Micropaleontology of Pyawbwe Formation in Sitsayan Area, Kama Township, Magway Region

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Abstract

The Sitsayan area is situated in the Kama Township,Magway Region. It lies between North Latitude $18^0$45' 28.9" to $18^0$44' 59.1" and East Longitude $95^0$13' 01.1" to $95^0$14' 16.8" There are (118) species under (29) genera, all belonging to (14) families and subfamilies. The fauna of Pyawbwe formation contains about 65% of Benthonic species, 25% of Planktonic species and10% of arenaceous species. The Biostratigraphy of the Sitsayan area can be established into two Biozones such as *Globigerinoides sicanus/Globigerionoides altiapertura* Zone and *Globigerinoides quadrilobatus primordius* zone */Uvigerina multicostata* Zone. The base of formation is defined by the occurrences of *Globigerinoides quadrilobatus primordius* which indicates that the Early Miocene,(Aquitanian) definitely and the upper boundary is defined by the combined occurrences of *Globigerinoides altiapertura* and *Globigerinoides sicanus* showing that upper part of Early Miocene,(Burdigarlian).As the shales are enriched with 90% of calcareous and hyaline group, the condition of deposition had been assigned to be within the outer part of the shelf. So the sediments were deposited under fairly deep marine. The depositional condition is considered as deeper marine condition possibly near the shelf edge partly of bathyal condition.Attempt had been made to correlate the Oligocene-Miocene fauna of study area not only with some areas of Myanmar but also with those of other foreign countries.

#Keywords: Pyawbwe Formation, foraminifera, biozone, Aquitanian, Burdigalian

Introduction

The Sitsayan area is is situated in the Kama Township, Magway Region.It lies between North Latitude $18^0$45' 28.9" to $18^0$44' 59.1" and East Longitude $95^0$13' 01.1" to $95^0$14' 16.8" This area is bounded by vertical grids no 08 to 13 and horizontal grids 26 to 41 using the one inch topographic Maps of 85 N/1,85 M/4.Figure.(1)

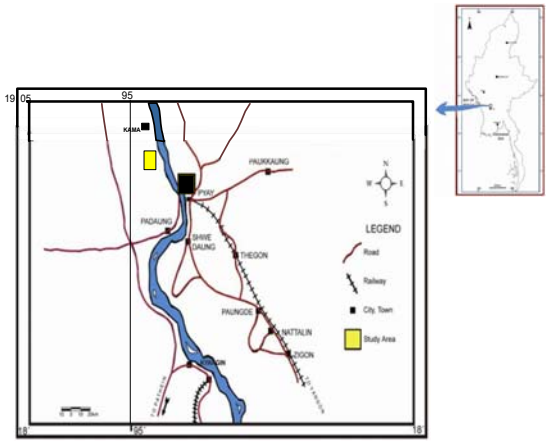

Figure (1). Location map of the study area

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Objective

The main purpose of the present research work is described by

(1) To reinvestigate the stratigraphic units of the area.
(2) To study the most important species and index species present in the study area
(3) To determine the geological age based on the zone fossils
(4) To review the paleoecological condition when Miocene sediments were being deposited.

Previous Works

Theobald (1869, 1910), proposed the stratigraphic name as Pegu group which includes the Oligocene-Miocene sediments of Lower Myanmar (including Bago Yoma, and Ayeyarwaddy Delta areas).

Vredenberg (1921) and Chhibber(1929, 1934).Eames (1950) verified the stratigraphic position of the shales based on molluscan fauna and assigned to the Pyawbwe Formation (Miocene, Aquitanian). Kyaw Kyaw Myint (1993), Soe Myint (et.al 1996) and studied the stratigraphy of this area was established.

In 1966, Soe Myint and Tsung Aung accompanied by Mr. P. Dutescu, carried out a detailed geological mapping in the Kama and Padaung area.Generalized mapping of this area on reconnaissance level was done by Myanmar Oil and Gas Enterprise (MOGE)'s geologists.

