Diagenetic Imprints Reflect on Sedimentary Facies of Oligo-Miocene Rock Units in Southern Portion of Tantkyi Range, Pakokku Township, Magway Region

Myat Kay Thi[1], Day Wa Aung[2]

Abstract

Metasedimentary and igneous rocks are well exposed in the Bodawgyi area, Madaya The study area is located at the Tanchaungbin village, west bank of the Ayeyarwaddy River, Pakokku Township, Magway Region in Central Myanmar. Structurally, the study area is characterized by N-plunging major anticlinal fold. The core part is occupied by the Padaung Formation. The east limb is composed of the Irrawaddy Formation, Kyaukkok Formation, Pyawbwe Formation and Okhmintaung Formation. And the west limb is composed of the Irrawaddy Formation, Kyaukkok Formation, Pyawbwe Formation and Okhmintaung Formation. The Okhmintaung Formation is consist of massive, argillaceous and conglomeratic sandstones with sandy shales. Pyawbwe Formation is mainly composed of grey sandy shales. The Kyaukkok Formation consist of soft, yellow and brown sandstones with thin shale partings and concretions. The Irrawaddy Formation, which is composed of coarse-grained, buff coloured sandstones with pebbles. Sedimentary facies and depositional environments reflect the diagenetic features which are calcite cementation, compaction, pyritization, replacement, chloritization, glauconitization, iron oxide cementation and dolomitization. According to the diagenetic fectures, offshore facies deposited under reducing environment. Subtidal facies deposited under slightly reducing and weakly oxidizing environment and intertidal facies deposited under oxidizing environment. The Okhmintaung Formation deposited under subtidal and intertidal environment. The Pyawbwe Formation deposited under offshore and intertidal environment. The Kyaukkok Formation deposited under intertidal environment.

Keywords:

Introduction

The study area is situated in the Central Basin which is mainly made up of Peguan rock units. Stratigraphic units observed in the study area are Padaung Formation, Okhmintaung Formation, Pyawbwe Formation, Kyaukkok Formation and Irrawaddy Formation.But detail field investigation was done Okhmintaung, Pyawbwe and Kyaukkok Formations.Many previous geologists (Theobald (1869), Cotter (1912) Verdenburg (1920-1921), Pascoe (1931), Clegg (1938), Chibber(1934), Aung Khin and Kyaw Win (1969), San Ngwe(2001), Zin Min Ei(2001) and Yin Yin Latt (2004) studied the geology, stratigraphy and paleontology. The aim of the present study is to detailed study the petrology and facies related diagenesis and estimate the paleodepositional environment of the study area.

Location

The study area is located at the Tanchaungbin village, west bank of the Ayeyarwaddy River, Pakokku Township, Magway Region in Central Myanmar. It lies between latitude 20°00' to 21°5'N, and longitude 94°45' to 94°50' bounded by vertical grids 4 to 12 and horizontal grids 51to 59with one-inch topographic map No.84K/16.Figure (1)

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Method

Lithologic character, boundary characteristic features, sedimentary structures, detail fossil collection in each exposures and altitudes of the rock units were studied along the field traverses. And the lithology was recorded by brief description including color, grain size, bedding nature the presence and kinds of fossils and the observed sedimentary structures.The paleodepositional environment is based on the primary sedimentary structures and diagenetic features according to the Reineck and Singh (1980) and Nichols(2009). Thin sections were prepared and examined under the petrographic microscope.

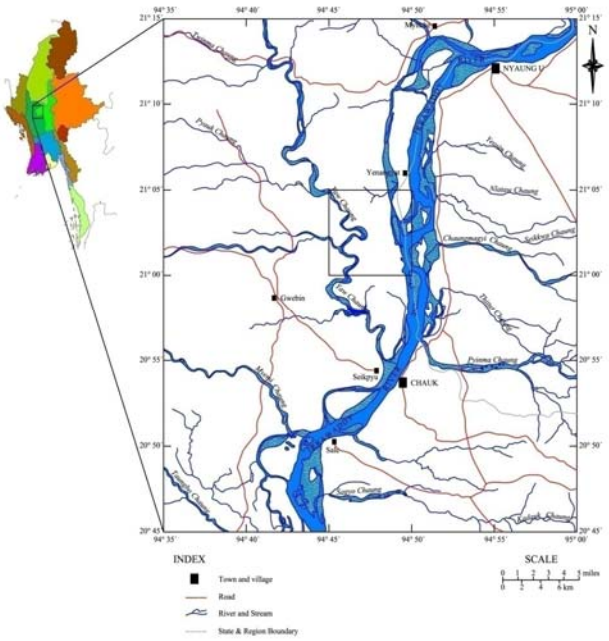

Figure (1). Location map of the study area.

