PALEONTOLOGY AND TAPHONOMY OF CRINOID LIMESTONE IN AMPHOE BUNGSAMPHAN, PHETCHABUN

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บรรพชีวิน และ กระบวนการเปลี่ยนแปลงจากสิ่งมีชีวิตจนกลายเป็นซากบรรพชีวิน ของ ลิลลี่ทะเล บริเวณอำเภอ บึงสามพัน จังหวัดเพชรบูรณ์

นางสาว ศศิอร เสนาะดี

รายงานฉบับนี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาตรี

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Thanks you for my friend that let me know about helping and sharing in the world

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Abstract

Crinoid limestones are founded in Amphoe Bungsamphan,Phetchabun,contain not only abundant crinoids stems and also they associate with coral building animals, Brachiopods, Mollusca, Rugosa, Ammonoids, Calcareous sponges and Bryozoas. The longest chain stem is 78 cm. At first, I prepared the geologic map and classified geomorphic surface in study area and making the stratigraphical relationship between limestone and tuff. And the occurrence of crinoids fossils can be described the paleoenvironment are reconstructed. Crinoid stems are scattered in the layer parallel to bedding plane. Crinoids fossils are almost chained stems. The surface abrasion of stem is common. Unfortunately, all most of calyx are separated and lost, only one specimen of calyx is identified. Totally, 4 horizons are discriminated. Size frequency analysis of Crinoids diameter and length has been carried .Maximum and minimum length of chained stem is 104.0 mm and 0.3 mm. Maximum and minimum diameter of chained stem is 39.9 and 0.5 mm. Crinoids was the first invader as suspension feeder to the community. If the bottom conditions too soft, Crinoids cannot stand to get the foods. At first, lapilli tuff may be the last stage. In the final stage all most of the animals of the communities had been broken out and transported by the stronger current stem.

ชื่อโครงการ บรรพชีวิน และ กระบวนการเปลี่ยนแปลงจากสิ่งมีชีวิตจนกลายเป็นซาก บรรพชีวินของลิลลี่ทะเล บริเวณ อำเภอบึงสามพัน จังหวัดเพชรบูรณ์

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บทคัดย่อ

เนื่องมาจากในการออกภาคสนามครั้งที่ 2 เราพบหินปูนที่เต็มไปด้วย เสต็มของไครนอยด์ อีกทั้งยังพบอยู่ร่วมกับ ปะการัง แบร็คคิโอพอด มอลลัสการ์ รูโกซา แอมโมนอยด์ แคลคาเรียส สปองค์ และ ไบรโอซัวร์ความยาวสูงสุดที่เคยพบคือ78 เซนติเมตร เราเริ่มต้นศึกษาโดยการเตรียมเกี่ยวกับ แผนที่ธรณีวิทยาเดิมที่ถูกจัดทำไว้แล้ว ธรณีสัณฐานเบื้องต้นในพื้นที่ศึกษา และ จัดทำลำดับชั้นหินเพื่อศึกษาความสัมพันธ์ระหว่าง หินปูน และ หินทัฟ อีกทั้งการปรากฏขึ้นของซากบรรพชีวินของไครนอยด์เช่นนี้ ยังอาจสามารถอธิบายเกี่ยวกับสภาวะแวดล้อมเดิม ว่าเกิดขึ้นและเป็นเช่นนี้ได้อย่างไร เสต็มของไครนอยด์นั้นแผ่กระจายทั่วไปในชั้นหิน และส่วนมากวางตัวขนานกันกับชั้นหิน ซากบรรพชีวินที่เราพบส่วนมากเป็นส่วนของเสต็มบริเวณพื้นที่ศึกษาด้านผิวบนพบเสต็มของไครนอยด์หลุดออกมาจากพื้นผิวของชั้นหินจำนวนมาก แต่เรากลับไม่พบส่วนที่เป็น แคลิกซ์ ของไครนอยด์เลย หากเราพบแคลิกซ์ เราจะสามารถบอกได้ว่าไครนอยด์นี้เป็นชนิดใด เราแบ่งพื้นที่ศึกษาออกเป็น 4 ชั้นเพื่อที่จะวัดหาความถี่ของ ขนาดเส้นผ่าศูนย์กลางและความยาวของไครนอยด์ ความยาวมากสุดที่เราพบนั้นคือ 104.0 มิลลิเมตร และ สั้นที่สุดคือ 0.3 มิลลิเมตร และเส้นผ่าศูนย์กลางที่มากที่สุดคือ 39.9 มิลลิเมตร และ น้อยที่สุดคือ 0.5 มิลลิเมตร ไครนอยด์นั้นถูกสันนิษฐานว่าเข้ามาอยู่เป็นพวกแรกๆที่เข้ามาอยู่บริเวณนี้ ถ้าบริเวณพื้นที่ยึดเกาะนิ่มเกินไป ไครนอยด์จะไม่สามารถยืน และ หาอาหารได้ เราจึงคาดเดาเบื้องต้นว่า ลาพิลลี่ทัฟ เป็นพื้นที่ยึดเกาะสุดท้าย และ ซากบรรพชีวินอื่นๆ ที่พบนั้นถูกขนถ่ายโดยคลื่นที่มีความแรงสูง จึงเกิดการแตกหักเป็นจำนวนมาก

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Chapter I

Introduction

During fieldwork 2, Crinoid limestones are founded in Study area 2 in Amphoe Bungsamphan, Phetchabun. It's containing abundant crinoid's stems and much type of fossils. And the occurrence of crinoids fossils can be described the paleoenvironment. The Crinoids, Encrinite or 'Sea Lily' is exclusively a marine animal. Though resembling a plant it is a member of the Phylum Echinodermata. Crinoids, also know in class Crinoidea of the echinoderms (phylum Echinodermata). They live both in shallow water Crinoids are characterized by a mouth on the top surface that is surrounded by feeding arms. They have a U-shaped gut, and their anus is located next to the mouth. and some thick limestone beds dating to the mid- to late-Paleozoic are almost entirely made up of disarticulated crinoid fragments.The Calyx: contains the vital organs of the animal. It is small when compared to the total mass, most of which is devoted to food collection. The mouth and anus are located on the upper surface of the body, and are connected by a simple gut. The Arms: composed of an articulated series of ossicles that are used in suspension feeding and respiration. The gonads are also located in the arms; fertilization takes place in open sea water during mass spawning. The Stem: this supports the animal and together with the roots and cirri served as a means of attachment to the sea bed or other useful substrate such as logs.

Literature review

Srithongdee, T. et al., (2009) the study area of area 2 is located in Amphoe Bung Sam Phan, Phetchabun Province. The total area is 147 kilometer square where is rather flat and consists of a few mountain there could be divided into 7 units of rock is Quaternary, conglomerate limestone, sandstone (lithic arkose), andesitic lava, rhyolotic tuff, andesitic tuff, limestone. Many fossils are founded in eastern of area. It's presented a fossil bed that has limestone interfingering with chert bed and crinoids bed has attitude of bedding 330/30.The thickness of this bed is 40 cm.

Mohamed El Tabakh et al., (1998) In Thailand, during the Permian, an extensive carbonate platform developed on the margin of the Indochina Plate and near to a coeval and deeper siliciclastic-dominated marine basin. This basin separated the Indochina Plate, to the east, from the Shan Thai Plate to the west. Sedimentation in the area of both platform (Pha Nok Khao Platform) and basin (Nam Duk Basin) was ended by a late Permian/early Triassic orogenic event that caused closure of the Palaeo-Tethys ocean. Tectonism has controlled the pattern of platform sedimentation and supplies of carbonate and clastic sediments into the basin area. The Pha Nok Khao Platform developed on an extensive distally steepened ramp-like margin along which carbonates and siliciclastics accumulated. Adjacent to this platform, to the west, the Nam Duk Basin received coeval hemipelagic siliciclastics and minor amounts of carbonates. Biostratigraphic evidence, based on foraminiferal assemblages, suggests an early to middle Permian age equivalence between platform and basin lithofacies. The platform strata are exposed along the Loei fold and thrust belt in northeast Thailand and basin strata are exposed within the Phetchabun fold and thrust belt in central Thailand, respectively. The two belts extend in a north–south direction and their rocks exhibit extensive karstification. On the basis of seismic data, platform lithologies extend further east in the subsurface, beneath the continental sediments of the Khorat Group into Kampuchea and Laos. Facies groups of the platform environments include restricted platform, platform interior, and outer platform. The facies groups of the basin environments include basin margin and basin plain. Minor layers of volcaniclastics and green coloured tuffites are interbedded with both the platform carbonate layers and basinal pelagic layers, suggesting active volcanism during sedimentation. The carbonate lithofacies of the shallow platform to the east (in the Loei Fold Belt) grade westward into turbidites (in the Phetchabun fold belt), and include shales and sandstones with minor carbonates. Farther to the west they pass into hemipelagic lithofacies of shale and carbonate. Lithologies and fauna of the limestones suggest tropical to subtropical climate during deposition

Wladyslaw Altermann (1991) Current ideas and models of geotectonic reconstructions of Southeast Asia are reviewed and new data on Late Carboniferous through Middle Permian tuffites and sills from central Thailand are presented in the light of the problems of Southeast Asian palaeogeography. The volcanic rocks of quartz-keratophyric to spilitic composition are associated with platform carbonates and deep basin sediments. Their geochemistry and the character of the accompanying sediments suggest the existence of a Late Palaeozoic volcanic arc separating a subduction zone in the west from a back arc basin to the east. The geotectonic frame of Southeast Asia is explained in terms of repeated accretion of volcanic arcs by the Late Palaeozoic subduction zone along the northern Tethys margin.

Simms (1994) presented an alternative phylogeny based on a greatly revised scheme of calyx plate homologies. Rather than the radial plates (the upper plates of an aboral cup, sensu Moore & Teichert, 1978) being homologous among all crinoids and the landmark for determining all calyx plate homologies, Simms (1994) proposed that the lowest plates in the aboral cup (the infrabasal plates of three-circlet forms but the basal plates of two-circlet forms) were homologous and the homology landmarks. This substantially altered more traditional views on crinoid phylogeny, as Simms (1994) illustrated using a cladogram with inferred synapomorphies. Few workers have followed Simms (1994).

Chapter II

Theory

Geology of Thailand

Tectonic model of Thailand by Bunopas(1981) and Bunopas and Vella(1983) was used as the framework in producing the metallogenic map of Thailand, since it best fits to the geology of Thailand, so far. They believe that Thailand is composed of 2 microcontinents, Shan-Thai and Indochina joining together during middle Triassic due to continent continent collision. However, before the collision the 2 microcontinents have similar tectonic evolutions which result in continental accretion of each microcontinent. The similarity is subduction of oceanic crust underneath the 2 microcontinents but in opposite direction during late Permian. Consequently, paired orogenic belt of similar stratigraphic sequences and paleolatitudes are obviously present in the two tectonic areas. They also divided Thailand into 3 geological provinces, western province, central province and eastern province

The western and eastern province which flank central province are Shan-Thai and Indochina microcontinents respectively. These microcontinents consist of Precambrian crystalline basement rocks. The central province are composed of approximately N-S trending fold belts of Paleozoic to Mesozoic marine sequences and subdivided into Sukhothai fold belt in the west and Loei fold belt in the east. These fold belts have generally N-S trend of volcanic rocks which are parallel to each other and are bound in the south by an strike-slip fault. The fault can be quite clearly observed form 1:1,000,000 magnetic anomaly map of Thailand, 1989, and henceforth will be refered to as Chao-Phraya fault. The south end of the fold belts, then were displaced into Kampuchea. Western part of Thailand and western half of eastern coast of Thailand today is portion of Shan-Thai microcontinent. The whole Khorat Plateau today is part of Indochina microcontinent. The authors believe that the fold belts were used to be continental margins including arc trench systems which contemporaneously evolved in between Shan-Thai and Indochina micro continents. Consequently, when collision of the 2 microcontinents took place, those continental margins were compressed and became paired fold belts. From the mentioned tectonic scheme of Thailand, the mineralization style in Thailand can be regarded as oceanic setting to continental setting. Mineralization in the oceanic setting would be the spectrums which are found in island arc and trench environmentals.