Materials and Methods

Collection of representative shale samples were made mostly with an equal interval of space (50) ft all along the sections. Outcrop sampling, tape and compass traverse method, Global Positional System method is used to plot the sample positions, and draw the geological mapping of the study area.Each sample was weighted about 100g and these shale samples were broken into small chips. Then these were heated in an oven or over the hot plate to a temperature of about 40^{o}C-60^{o}C with a cover. The kerosene soaked sample was treated again with water and some detergents. The samples were slowly distinguished into mud solution. The oil emulsion together with some muddy solution washed over the brass or steel sieve with normal opening of mesh size 180. The washed residue was again dried and separated into four fractions of mesh sizes 30, 60, 90 and 120 respectively. Microscopic examination of all fractions was done very carefully.All type species are chosen. Microphotographs were prepared after photograph was taken. All relevant literatures such as the works of Cushman (1954), Bolli and Saunders (1985), Bolli (1957, 1969), Bermudez, (1949), Cushman and Stainforth (1945), and Le Roy (1941, 1944) were used for accurate identification.

Regional Geologic Setting

A total of (6) sub-basins have been defined by Chit Saing (2003) based on the geomorphic and tectonic features as described by Stamp(1922),Chhibber(1934), Tanish(1950), Win Swe (1981), Maung Thein (1973,1983,2000). These six subbasins are separated within the Central Belt, i.e. in the Fore-arc Trough or Central low lands. There are (4) interconnected sub-basins, which are located in the middle part of the Central Belt. The study area is located in the centre of the Pyay Embayment, on the western bank of the Ayeyarwady River.

These basins are composed of Eocene, Oligocene, Miocene and Pliocene rocks which are folded into several anticlines and synclines. In the southern part, there is a vast area where the Miocene Age the Pyawbwe, the Kyaukkok and the Obogon Formations are exposed, most

of which are folded and faulted trending NW to SE direction. Except for the study area, including Kama and Padaung area, all the older strata are strongly folded and faulted with many cross faults truncating all the older formations. Starting from the Pyawbwe Formation, all Miocene Formations are strongly folded and thrusted, generally dipping as a large homocline at low angles to northeast.

The lowland study area is one of large plains where the whole area is formed of the Pyawbwe Formation. To the west are bounded by high lands, where formations of the Okhintaung and the Kyaukpon Formations are well exposed. There is a very wide slope of the Rakhine Yoma generally lowering down to the centre valley which is cut by the Ayeyarwady River, flowing down to the east of the study area.

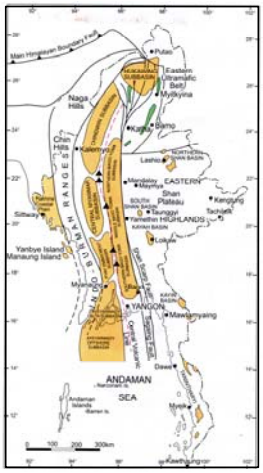

Figure (2). Showing the subbasin in Myanmar
(Chit Saing, 2003)

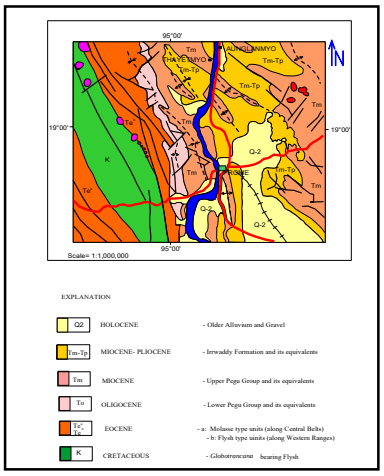

Figure (3). Regional Geological Map of the Pyay Embayment (Earth Sciences Research Division, 1973**)**

Systematic Micropalaeontology

In the study area, there are (118) foraminiferal species, under (29) genera all belonging to(14) families and sub-families. They are described systematically and classified according to the classification on adopted by Loeblish & Tappen (1985).

The benthonic species are predominant over the planktonic species, with a distinct ratio of 3:1 (Benthonic to planktonic species).The most richest samples or peaks are found at the base, middle and upper most part of the shales.