Regional Geologic Setting

Geomorphically as well as tectonically, Myanmar has been divided into four main belts (Stamp 1922, Chibber 1934, Tanish 1950, Win Swe 1981, Maung Thein 1973, 1983, 2000). These four belts are (1) the Rakhine coastal and offshore islands and northern coastal plains, (2) the Western Ranges (IndoBurma Ranges), (3) the Central Low Lands, which is separated into force-arc and back-arc by the Central Volcanic Line and (4) the Eastern High Lands. Among these four belts, the present study area is located in the Central Lowland, especially in the force-arc region.

The Central Low Land is an area of Triassic-Cretaceous to Pliocene marine and non-marine strata bounded by the Western Ranges in the west and in the east by the Eastern High Lands. The Central Volcanic Line (CVL) is a distinct continuous north-south trending series of volcanic cones and massif. According to Curray et.al, (1979) and Bender (1983), these volcanic chains continue to offshore where it separates the west and east Gulf of Moattama or Martaban Basin.

The study area is located at the Central Low Land and eastern flank of Minbu basin .The Central Volcanic Line is longitudinally cutting the Central Belt as to be categorized as fore-arc and back-arc basins. The study area is entirely falls within the fore-arc basin.Structurally, the study area is characterized by N-plunging major anticlinal fold. It is strongly asymmetric, with a steeply dipping at the east limb and gently dipping at the west. At the core of the anticline, where it is made up of Padaung Formation, which is the oldest (Figure 2).The east limb is cut by thrust fault Yenangyat-Chauk thrust (Khin, 1991) In the study area, the Padaung Formation (Middle Oligocene) composed of mainly blue concretionary shales with thin sandy bands and interbedded sandstones occurred. It is conformably underlain by the Okhmintaung Formation.

The Okhmintaung Formation (Upper Oligocene) which is unconformably overlain by the Pyawbwe Formation. It is massive, argillaceous and conglomeratic sandstones with sandy shales and locally bands of hard shelly limestones. The Pyawbwe Formation is unconformably underlain by the Okhmintaung Formation. It is mainly composed of grey sandy shales with thin fossiliferous sandstones and conglomerates. Gypsum are common. The Kyaukkok Formation (Lower Miocene) consist of soft, yellow and brown sandstones with thin shale partings and concretions. Beds of fine alternation of yellow sand and shale also occur. The Irrawaddy Formation, which is composed of coarse-grained, buff coloured sandstones with pebbles .Fossils woods are abundant.

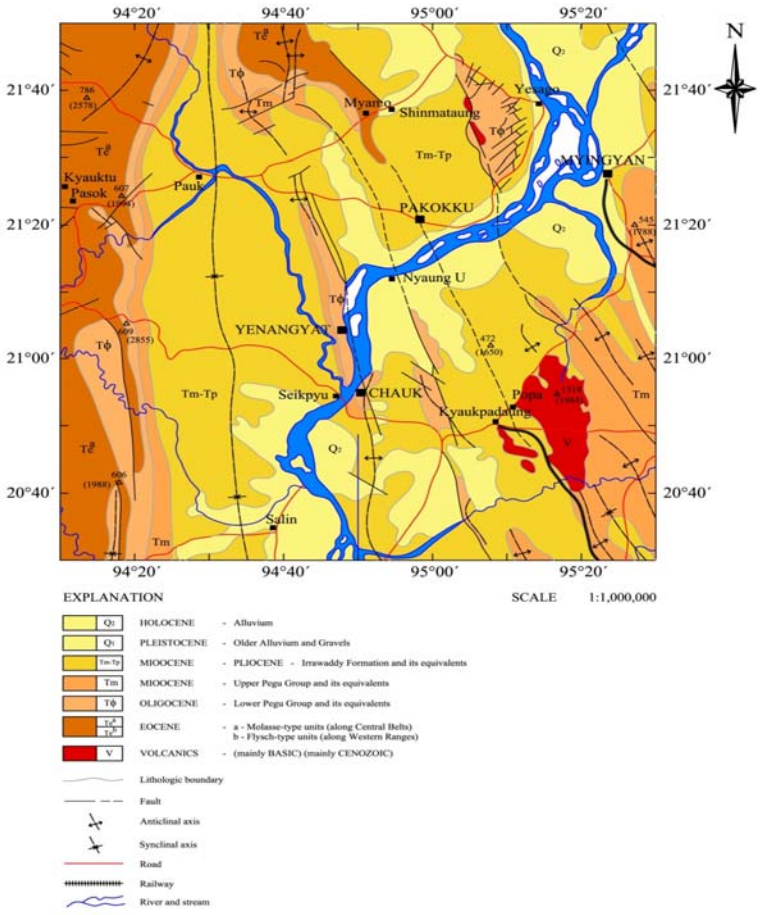

Figure (2). Regional Geological map of the study area.