Consideration of Specifying Provinces

By using the criteria previously mentioned, Thailand can be into 3 metallogenic provinces, Western, Central and Northeastern province. Some of these provinces are subdivided into subprovinces .The reasons of the dividing will be discussed in detail for each province.

Northeastern Province

Northeastern province or Khorat plateau is composed of Sakon Nakhon and Korat basin. The boundary of this province has been decided by using magnetic anomaly map of Thailand, 1989, scale, 1:1,000,000, geology contrast, mineralization styles, tectonic aspect, geomorphology and physiography.

From the magnetic anomaly map of Thailand, the striking contrast for magnetic intensity patterns between Khorat plateau and the fold belts west of the plateau suggests the deeper magnetic bodies in the pleateu. This contrast generally follows the edge of Khorat plateau. The geology contrast between the two areas is also very helpful in discrimination of the plateau from the adjacent fold belts or even others geological province of Thailand. Loei fold belt comprises of middle Paleozoic-Triassic clastic sediments, Triassic andesitic volcanic rock and intermediate intrusive rocks in association with late Triassic-early Jurassic high alkaline rhyolites while Khorat plateau is mainly composed of Mesozoic continental red beds with some basalt fields in the south (Vimuktanandana,1984). Bunopas(1981) believes that vigorous tension during Cenozoic caused eruption of the basalt along N-S fractures. Although deep root faults in relation to the basalt have not been found and the basalt distribution pattern is still not clear, the basalt has been proved to be high alumina alkaline basalt.

Mineralization style in Loei subprovince is the type that is found in subduction zone system in which prophyritic intrusion related deposits of iron, copper, molybdenum, gold and silver are common. These deposits are iron-copper skarns with some gold and traces of lead and zinc, porphyry copper, epithermal vein of precious metal or base metals, etc. Most of the deposits are hosted by lower to middle Palezoic rocks. On the contrary, the deposits in Khorat plateau indicate continental environment. Uranium-copper occurrence in sandstone, Pratoo-Teema, Amphoe Phu Wiang, Changwat Khon Kaen other than potash (sylvite: KCL, and carnallite; $KMgCl_3.6H_2O$) and rock salt (halite: NaCL) deposits in both Sakon Nakhon and Khorat basin well indicate the continental environment. The potash and rock salt deposits are the result of chemical precipitation and are of prime economic significance since the measured reserves are 18 million metric tons and 607,000 million metric tons respectively while the uranium-copper occurrence has no economic importance due to its low grade and reserves (Potsat et al., 1987). The slightly disturbance on Mesozoic clastic sediment of Khorat plateau when compared to orogeny suggests the stability of the plateau which is a portion of the Indochaina miccrocontinent. Other than the plateau, Kampuchea, Laos and Vietnam which comprise to be the Indochina microcontinent are believed to be a craton because of the exposures of Precambrain crystalline basement in central Vietnam and eastern Laos have been found.

The abrupt change in elevation and magnetic intensity pattern contrast are correspond to the edge of Khorat plateau. In addition, in many parts of the plateau there appear some magnetic intensity patterns that probably suggest deep mafic intrusive bodies especially in the central part.

These mentioned differences on contrasts and characteristics, then, were clearly capable to discriminate the Northeastern province from other provinces.

Loei Subprovince

According to tectonic setting, Loei subprovince is similar to Sukhothai subprovince in begin an island arc caused by subduction, and bouth of them generally have the belts of volcanic rocks parallel to each other. The noticeable difference are the exposure of volcanic and intrusive rocks and the known mineralization styles. More intrusive and volcanic rock ara exposed in Loei subprovince, i.e., diorite at Amphoe Ban Na, Changwat Nakhon Nayok (Sitthithaworn and Tiyapairach, 1982), porphyritic quartz-monzonite, monzonite, monzodiorite, diorite and granodiorite in Phu Lon area,Amphone Sangkhom, Changwat Nongkhi (Sitthithaworn,1989), diorite and granodiorite at Amphone Khok Samrong and Tambon Khok Krathiem, Changwat Lopburi, diorite and granodiorite at Amphone Pak Chong. Changwat Nakhon Ratchasima, and granodiorite SW of Changwat Phetchabun. These intrusive rocks are commonly associated with andsite, rhyolite and andesitic tuff, and generally produce skarn deposits of iron and copper (usually malachite and chalcopyrite). In some relatively well studied areas, such as the Phu Lon, significance amounts of native gold, electrum, silver and molybdenite in affiliation with magnetite and chalcopyrite have been reported to have relationship with porphyritic intrusions which show indication of skarn and porphyry copper deposit. Most known deposits in Loei subprovince are skarn of iron and copper but very few placer gold and epithermal veins deposits have been reported in details. In addition, copper-bearing brecciated zones parallel to granite mass at Khao Phrabat Noi, Amphone Muang, Changwat Lopburi has been reported by Sampattavanich and Angatavanich (1975). All the mentioned deposits imply the predominance of lower level in vertical spectrum deposits normally found in island arc system.

Although Sukothai and Loei subprovinces have the same tectonic setting, the more intense of erosion degree of Loei subprovince makes it differ from Sukhothai subprovince in mostly revealing the deposits which lie closer to intrusions within the vertical spectrum.

Chapter III

Crinoids

Crinoids, also known as sea lilies or feather-stars, are marine animals that make up the class Crinoidea of the echinoderms (phylum Echinodermata). Crinoidea comes from the Greek word *krinon*, "a lily", and *eidos*, "form".They live both in shallow water and in depths as great as 6,000 meters.Crinoids are characterized by a mouth on the top surface that is surrounded by feeding arms. They have a U-shaped gut, and their anus is located next to the mouth. Although the basic echinoderm pattern of fivefold symmetry can be recognized, most crinoids have many more than five arms. Crinoids usually have a stem used to attach themselves to a substrate, but many live attached only as juveniles and become free-swimming as adults. There are only a few hundred known modern forms, but crinoids were much more numerous both in species and numbers in the past. Some thick limestone beds dating to the mid- to late-Paleozoic are almost entirely made up of disarticulated crinoid fragments.

Morphology

Figure 1 morphology of crinoid

A typical crinoid fossil, showing (from bottom to top) the stem, calyx, and arms with cirr

Crinoids comprise three basic sections; the stem, the calyx, and the arms. The stem is composed of highly porous ossicles which are filled with muscular tissue. The calyx contains the crinoid's digestive and reproductive organs, and the mouth is located at the top of the dorsal cup, while the anus is located peripheral to it. The arms display pentamerism or pentaradial symmetry and comprise smaller ossicles than the stem and are equipped with cirri which facilitate feeding by moving the organic media down the arm and into the mouth.

The majority of living crinoids are free-swimming and have only a vestigial stalk. In those deep-sea species that still retain a stalk, it may reach up to 1 metre (3.3 ft) in length, although it is usually much smaller. The stalk grows out of the *aboral* surface, which forms the upper side of the animal in starfish and sea urchins, so that crinoids are effectively upside-down by comparison with most other echinoderms. The base of the stalk consists of a disc-like sucker, which, in some species, has root-like structures that further increase its grip on the underlying surface. The stalk is often lined by small cirri.[2]

Like other echinoderms, crinoids have pentaradial symmetry. The aboral surface of the body is studded with plates of calcium carbonate, forming an endoskeleton similar to that in starfish and sea urchins. These make the calyx somewhat cup-shaped, and there are few, if any, ossicles in the oral (upper) surface. The upper surface, or *tegmen*, is divided into five *ambulacral areas*, including a deep groove from which the tube feet project, and five *interambulacral areas* between them. The anus, unusually for echinoderms, is found on the same surface as the mouth, at the edge of the tegmen.

The ambulacral grooves extend onto the arms, which thus have tube feet along their inner surfaces. Primitively, crinoids had only five arms, but in most living species these are divided into two, giving ten arms in total. In most living species, especially the free-swimming feather stars, the arms branch several times, producing anything up to two hundred branches in total. The arms are jointed, and lined by smaller feather-like appendages, or *pinnules*, which also include tube feet.

Fossil Crinoids

Description: Because many crinoids resemble flowers, with their cluster of waving arms atop a long stem, they are sometimes called sea lilies. But crinoids are not plants. Like their relatives--starfishes, sea urchins, sea cucumbers, and brittle stars--crinoids are echinoderms, animals with rough, spiny surfaces and a special kind of radial symmetry based on five or multiples of five.Crinoids have lived in the world's oceans since at least the beginning of the Ordovician Period, roughly 490 million years ago. They may be even older. Some paleontologists think that a fossil called Echmatocrinus, from the famous Burgess Shale fossil site in British Columbia, may be the earliest crinoid. The Burgess Shale fossils date to the Middle Cambrian, well over 500 million years ago. Either way, crinoids have had a long and successful history on earth.


Figure 2 crinoids stem

Stem fragments from assorted Pennsylvanian crinoids show some of the variation in the fossils found in Kansas rocks.Crinoids flourished during the Paleozoic Era, carpeting the seafloor like a dense thicket of strange flowers, swaying this way and that with the ocean currents. They peaked during the Mississippian Period, when the shallow, marine environments they preferred were widespread on several continents. Massive limestones..

Crinoids came close to extinction towards the end of the Permian Period, about 250 million years ago. The end of the Permian was marked by the largest extinction event in the history of life (see mass extinctions). The fossil record shows that nearly all the crinoid species died out at this time. The one or two surviving lineages eventually gave rise to the crinoids populating the oceans today.

In general, crinoids have three main body parts. The first, the stem, attaches the animal to the ocean floor and consists of disk-shaped pieces stacked on top of each other. These stem pieces come in a variety of shapes--round, pentagonal, star-shaped, or elliptical--and each stem piece is perforated in its center.

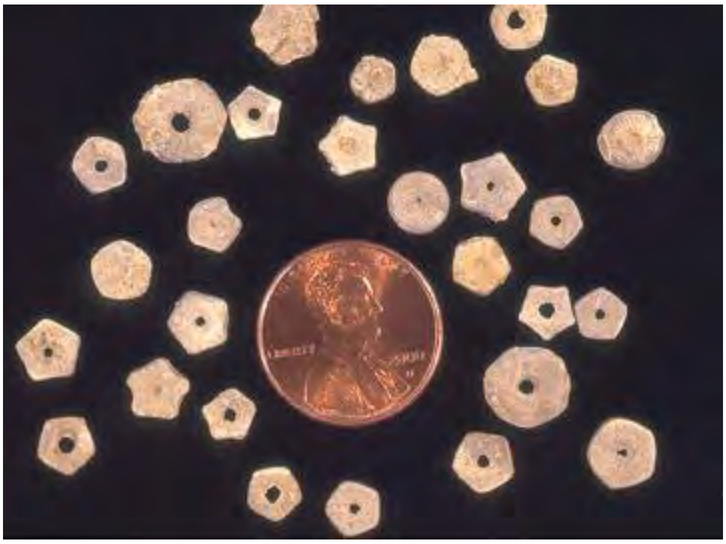


Figure 3 crinoids shape

Individual stem pieces are common fossils in Kansas rocks. These samples of different Pennsylvanian crinoid species are from the Spring Branch Limestone Member, Lecompton Limestone, Greenwood County, Kansas.

At the top of the stem is the cuplike calyx, which contains the mouth, the digestive system, and the anus. The lower part of the calyx is made up of rigid, five-sided plates, arranged radially in rows of five.