However, benthonic foraminifera such as *Bathysiphon* sp. *Haplophragmoides sp.,Robulus sp.* and *Nodosaria sp.,Rotalia sp., Uvigerina sp.*are common in these area. And also planktonic foraminifera such as *Globigerina sp., Globigerinoides sp., Globorotalia sp.* are common.

On the other hand, the *Uvigerina sp* and *Globigerinoides sp.,* are common in these area. And very important for the consideration of the geologic age, biozone and occur in the stratigraphic levels within the Miocene Formation.

The most common arenaceous species are *Bathysiphon arenacea, Haplophragmoides compress,* both of which occur throughout the Sitsayan area.

Among 89 benthonic species, every members of *Nodosaridae, Laginidae, Buliminidae, Bolivinidae and Uvigerinidae* are consistently by occurring in most of the shales

samples, together with a large number of members of *Globigerinidae*. Among the planktonic species, *Globigerina sp.,Globigerinoides sp. and Globorotalia sp.*species are recognized as the most common and abundant forms. More than 66% of benthonic species are found in association with 25% to 37% of planktonic species which occur very commonly and abundantly. The Sitsayan area was considered to be deposited in the outer neritic (outershelf) at the depth about 150 m under the temperature of 18° C .(See figures by J.C. Ingle 1980 and Lowman 1949).

Phyllum - Protozoa
Class - Sarcodina
Subclass - Foraminiferida
Order - Foraminifera
Family - Bathysiponidae, Avnimelech, 1952
Genus - *Bathysipon*, M.Sars, 1872
Type species - *Bathysiphon filiformis,* M.Sars, 1872
- *Bathysiphon arenaceous*, Le Roy, 1944
- *Bathysiphon* sp.

Description:

Test large to medium in size, cylindrical, not tapering, opening with two apertures composed of arenaceous grains.

Distribution; This species occurs very commonly in the lower and middle stratigraphic level of the area.

Family - Haplobhracmoidae,Mayna, 1952
Genus - *Haplobhracmoides*, Cushman 1910
Type species - *Haplophragmoides compressa,* Le Roy, 1944
- *Haplophragmoides wilberti,* Todd & Bronnimann 1957

Description:

Test medium, circular, compressed, with 4-6 chambers arranged planispirally with indistinct aperture.

Distribution: This species occurs rarely throughout the Sitsayan area.

Family - Vaginulinidae, Reuss, 1860
Genus - *Robulus*, de Montfort, 1808
Type species - *Robulus cultratus,* de Montfort 1808
- *Robulus abuillottensis,* Bermudez, 1949
- *Robulus calcar* (Linne), Bermudez, 1949
- *Robulus convergens,* Bermudez, 1949
- *Robulus sumatrensis* , Bermudez, 1949
- *Robulus pseudolimbosus,* Le Roy, 1944
- *Robulus submilligenus,* Cushman & Stainforth, 1945

Description:

Test free, medium size, coiled planispirally, bi umblicate with distinct umbo on both side; calcareous, hyaline; aperture radiate.

Distribution: This species is very rare specimen which has been recorded not only in the lower part but also in the upper part of the study area.

Family - Nodosaridae,, Ehrenberg, 1838
Genus - *Nodosaria,* Lamarck, 1812
Type species - *Nodosaria longisclta,* Cushman & Stainforth, 1945

Description

Test small to medium in size, cylindrical, chambers about 10-14 arranged uniserial ; chambers rounded, the test is slightly curved, with pointed initial and last chamber; wall calcareous, hyaline; aperture radial with a thin lip or rim.

Distribution: This species has been recorded from the middle and the upper part of Pyawbwe formation.