Stratigraphy

The study area is situated in the Central Basin which is mainly made up of Peguan rock units. Stratigraphic units observed in the study area are Padaung Formation, Okhmintaung Formation, Pyawbwe Formation, Kyaukkok Formation and Irrawaddy Formation.But detail field investigation was done Okhmintaung, Pyawbwe and Kyaukkok Formations.

Table (1). The stratigraphic sequences of the Tanchaungbin chaung area.

Subdivision	Age
Alluviuum	Quaternary to Recent
Irrawaddy Formation	Late Miocene to Pliocene
Kyaukkok Formation	Early Miocene
Pyawbwe Formation	Early Miocene
Okhmintaung Formation	Late Oligocene
Padaung Formation	Middle Oligocene

In the study area, the Padaung Formation (Middle Oligocene) composed of mainly blue concretionary shales with thin sandy bands and interbedded sandstones occurred. It is conformably underlain by the Okhmintaung Formation. The Okhmintaung Formation (Upper Oligocene) which is unconformably overlain by the Pyawbwe Formation. It is massive, argillaceous and conglomeratic sandstones with sandy shales. Pyawbwe Formation is unconformably underlain by the Okhmintaung Formation. It is mainly composed of grey sandy shales and conglomerates. Gypsum is common. The Kyaukkok Formation (Lower Miocene) consist of soft, yellow and brown sandstones with thin shale partings and concretions. Beds of fine alternation of yellow sand and shale also occur. The Irrawaddy Formation, which is composed of coarse-grained, buff coloured sandstones with pebbles .Fossils woods are abundant.