Figure 4 calyx

This specimen is from the Iola Limestone, Allen County, Kansas.

These plates form the base of the third part, the food-gathering arms. The arms, which are also segmented, have grooves with cilia, or tiny hairs, that capture suspended food particles and direct them back towards the mouth. The number of arms varies from five, common in primitive species, to as many as 200 in some living species. The number of arms is always a multiple of five. Based on the fossil record of crinoids, especially the details of the plates that made up the arms and calyx, experts have identified hundreds of different crinoid species. Though most crinoids had stems, not all did. Today, stemless crinoids live in a wide range of ocean environments, from shallow to deep, whereas their relatives with stems normally live only at depths of 300 feet or more. These modern crinoids are an important source of information about how the many different extinct crinoids lived.

Rarely are crinoids preserved in their entirety: once the soft parts of the animal decayed, sea currents generally scattered the skeletal segments. By far the most common crinoid fossils are the stem pieces. These are abundant in limestones and shales. Only occasionally is the cuplike calyx found. however, is home to a spectacular and rare fossil crinoid called Uintacrinus,

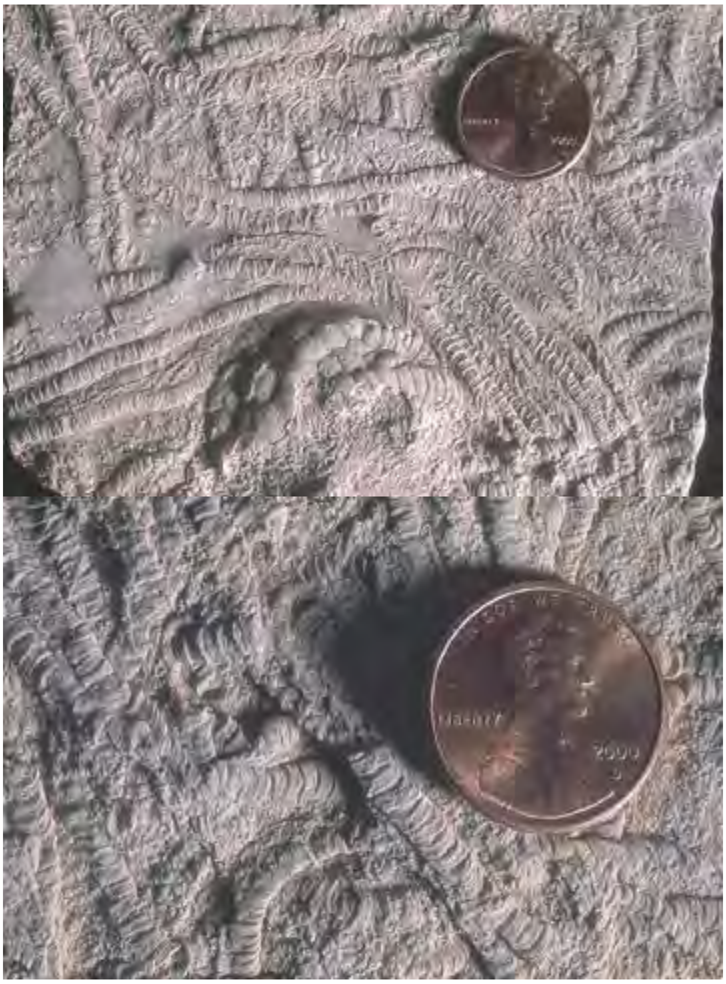


Figure 5 Crinioids fossil

Uintacrinus socialis is a stemless crinoid that lived in the shallow Cretaceous seas that covered much of North America roughly 70 million years ago. Among the numerous arms preserved in the top photo, a segmented calyx is also visible. These specimens were collected from the Niobrara Chalk, Gove County, Kansas. In this close-up of another specimen (lower photo), the individual arm segments are easy to see.

Chapter IV

Objectives

1. To making a geologic map in study area.
2. To making stratigraphic column between limestone and tuff.
3. To reconstruct paleoenvironments by data in field work.

Scope of work

To making the geologic map in study area and making the stratigraphical relationship between limestone and tuff. Then described the paleoenvironment are reconstructed

Output

1. Paleoenvironment of crinoids assemblage
2. Relationship between limestone and tuff
3. Stratigraphic column in study area

Chapter V

Methodology

1. Study data of research.

   -Finding data and research crinoids from previous work and compile all data and applied to my study.

2. Study of geology in study area.

   -Compile geologic map in study area.

   -To making stratigraphic column before laboratory.

   -Keep sample of crinoids and other fossil in this area from loose block.

   -To measure diameter and length of stem on crinoids bed.

3. Study in laboratory.

   -Using the excel program to make a graph.

   -Repairing geologic map.

   -Making a stratigraohic column

4. Discussion of all data from laboratory and study area.
5. Conclusion and prepare to present senior project.
6. Full report

Data Acquisition and Analysis

Tools

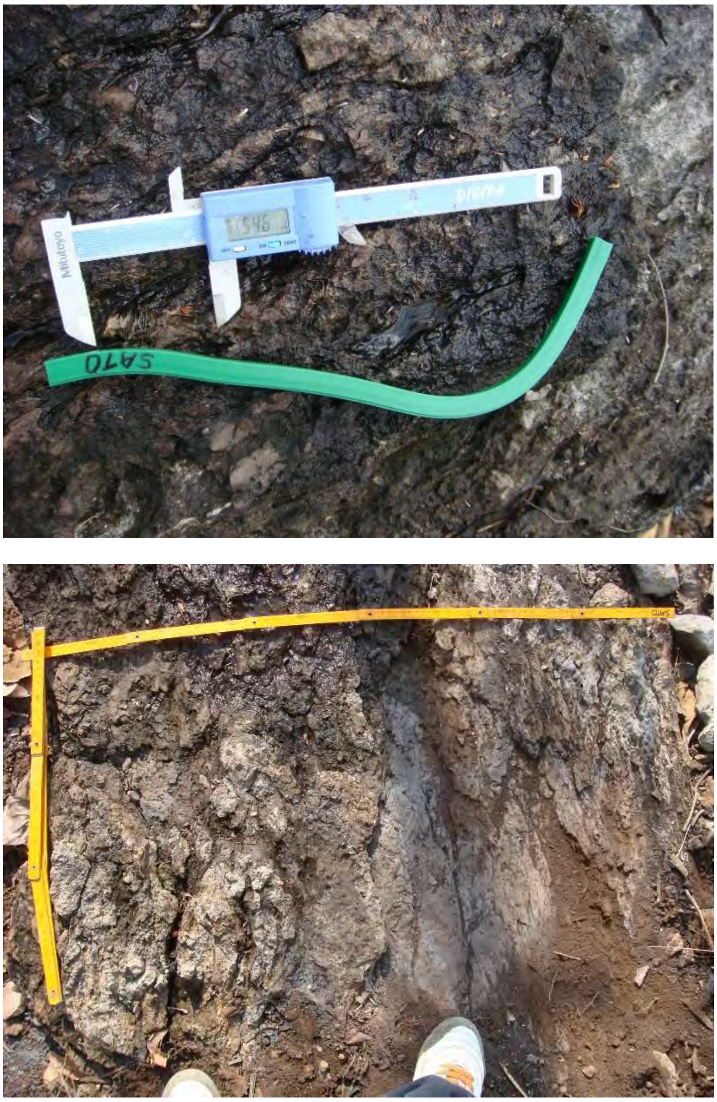


Figure 6-7Measurement

Previous work

To repairing a geologic map and finding data for applied to my work

In field project 1

To making a stratigraphic column and finding calyx to identified crinoids

In field project 2

To measure a diameter and length of crinoids about 600 pieces on surface bedding of crinoids limestone.