Genus - *Globoquadrina*, Finlay, 1947
Type species - *Globorotalia siakensis* Le Roy, 1944
- *Globorotalia mayeri,* Bolli, 1957
- *Globorotalia opima nana ,* Bolli, 1957
- *Globorotalia obesa* ,Bolli, 1957

Description:

Test small, bilaterally symmetrical, biconvex, ventral side slightly more convex than dorsal side, circular in transverse section section,2-10 chambers in the last whorl; periphery rounded,; wall calcareous, sutures distinct, depressed, straight to curved, ventrally and extending to an irregular slightly opened umbilical area having a small though conspicuous umbo of clear shell materials plug

Distribution: This species was obtained as a single specimen in the upper part only.

Family - Uvigerinidae, Cushman- 1937- Cushman & Stainforth ,1945
Genus - *Uvigerina gallowayi,* Cushman- 1937- Cushman & Stainforth ,1945
Type species - *Uvigerina sp.* Cushman- 1937- Cushman & Stainforth ,1945

Description:

This species is coiled triserially to uniserially with costate chambers, it becomes a little longer than the type. So, it is a variant of. *U. multicostata*.

Distribution: This species occurs very commonly in throughout the study area.

Family - Globigerinidae,Carpenter, Parker & Jones, 1862
Genus - *Globigerina*, d' Orbigny, 1826
Type species - *Globigerina bulloides* ,d' Orbigny 1826
- *Globigerina baraemoensis* ,Le Roy, 1944
- *Globigerina praebulloides praebulloides* ,Blow, 1959

- *Globigerina prabulloides occlusa* , Blow, 1959
- *Globigerina ciperoensis augustiumbilicata,* Bolli, 1957
- *Globigerina venezuelana,* Hedberg, 1937, Bolli 1957
- *Globigerina triloculersis*, d' Orbigny – Bolli, 1957

Description:

Test small, chambers globular or ovoid, about 10 to 11 arranged in a low trochospiral of 2 and ½ whorls, the last whorl, consisting of 4 chambers;, equatorial periphery strongly lobate, wall calcareous,strongly perforate, sutures on dorsal and ventral sides, depressed radial; aperture a highly arched with a thin lip or rim opening to umbilical area with a fairly quardrate umbilicus.

Distribution: This species occurs very commonly in lower part of the study area.

Genus - *Globigerinoides*, Cushman, 1927

Type species - *Globigerinoides rubra,* d' Orbigny 1839
- *Globigerinoides transitoria,* Blow, 1956
- *Globigerinoides triloba immatura,* Bolli, 1957
- *Globigerinoides quadrilobatus primordius,* Blow & Banner1962
- *Globigerinoides scculifera,* Brady-Bolli, 1957
- *Globigerinoides rubra* ,d' Orbigny- Bolli, 1957
- *Globigerinoides sicanus* ,Desteni, 1950-Postuma, 1971
- *Globigerinoides diminutus*, Bolli & Saunders, 1985

Description:

This species is coiled trochospirally with a more height with 3-4 chambers in the last whorl, with high apertures between the chambers,wall calcareous, perforate, depressed umbilicus fairly narrow, deep, primary aperture a high distinct area,

Distribution: This species occurs fairly abundant in the basal Pyawbwe Formation. It occurs commonly and becomes fairly abundant in the basal part of the study area.

Biostratigraphy and Age

Foraminiferal specimens occured both in number of species and genera. According to Hedberg (1967), Two Biostragraphic zones can be established as below :-

Serial No.	Name of Biostratigraphic Zones	Geological Age
Zone. 2.	*Globigerinoides sicanus/*	
	Globigerionides altiapertura zone	Burdigalian
Zone. 1	*Globigerinoides quadrilobatus primordius* zone/	
	Uvigerina multicostata zone	Aquatanian

The common occurrences of *Globigernia* spp. and *Globigerinoides* spp, may probably Miocene age.

According to Bolli and Saunders (1985), *Globigerina ciperocensis augustiumblica* range from Oligocene to Early Miocene. *Globigerinoides transitoria* ranges from Neogene Biozone.N7 to N9 which are included in the Early Miocene. *Globigerinoides quardrilobatus primordius* ranges from Neogene Biozone N4 to N5 only.

