1
20.Fuspira fortunei (Reeve)				12				12
21.Homalopoma sangarense (Fischer von Waldheim)				1				1
22.Faunus ater (Linnaeus)		1		1	1			3
23.Cryptospira ventricosa (Fischer von Waldheim)				13				13
24.Nassarius siquijorensis (A. Adams)				1				1
25.Thais lacera (Von Born)		2				3		5
26.Telescopium telescopium (Linneaus)						1		1
27.Cycladicama luciniformis (Valenciennes)						1		1
28.Tellina casta (Hanley)						2		2
29.Vexillum curviliratum (Sowerby II)						1		1
30. Mactrinula angulifera (Reeve)		1						1
31.Moerella sp. Cf. M. iridescens (Benson)			1					1

Name	Table summary							
	Block1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Total
32.Fulirla hungerforde (Sowealag)			1					1
33.Mactra Luzonica (Reeve)			2					2
34.Tellina lanceolata (Gemlin)					1			1
35.Cylichna modesta					1			1
36. Dentalium aprinum (Linnaeus)					6			6
37.Parthenia affectuosa					2			2
38.Eulima sp.1					2			2
39. Modiolus micropteris (Deshayes)					1			1
40.Vitrinella sp.							1	1
41. Balanus	2							2
Total								700

Table 4.1 List of species molluscan fossils

Serial No.	Sample No.	Site	Material	Description		
1	Block1-1-1	Ban Phraek Sa Pit	Shell	1.0	1175±28	NUTA2-14801
2	Block 1-2-1	Ban Phraek Sa Pit	Shell	-0.1	1240±28	NUTA2-14802
3	Block 3-1-1	Ban Phraek Sa Pit	Shell	0.4	1276±29	NUTA2-14803
4	Block 4-1-1	Ban Phraek Sa Pit	Plant	-26.3	3456±30	NUTA2-14804
5	Block 4-2-1	Ban Phraek Sa Pit	Plant	-7.5	1395±28	NUTA2-14805
6	Block 6-1-1	Ban Phraek Sa Pit	Shell	2.0	1264±28	NUTA2-14808
				δ13C PDB	14C age	Laboratory No.
				(permil)	(BP)	

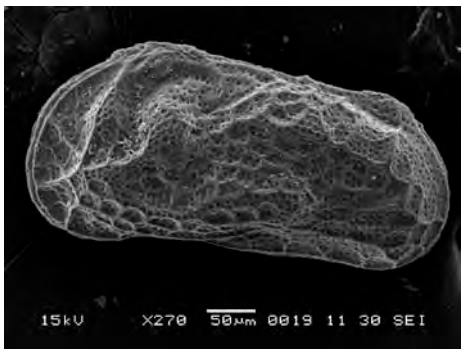
Table 4.2 Geologic age of molluscan fossils by using ^{14}C-AMS method

Discorbis sp

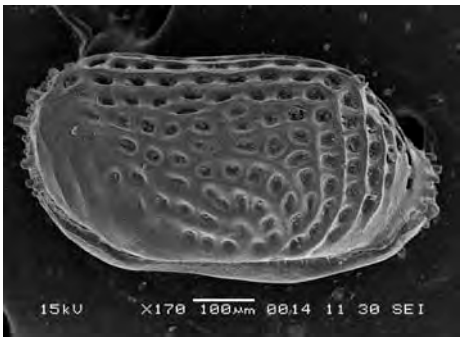
Kangarina sh. Cf. K delicata

Discorbis sp.

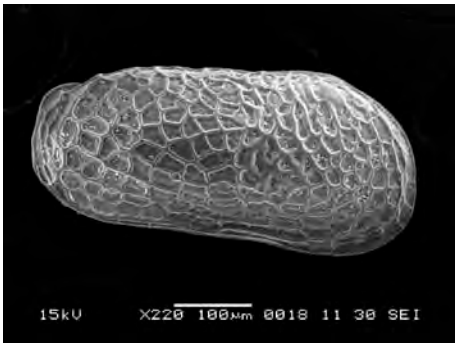
Leguminocythereis sp



Hiltermannicythere bassiounii

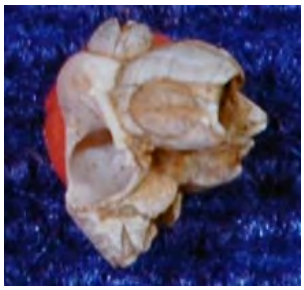


Limnocythere sp.