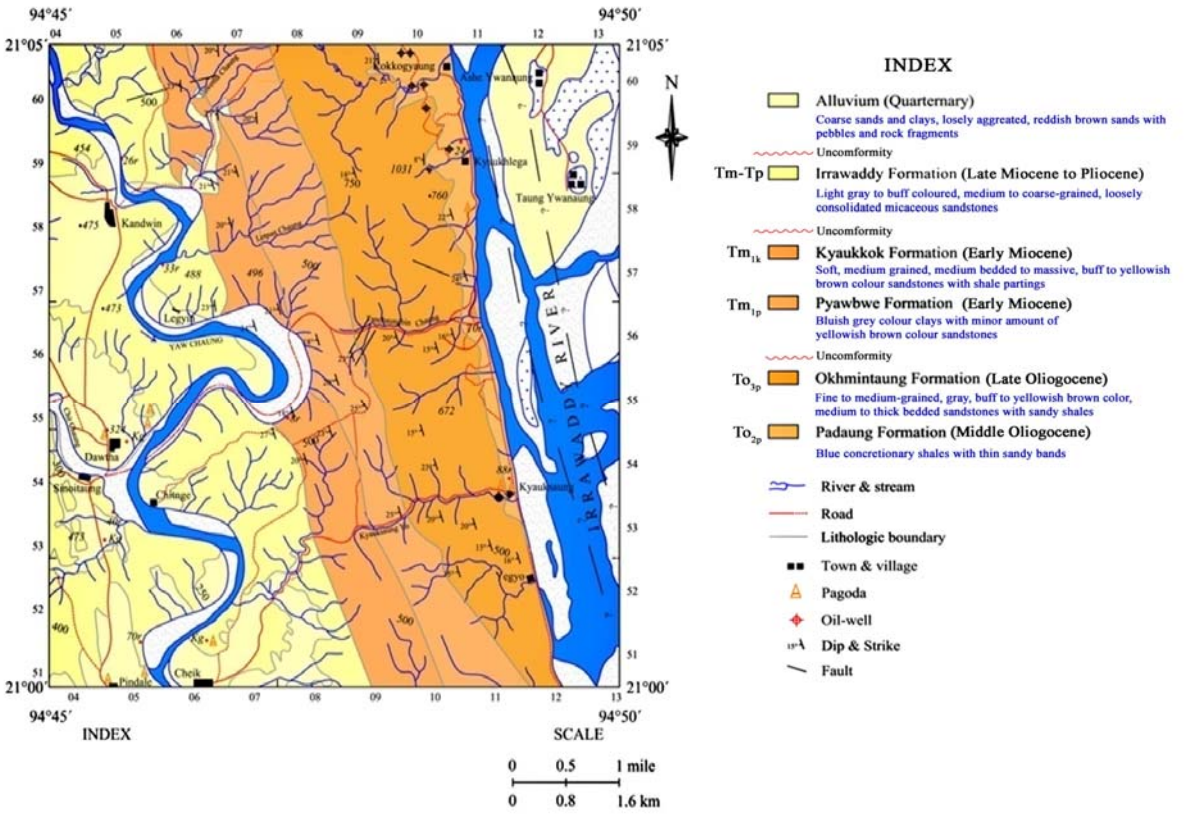

Figure (3). Geological map of the study area.

Facies Analysis

Lithofacies studies and interpretation, Okhmintaung Formation yield four lithofacies :(1) Swaley cross-stratified sandstone facies, (2) Trough cross bedded sandstone facies (3) Lenticular bedded facies, (4) Hummocky cross stratified sandstone facies, (5) Sandstone with gypsum intercalated facies, (6) Small scale rippled sandstone facies and(7) Thick bedded sandstone facies. Pyawbwe Formation yield three lithofacies: (1) Thick bluish grey shale facies, (2) Sand-mud intercalated facies and(3) Low angle cross bedded sandstone facies. Two lithofacies recognized in Kyaukkok Formation: (1) Sandstone with gypsum intercalated facies and (2) Thick bedded sandstone facies.

In the study area, three lithofacies association can be recognized: (1) Offshore Facies association (2) Subtidal Facies Association and (3) Intertidal Facies Association. Facies of the Okhmintaung Formation falls under Intertidal and subtidal environments. Pyawbwe Formation falls under offshore shelf, offshore transitional and intertidal environment. Kyaukkok Formation falls under Intertidal environment.Figure (4,5,6,7)

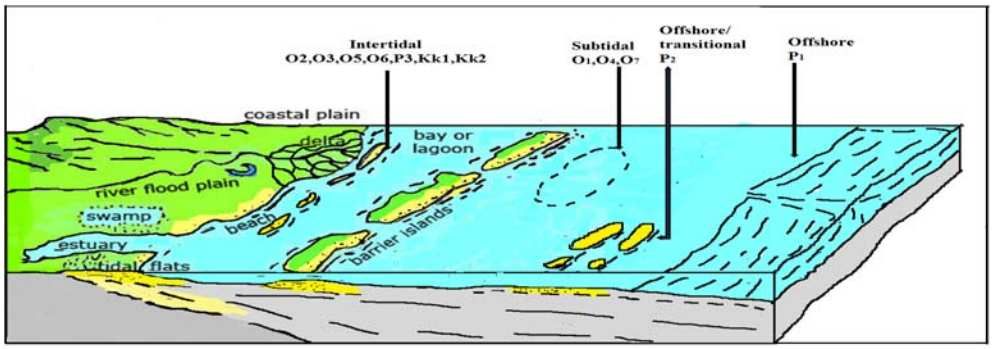

Figure (4). Facies Models showing the evolution of sedimentation of the study area.