Similarly, *Globigerinoides altiapurtura* ranges from Neogene Biozone N5 to Neogene Biozone N6, which is in the Early Miocene. Next, *Globigerinoides sicanus* ranges from upper part of Neogene Biozone. N6 and Neogene Biozione N7, so the whole stretch range of all species starts from the Neogene Biozone N4 to Neogene Biozone N7, falling in the Early Miocene. Berggren(*et. al*, 1985) determined that the age from Neogene zone.N4 to Neogene Zone N7 is the whole period of Aquitanian to Burdigalian. (Early Miocene). The age of this part of the Pyawbwe Formation in Sitsayan area have been assigned at Burdigalian according to Berggren (et.al 1985).

Possible Paleobiogeography of the Area

The Paleobiogeography of the Sitsayan area is represented by three main cycles of conditions of deposition.The cycle is represented by the Late Eocene, followed by the whole period of Oligocene (Early, Middle and Late) and finally Miocene and Pliocene.

The lower and middle part of the Yaw Formation (Late Eocene) contain foraminiferal species, *Ammobaculite* 6b and 6B, the occurrence of which indicate a type of reducing environments such as deltas, and swamps, were developed in several areas from the north Mann Chaung area to Kama- Padaung area. This cycle of deposition was followed by deposition of the Kyaukpon Formation.

The Kyaukpon Formation is composed of fine grained argillaceous sandstones with a fairly rich fauna, consisting of *Operculina* spp., *Amphistegena* spp., Some *Globigerina ampliapertura, pseudohastigerina, Lenticulina* spp. and some *Bulimina* spp., indicating that the Early Oligocene sea was widespread between above two areas, all along the foothills of Rakhine Yoma (Tainsh, 1950, Chit Saing, 2003). became an oceanic type with the development of thick argillaceous sequences of the Tiyo FormationThe Middle Oligocene and the Late Oligocene foraminiferl speices such as *Globigerina opima opima*, *Globigerina ciperoensis* and *Globigerina kugleri* are present throughout the Tiyo Formation, indicating a deep marine like bathyal type was developed up to the basal part of Early Miocene, because there is an occurrence *Globigerinoides quadrilobatus primordius* which appear in the Early Miocene to the occurrence of *Globigerionides sicanus* which indicate a wide and deep ocean that occurred all the Kama-Padaung areas to Thayetmyo- Minla areas. So, the depositon of thick sequences of the Tiyo Formation was followed by Neogene sea which covered all the Kama- Padaung area to the Thayetmyo- Minhla area. It can be assumed that the sea of the Tiyo time is considered to be continuous to the sea of Early Miocene, since there is no paleontological break between the Kama-Padaung and the Thayetmyo areas during which the fauna of the Tiyo Formation and the Pyawbwe Formation of Sitsayan area are very rich. The Tiyo Formation contains (103) benthonic species and (16) planktonic species. Similarly, the Sitsayan shales are very rich fauna i.e. (89) benthonic species and (29) planktonic species. Therefore, both the fauna of the Tiyo and the Sitsayan Formations show that physio-chemical conditions, and paleoecological controls are quite favourable for the growth of a large number of foraminiferal species. The frequent and abundant occurrences of heavily costae *Uvigerina* and hispid *Uvigerina* together with several species of *Buliminids,* and *Nodosarids* proved that the seas during the deposition of the Tiyo Formation and the Sitsayan area in Pyawbwe Formations were considered to be deposition under deeper marine, possibly outer shelf and some position of bathymetery, typically found in the depth greater than 300 fathons (Walton, 1964) (Lowman, 1949), (Ingle, 1980).