Laboratory work

To making a graph to interpretation the paleoenvironment

Chapter VI

Result and Interpretation

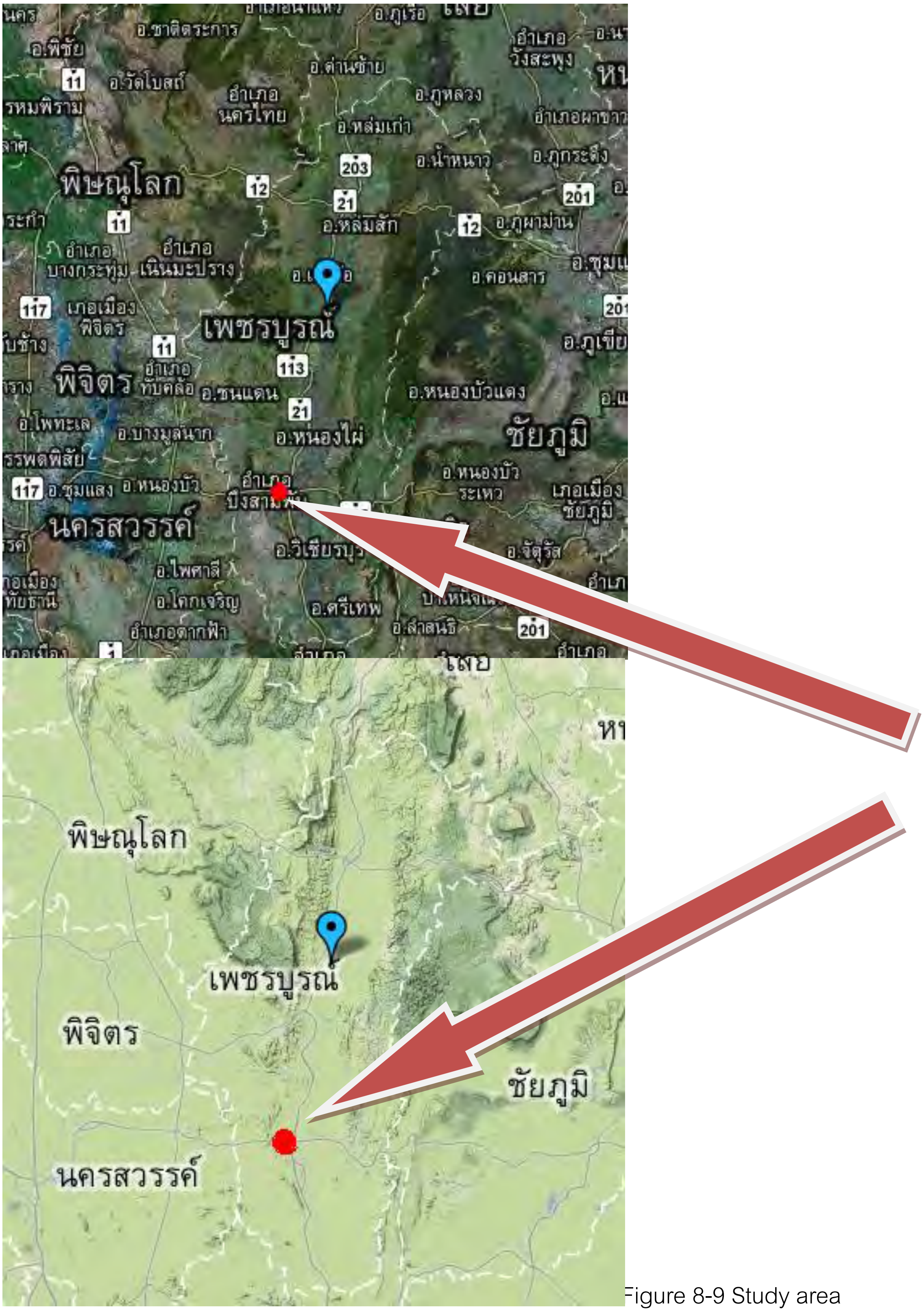


Figure 8-9 Study area

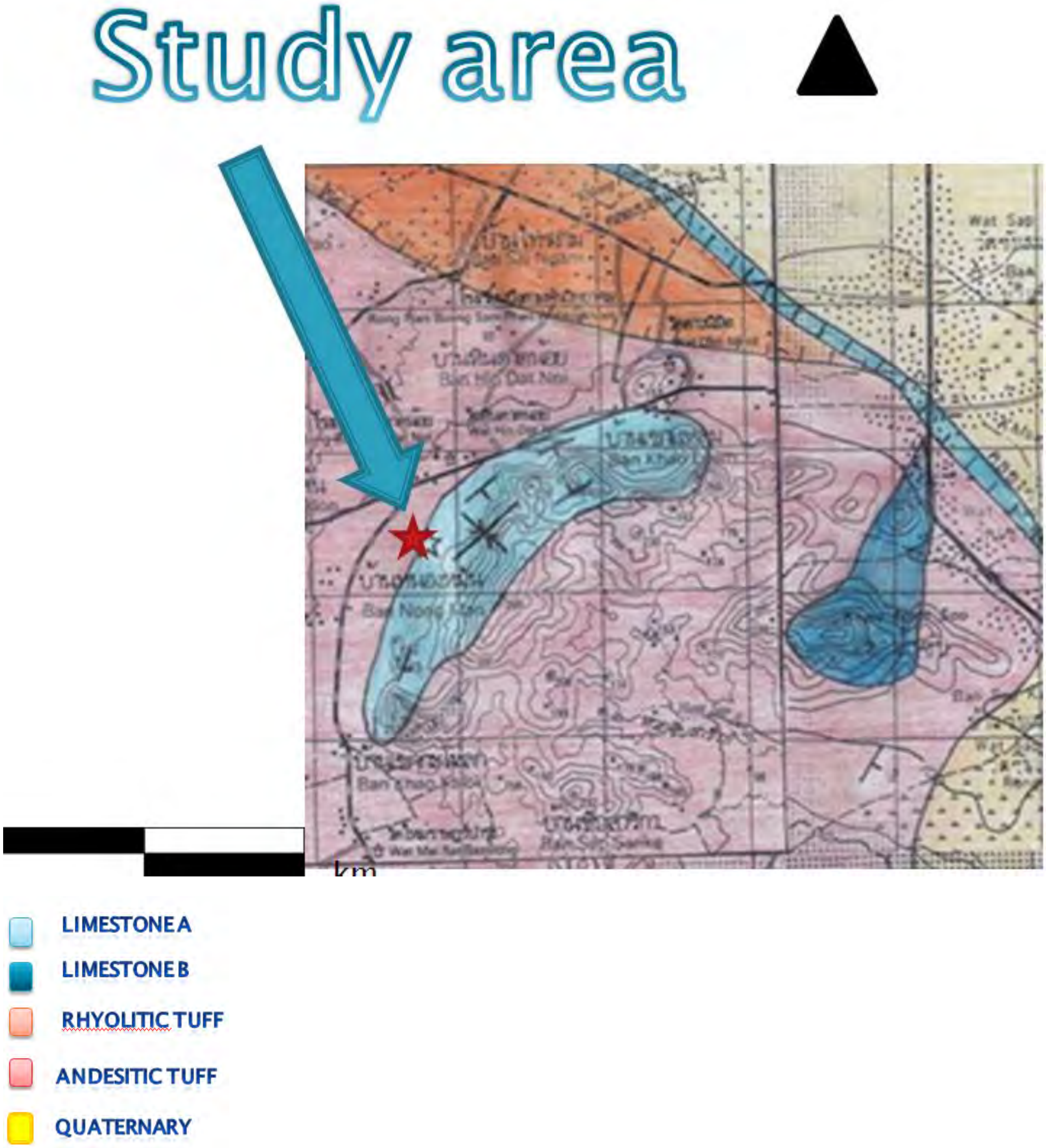


Figure 10 Study area

Field project 1

We go to study area to keep data collection. We kept crinoids sample and making a stratigraphic column (Figure 24) . The base rock is white limestone in 1^{st} and 2^{nd} bed(Figure 11) . The 3^{rd} bed is aragonite lamination and the 4^{th} bed is tuffaceous shale(Figure 12). The 5^{th} bed is andesitic tuff and we found crinoids assemblage in the 7^{th}, 8^{th} , 9^{th} ,10^{th} ,11^{th} bed and many kinds of fossil (Figure14,15,16). It's cover with white limestone until the top of the hill.

Figure 11 base rock and white limestone in the 1st and the 2nd bed in stratigraphic column

Figure 12 tuffaceous shale in the 4th bed

Figure 13 brachiopod in limestone in the 5th bed

Figure 14 crinoid bed(abundant) + white limestone in red block is the 7th and 8th

Figure 15 brachiopod in the 9th and crinoids in the 10th bed

Figure 16 crinoids and mollusca in the 11th bed

Figure 17 common crinoids and mollusca in the 13th bed

Figure 18 white limestone and a few crinoids

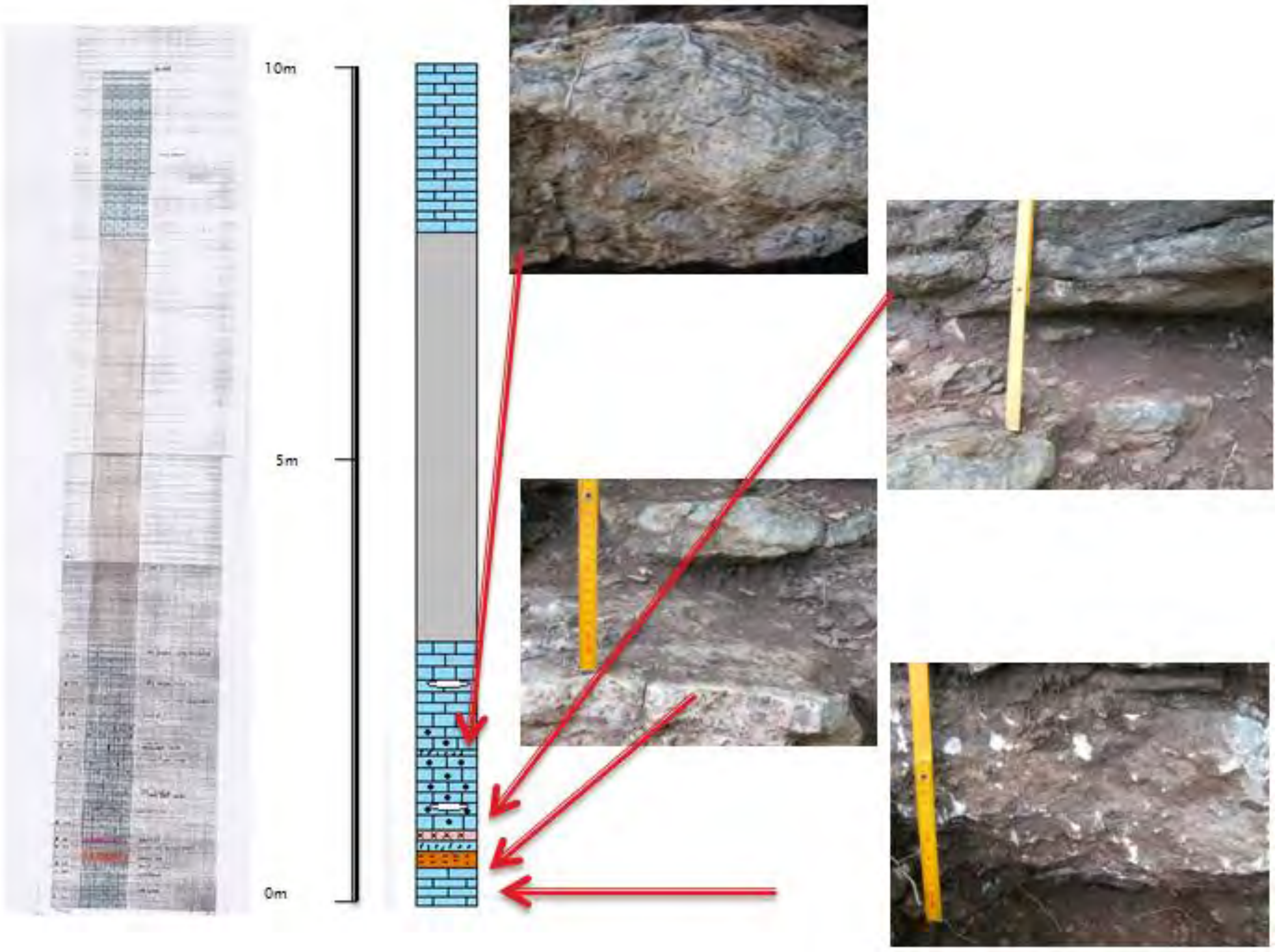
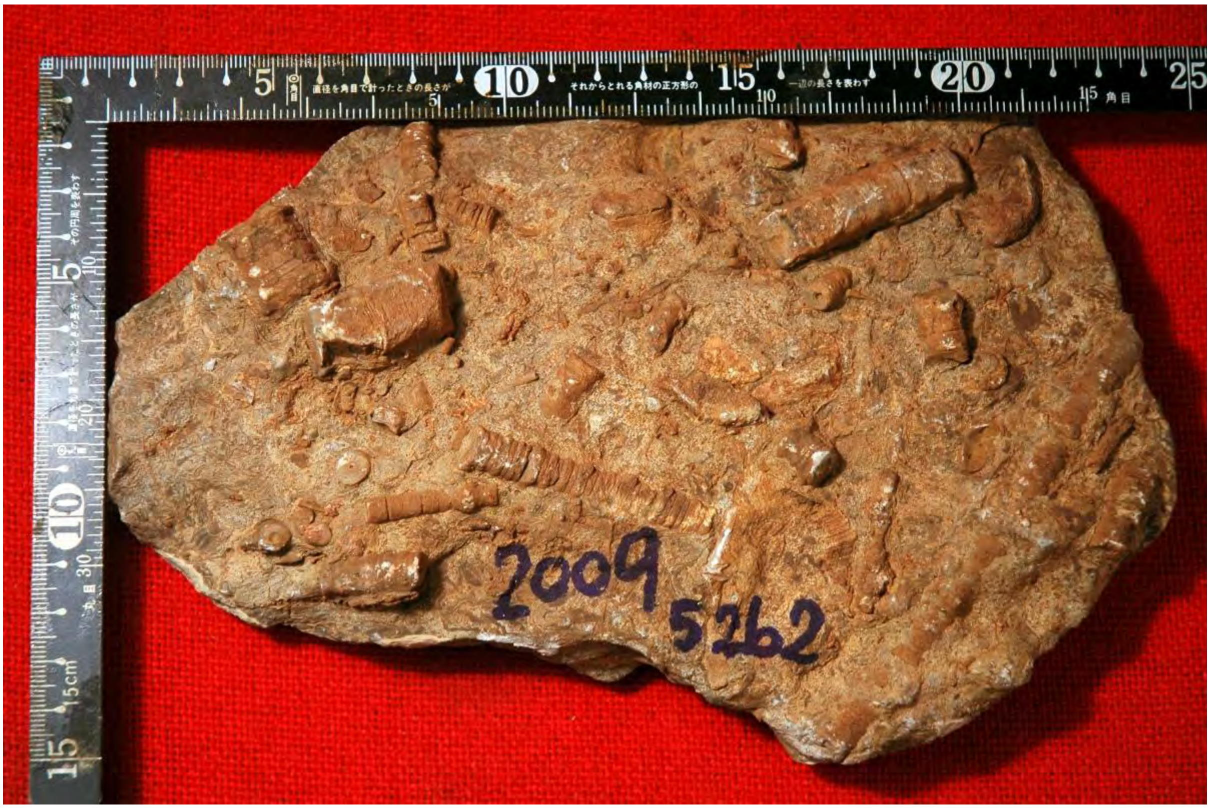


Figure 19 stratigraphic column in study area

Figure 20-21 Sample of crinoids



Field project 2

We go to field work project 2 to measure the diameter and length of crinoids. We chose 4 horizon(Figure:) in the 7^{th} ,8^{th} ,10^{th} and 11^{th} bed in stratigraphic column. We measure on block wide 0.5m and length 1.0m(Figure 24) .Total sample is 607 samples. In horizon 1 has 1 block samples and in horizon 2 has 1 block sample. In horizon 3 have 3 block sample. And in horizon 4 has 4 block sample. The data from field investigation is use to making a graph on excel program to be interprete.