Hemikrithe orientalis

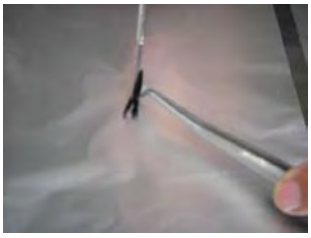
Figure 4.3 Foraminifera and Ostracoda in Ban Phraek Sa area



Balanus

*Mya (Arenomya) arenaria oonogai (*Makiyama*)*

*Euspira fortunei (*Reeve*)*



*Plant (*Mangrove*)*

*Siliqua pulehella (*Dunber*)*

Figure 4.4 Samples were collected to determine geological age of the molluscan fossils by using ^{14}C-AMS method

4.2 Interpretation

From identification from Ostracoda and Foraminifera can know the paleoenvironment are brackish water and from identification from molluscan can know each specie have different live position and sequence of living in the sea are follow :

Name	Position
1. *Balanus*	Living on surface of the sea
2. *Euspira fortunei (*Reeve*)*	Living in middle of the sea
3. *Siliqua pulehella (*Dunber*)*	Living on surface of mud
4. *Mya (Arenomya) arenaria oonogai (*Makiyama*)*	Living in mud

Table 4.3 Living position of molluscan fossils in the sea

CHAPTER V

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Discussion

1. Total number of block sample is 7 blocks. Molluscan assemblage primary consist of Pelecypod. From 7 blocks samples can identify molluscan fossils into 41 species and individuals are 700 samples. At the result of paleoecological analysis of molluscan assemblages, *Veremolpa-Scapharca* Assemblage are recognized.

2. From table 4.3 Balanus is a specie that live on the surface from identification can know the highest of sea level at study area is 2-3 meter. And paleoenvironment of study area is shallow marine.

3. From table 4.2 Geological age of the molluscan fossils by using ^{14}C-AMS method are 1175±28, 1204±28, 1276±29 and 1264±28 years. Whereas two plants yield an age of 3456±30 and 1395±28 years. In age of 3456±30 from plant it is error. Because in plant sample I divide them into 2 group including plant from seed and plant from wood error is from plant from seed that seed may transport from another place.

5.2 Conclusion

In study area at Ban Phraek Sa area, Amphoe Bang Pu, Changwat Samut Prakan. Total number of species is 41 and individuals are 700. *Veremolpa micra (Pilsbry)* is the most molluscan fossil that found in study area and from identification can know the paleoenvironment of study area is shallow marine in tidal zone and geologic age is upper most Holocene.

Shallow marine deposits by the Jyoumonn Transgression. In Thailand, the representative strata i.e. Bangkok clay in the central lowland can be correlated with Jyoumoun Transgression. Ban Phraek Sa Sand Pit in Samut Prakan. Reconstructed environment is similar to the first stage of Transgression.

5.3 Recommendation

For this project If has develop for next study should be study stratigraphy in study area or study comparison same species at different dept.

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Plates

Colour plates of species found in the area

1a-1b *Euspira fortunei*

2. *.Rapana spaff R. Wnosa*

3. *Scapharca gloliosa ursus*

4. *Architectonica perspective*

5. *Diluvarca ferruginca*

6. *Mya (Arenomya) arenaria oonogai*

7. *Turricula javana*

8. *Mactra cumingii*

9. *Tellina lanceolata*

10. *Siliqua pulehella*

11. *Nassarius siquijorensis* 12. *Modiolus micropteris* 13.*Cinguloterebra serptina*

14. *Cycladicama luciniformis* 15. *Veremolpa micra* 16. *Amaea acuminate*

17. *Ringicula* (Ringicuella) *doliaris Gould* 18. *Cylichna modesta*

19. *Zeuxis concinnus* 20. *Tellina casta* 21. *Vexillum curviliratum*

22. *Dentalium aprinum* 23. *Nuculana mauritiana* 24. *Thais lacera*

25. *Tegillarca granosa* 26. *Vitrinella sp.* 27. *Eulima sp.1*

28. *Tellina inflate* 29. *Mactra Luzonica* 30. *Balanus*

31. *Cryptospira ventricosa* 32. *Faunus ater* 33. *Hastula matheroniana*

34. *Telescopium telescopium* 35. *Mactrinula angulifera*