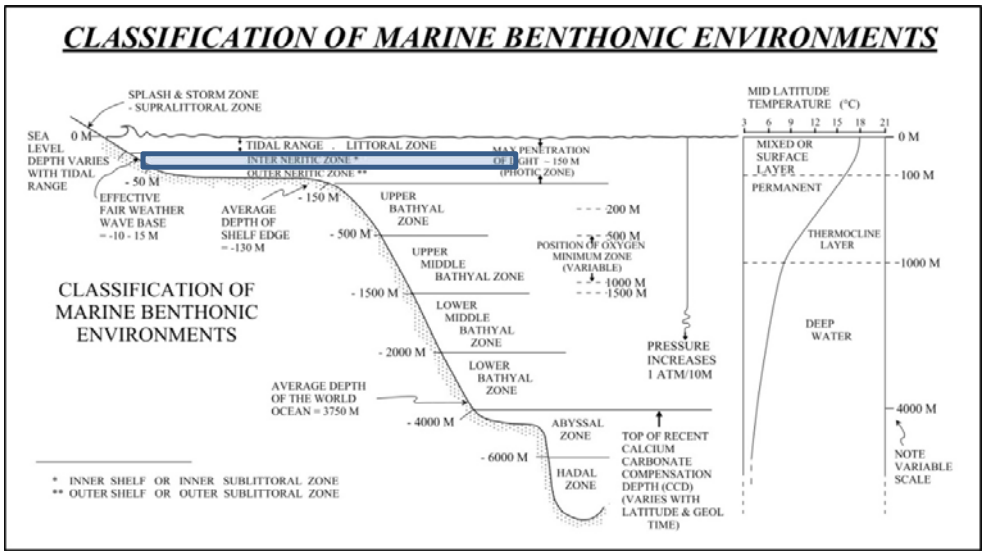

Figure (4). Bathymatric zonation of Environment (after J.C. INGLE 1980)
(modified by Hedgpeth , 1957 from Ingle,1975a)

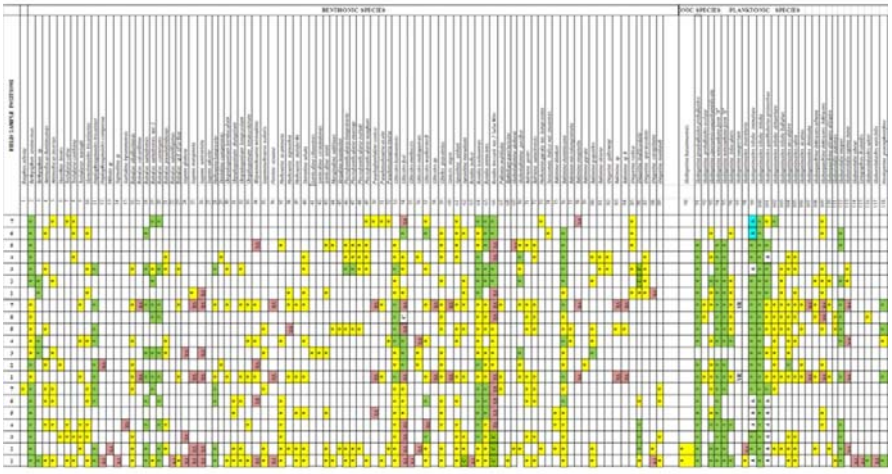

Figure (5). Range of distribution of the foraminifera in Pyawbwe Formation#

Conclusion

There are (118) species under (29) genera, all belonging to (14) families and subfamilies.Both benthonic and planktonic species are calcareous hyaline forms,which are usually enriched within the outer shelf. The true and correct determination of the age of shales has been done, based on the stratigraphic ranges ofplanktonic species. Therefore it is assigned to Early Miocene definitely, (Aquitanian/ and Burdigalian) by the occurrences of *Globigerinoides quadrilobatus primordius*, and *Globigerinoides sicanus.* The Paleobiogeography of the Sitsayan area is represented by three main cycles of conditions of deposition. The cycle is represented by the Late Eocene, followed by the whole period of Oligocene (Early, Middle and Late) and finallyMiocene and Pliocene. The vertical sequence of the Sitsayan shales (Pyawbwe Formation) in the study area are interpreted as transgressive sequence in the lower partshort time of regressive sequence in the middle part and again transgressive sequence in the upper partStratigraphic correlation of the fauna of shales can be attempted locally in Myanmar, and abroad, Indonesia and Trinidad.

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