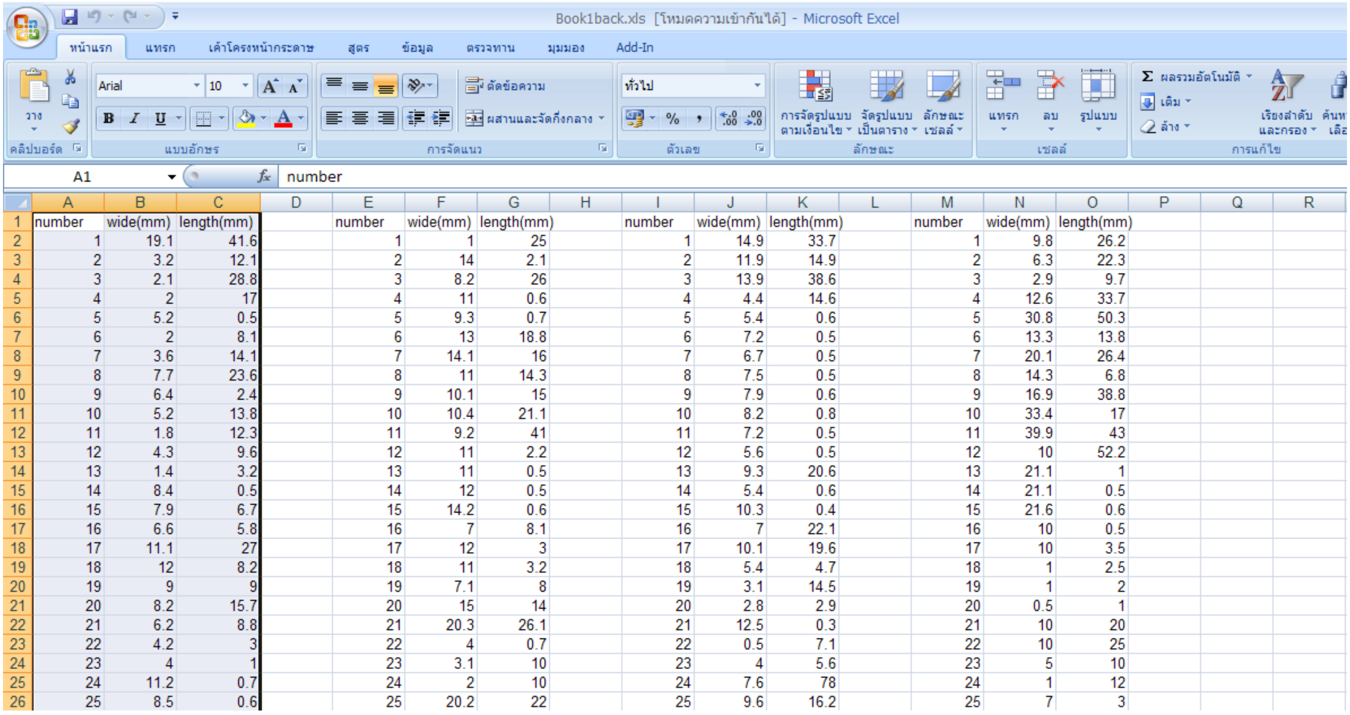
Figure 22-23 To cleaning out crop and To measure diameter and length

Figure 24 We chose sample on block that wide 0.5 m and length 1.0 m

Figure 25 Horizon 1 and 2 (the 7^{th} and 8^{th} bed in columnar section)

Figure 26 Horizon 3(the 9th bed in columnar section)

Figure 27 Horizon 4 (the 10th bed in columnar section)



number	wide(mm)	length(mm)	number	wide(mm)	length(mm)	number	wide(mm)	length(mm)	number	wide(mm)	length(mm)
1	19.1	41.6	1	1	25	1	14.9	33.7	1	9.8	26.2
2	3.2	12.1	2	14	2.1	2	11.9	14.9	2	6.3	22.3
3	2.1	28.8	3	8.2	26	3	13.9	38.6	3	2.9	9.7
4	2	17	4	11	0.6	4	4.4	14.6	4	12.6	33.7
5	5.2	0.5	5	9.3	0.7	5	5.4	0.6	5	30.8	50.3
6	2	8.1	6	13	18.8	6	7.2	0.5	6	13.3	13.8
7	3.6	14.1	7	14.1	16	7	6.7	0.5	7	20.1	26.4
8	7.7	23.6	8	11	14.3	8	7.5	0.5	8	14.3	6.8
9	6.4	2.4	9	10.1	15	9	7.9	0.6	9	16.9	38.8
10	5.2	13.8	10	10.4	21.1	10	8.2	0.8	10	33.4	17
11	1.8	12.3	11	9.2	41	11	7.2	0.5	11	39.9	43
12	4.3	9.6	12	11	2.2	12	5.6	0.5	12	10	52.2
13	1.4	3.2	13	11	0.5	13	9.3	20.6	13	21.1	1
14	8.4	0.5	14	12	0.5	14	5.4	0.6	14	21.1	0.5
15	7.9	6.7	15	14.2	0.6	15	10.3	0.4	15	21.6	0.6
16	6.6	5.8	16	7	8.1	16	7	22.1	16	10	0.5
17	11.1	27	17	12	3	17	10.1	19.6	17	10	3.5
18	12	8.2	18	11	3.2	18	5.4	4.7	18	1	2.5
19	9	9	19	7.1	8	19	3.1	14.5	19	1	2
20	8.2	15.7	20	15	14	20	2.8	2.9	20	0.5	1
21	6.2	8.8	21	20.3	26.1	21	12.5	0.3	21	10	20
22	4.2	3	22	4	0.7	22	0.5	7.1	22	10	25
23	4	1	23	3.1	10	23	4	5.6	23	5	10
24	11.2	0.7	24	2	10	24	7.6	78	24	1	12
25	8.5	0.6	25	20.2	22	25	9.6	16.2	25	7	3

Figure 28 Excel program and data collecting

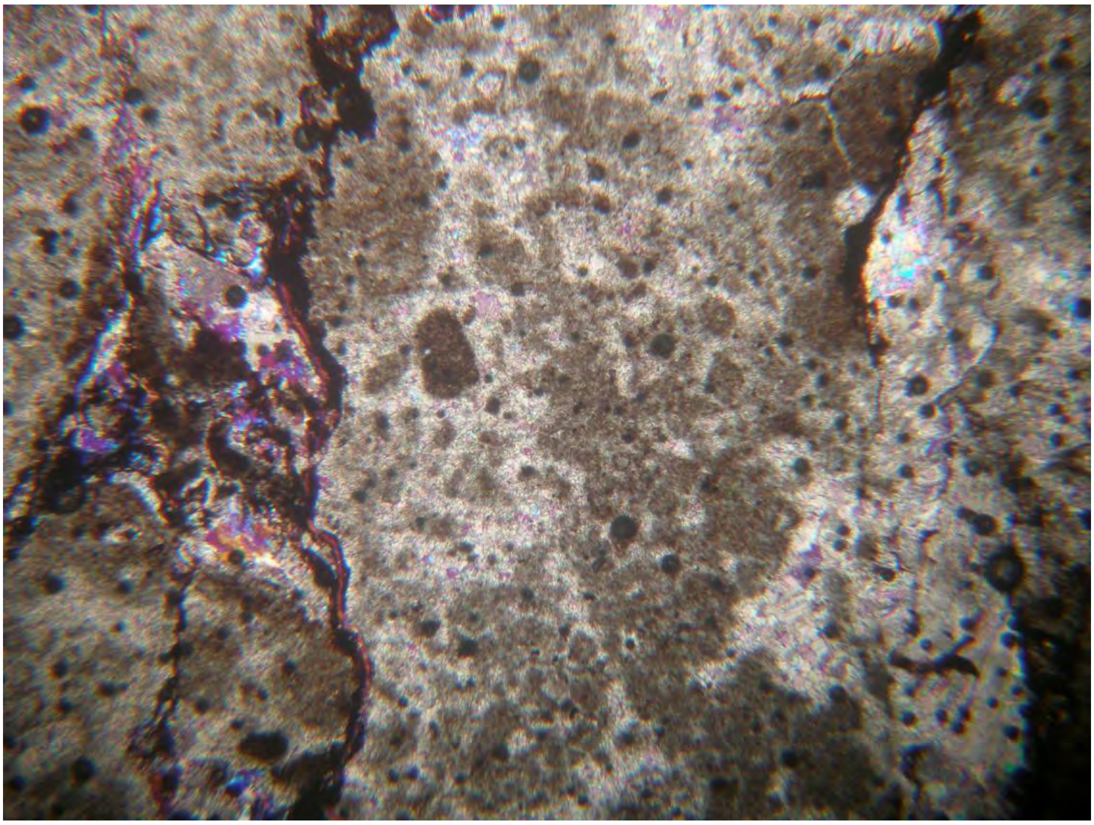


Figure 29 Thin section of outcrop in Wat Daonimit near study area (2mm)

(Tuffaceous limestone)

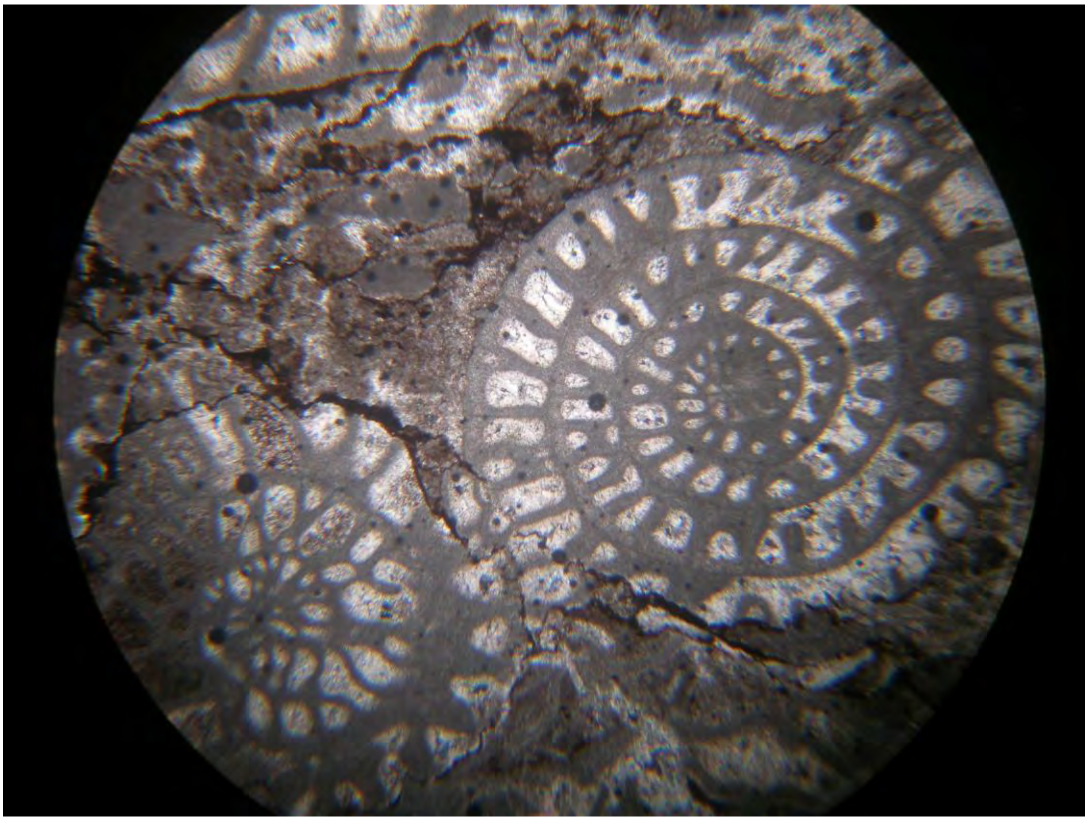


Figure 30 fusulinid in out crop at Wat Daonimit (4mm)

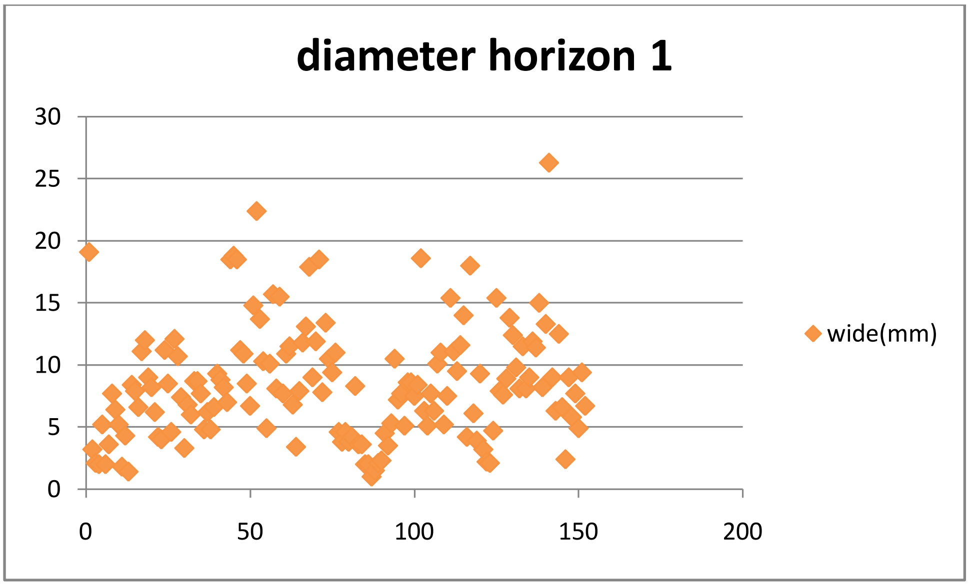


Figure 31 diameters of crinoids in horizon 1

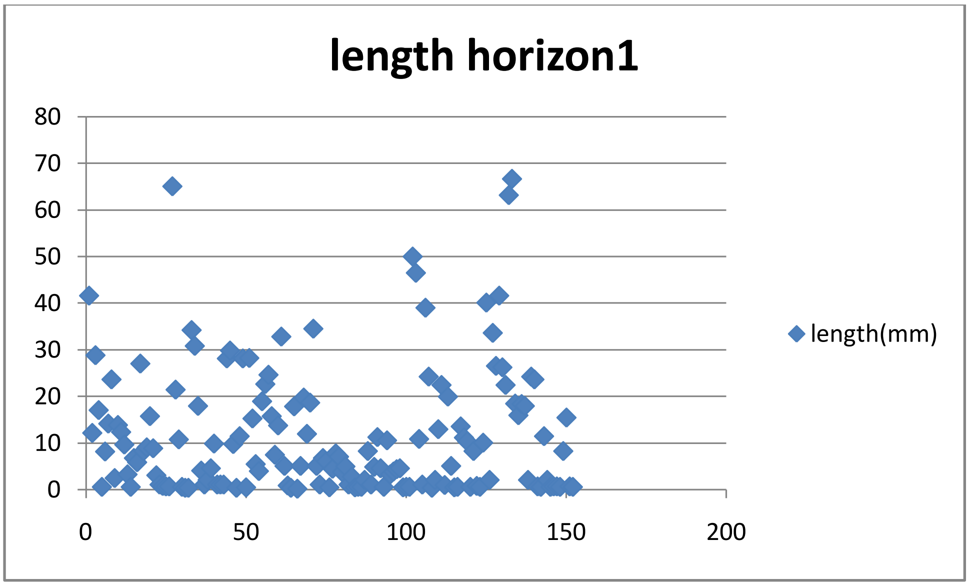


Figure 32 lengths of crinoids in horizon 1

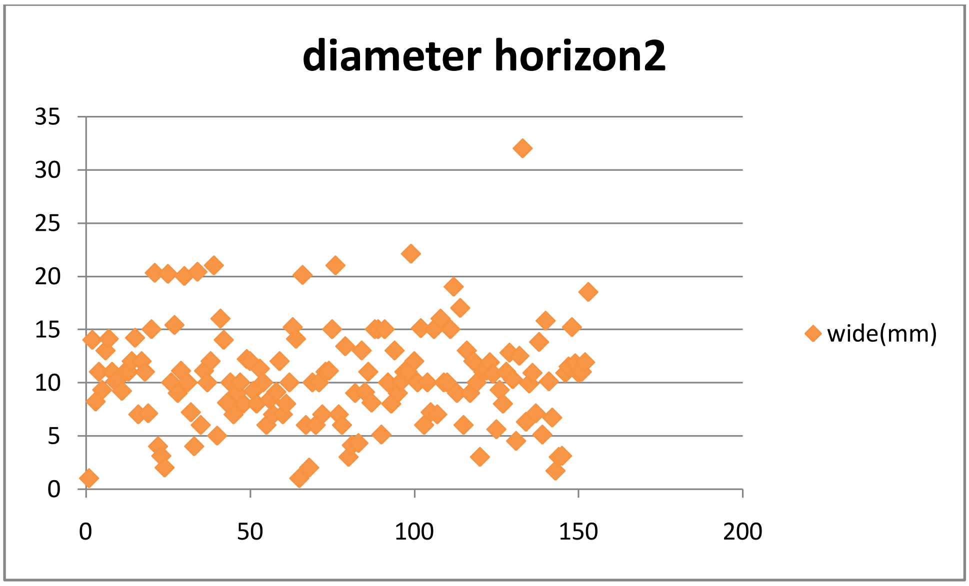


Figure33 diameter of crinoids in horizon 2

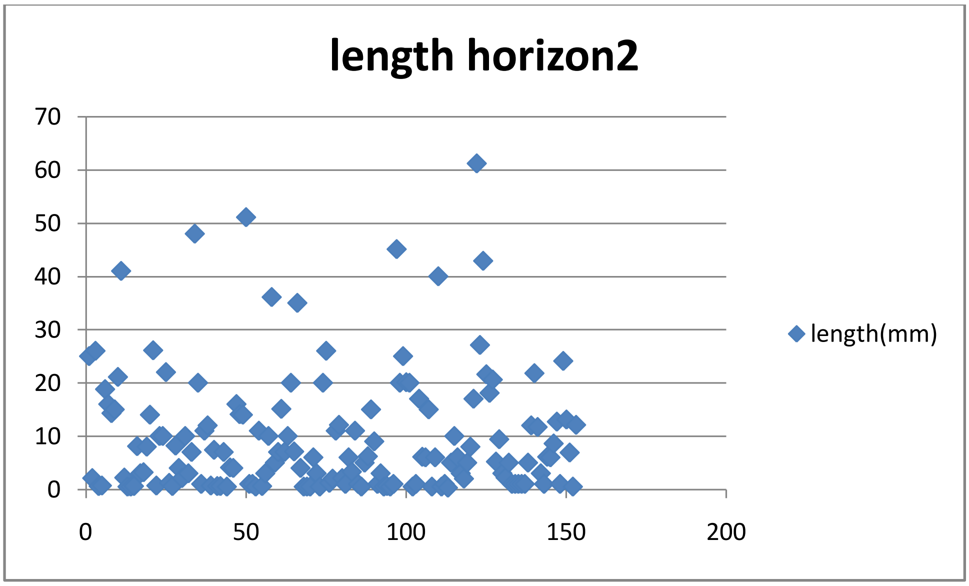


Figure 34 lengths of crinoids in horizon 2

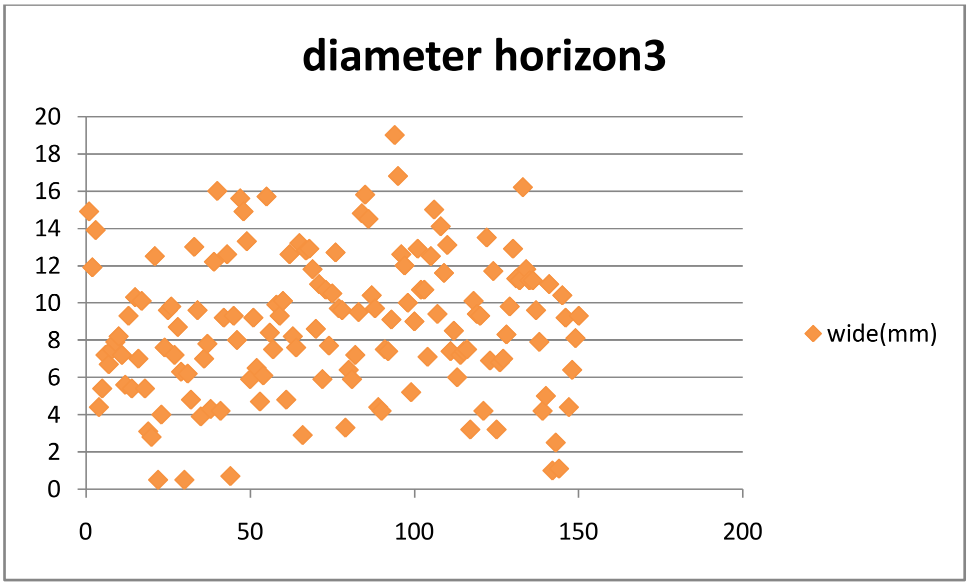


Figure 35 diameters of crinoids in horizon 3

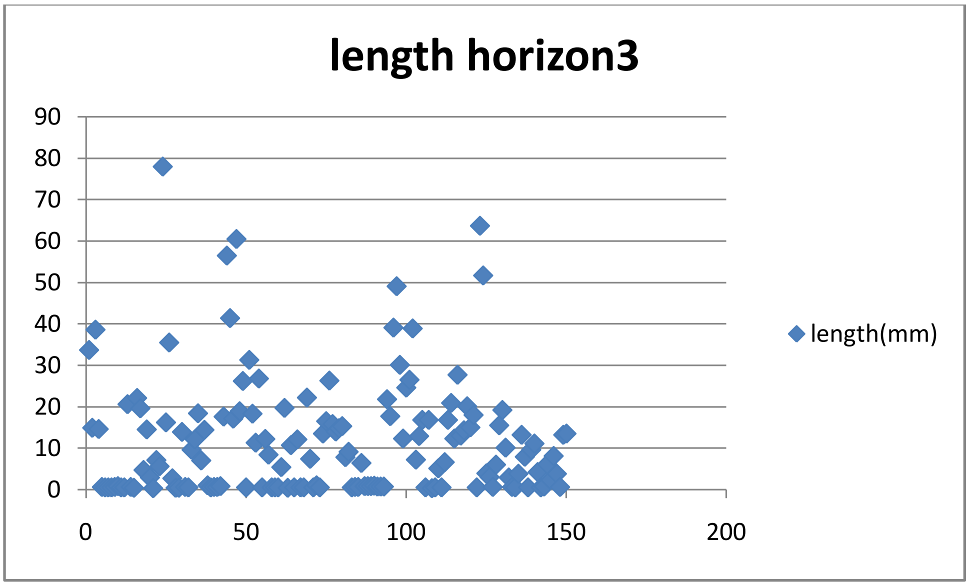


Figure 36 lengths of crinoids in horizon 3

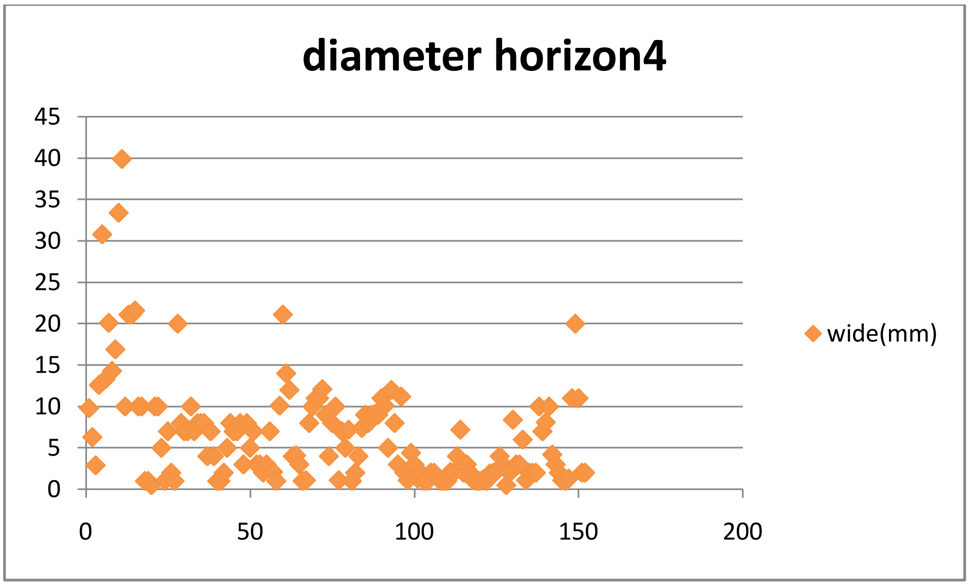


Figure 37 diameters of crinoids in horizon 4

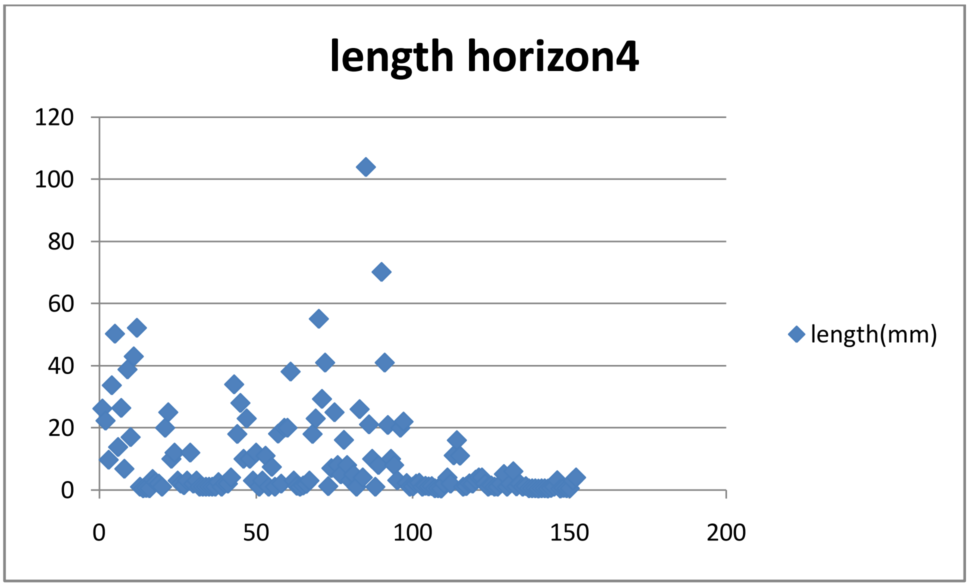


Figure 38 lengths of crinoids in horizon 4

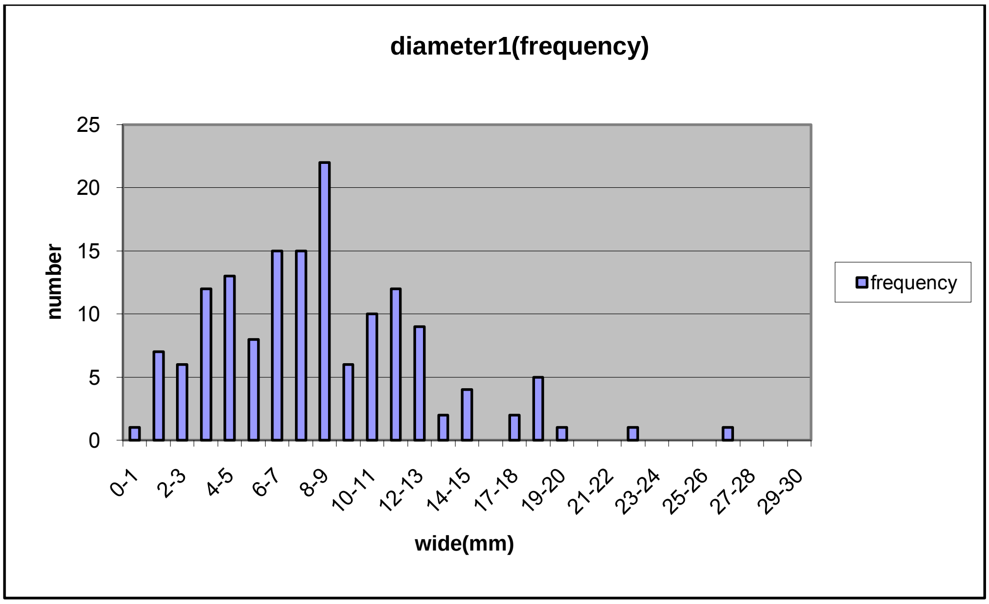


Figure 39 Frequency of diameter in horizon 1

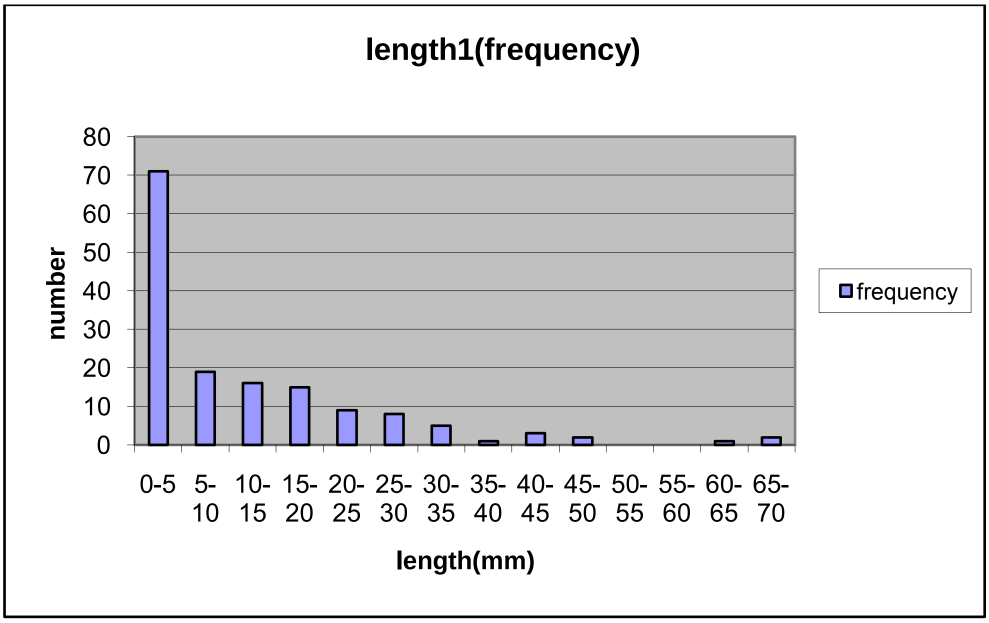


Figure 40 Frequency of length in horizon 1

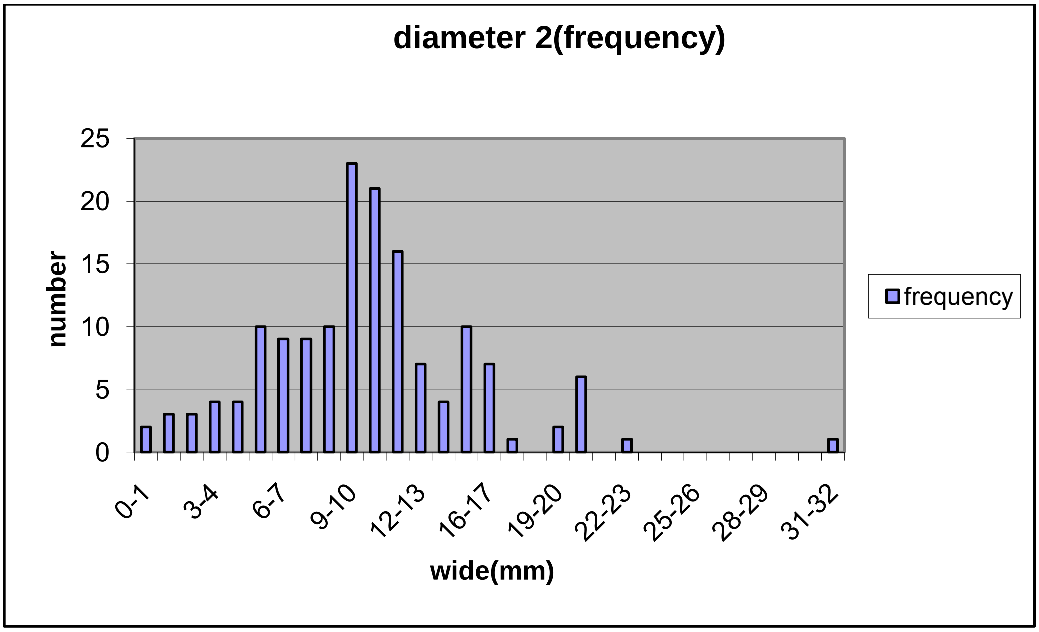


Figure 41 Frequency of diameter in horizon 2

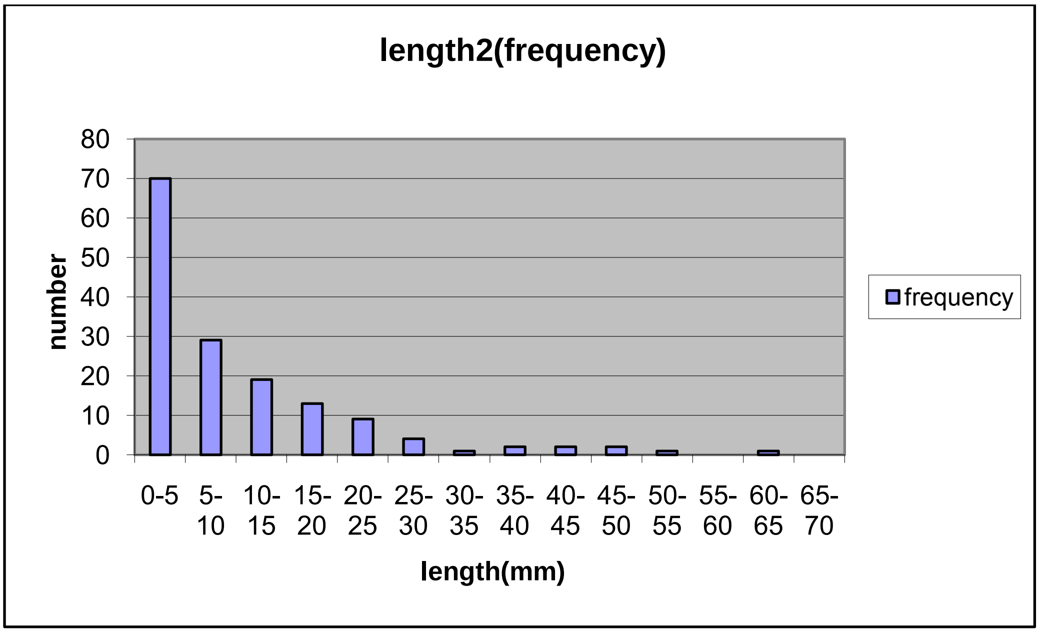


Figure 42 Frequency of length in horizon 2

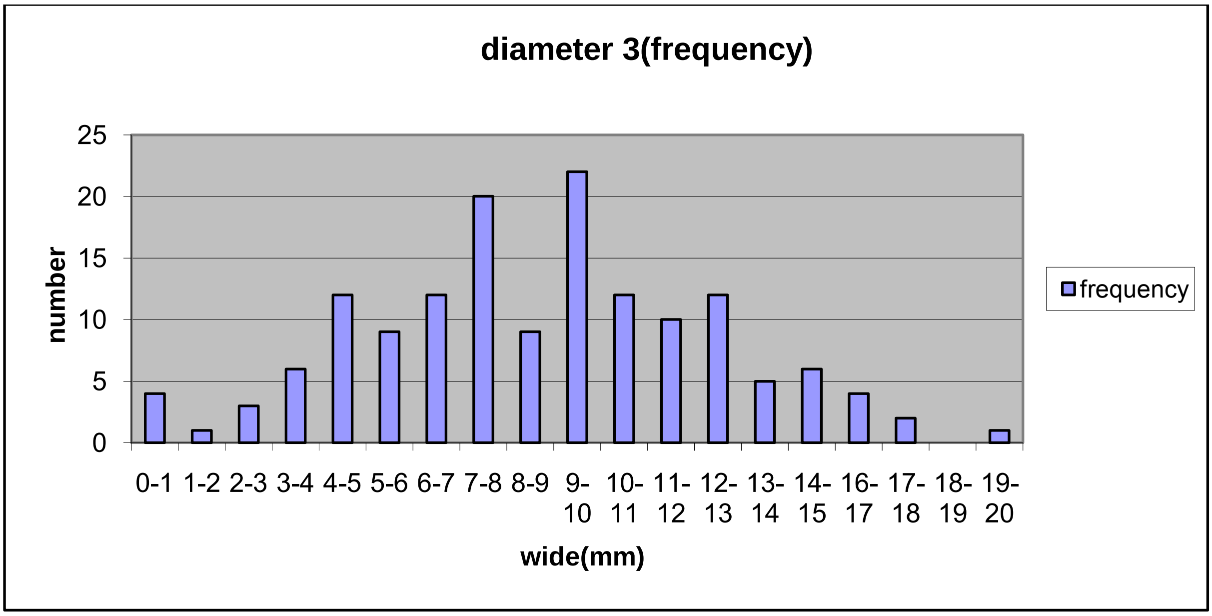


Figure 43 Frequency of diameter in horizon 3

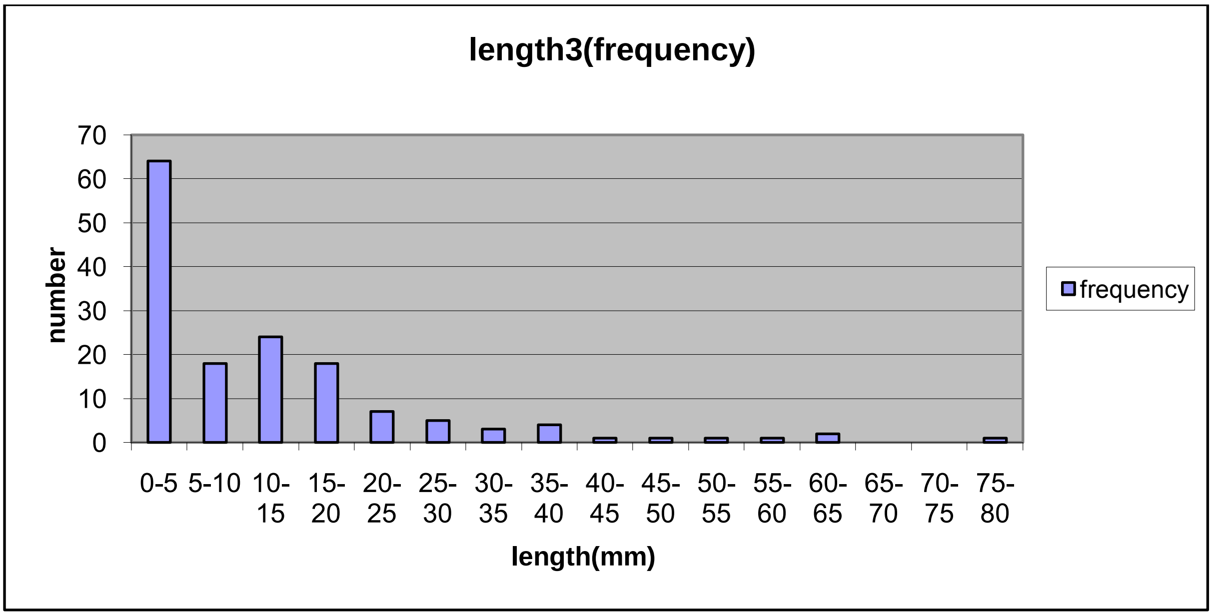


Figure 44 Frequency of length in horizon 3

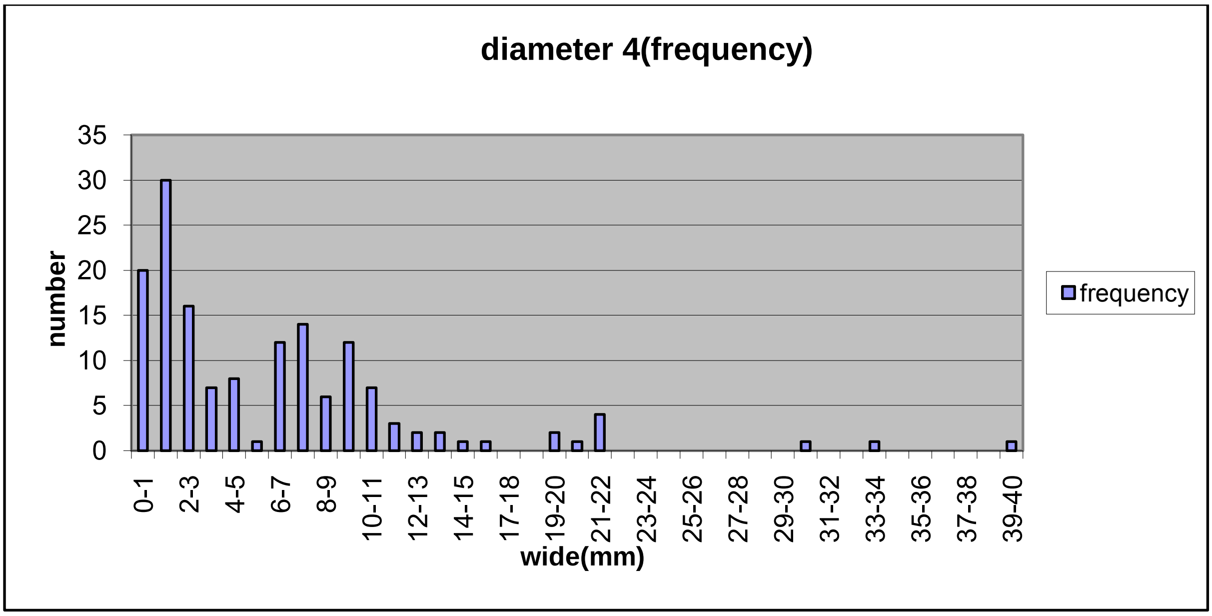


Figure 45 Frequency of diameter in horizon 4

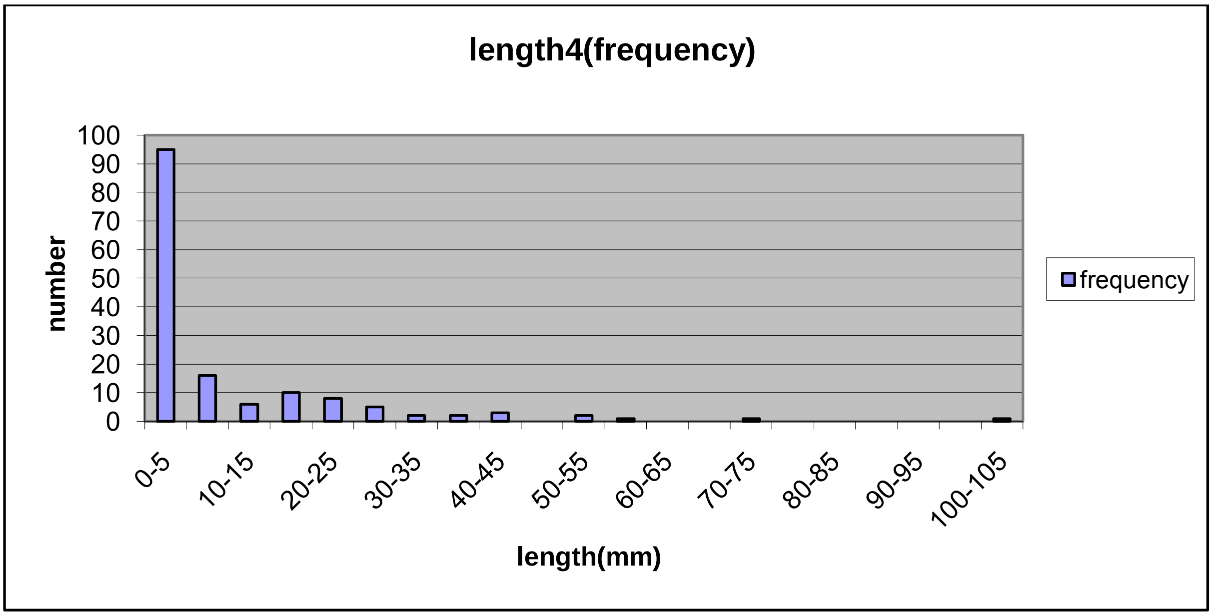


Figure 46 Frequency of length in horizon 4

Discussion

Totally, 4 horizons are discriminated. Size frequency analysis of Crinoids diameter and length has been carried .Maximum and minimum length of chained stem is 104.0 mm and 0.3 mm. Maximum and minimum diameter of chained stem is 39.9 and 0.5 mm. Peak of diameter graph is middle of graph. It's mean the average age of crinoids that is normal but Peak of length is left side of graph. It's mean they were broken by the strong current wave.

Conclusion

1. Crinoids were the first invader as suspension feeder to the community. If the bottom conditions too soft, Crinoids cannot stand to get the foods. It's has a big current to make them die.
2. The Lapilli tuff is the last stage of them because the crinoids limestone is red-purple color. It's a tuffaceous limestone. They are not to transport for a long way because the diameter of crinoids is average that is not too small.
3. Crinoids living in the shallow marine and study area are an atoll. Because stage of crinoids is tuffaceous limestone and the previous work data in field work II is support.
4. Degree of transportation may be to determine by the measure data of length and diameter of crinoids fossil. They die from a strong current because the frequency of length is too short. They were broken by a big current and deposit.

Recommendation

If we have more time to finding the calyx. It's can be describe species of crinoids in study area

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