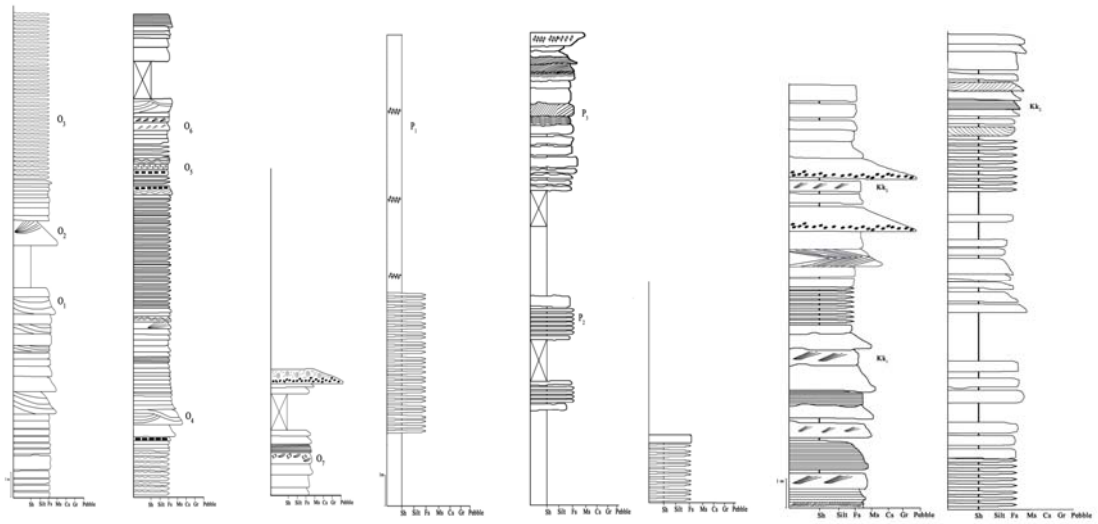

Fig. (5) Fig. (6) Fig. (7)

Figure (5). Stratigraphic columnar section of the Kyaukkok Formation along Tanchaungbin chaung area

Figure (6). Stratigraphic columnar section of the Pyawbwe Formation along Tanchaungbin chaung area.

Figure (7). Stratigraphic columnar section of the Okhmintaung Formation along Tanchaungbin chaung area.

Diagenetic Features

Sedimentary facies and depositional environments reflect the diagenetic features which are calcite cementation, compaction, pyritization, replacement, chloritization, glauconitization, iron oxide cementation and dolomitization. It is noteworty that the glauconites are formed, altered from biotites and fecal pellets. In such a reducing environment, glauconites commonly associated with pyrite, which characterized the Pyawbwe Formation. Formation of clay coating, compaction effects, cementation, chloritization, pyritization, glauconitization, dolomitization, replacement and iron oxide cementation are the distinctive diagenetic feactures of the study area.Figure (According to the diagenetic fectures, offshore facies deposited under reducing environment. Subtidal facies

deposited under slightly reducing and weakly oxidizing environment and intertidal facies deposited under oxidizing environment.

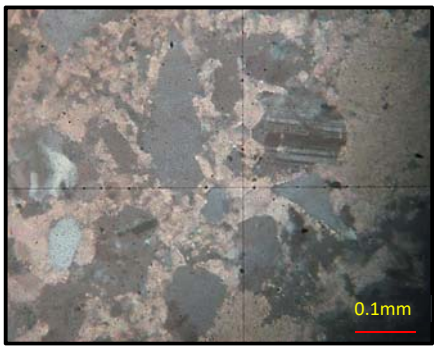

Fig. (8)

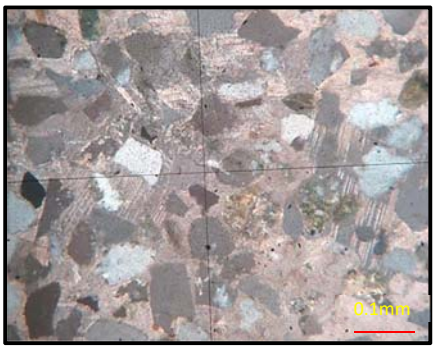

Fig. (9)

Figure (8). Photomicrograph showing the corrosion of feldspar by calcite cement in Okhmintaung Formation. Between X.N

Figure (9). Photomicrograph showing the poikilotopic crystals and dolomite crystal in Pyawbwe Formation. Between X.N

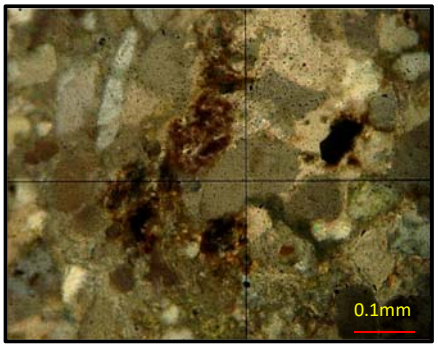

Fig. (10)

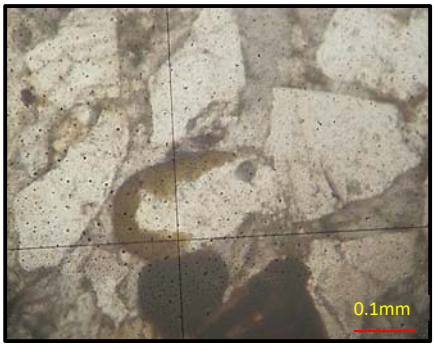

Fig. (11)

Figure (10). Photomicrograph showing the pyrite in Pyawbwe Formation Under P.P.L.

Figure (11). Photomicrograph showing the clay coating (chlorite) partially coated the quartz grain in Pyawbwe Formation Under P.P.L

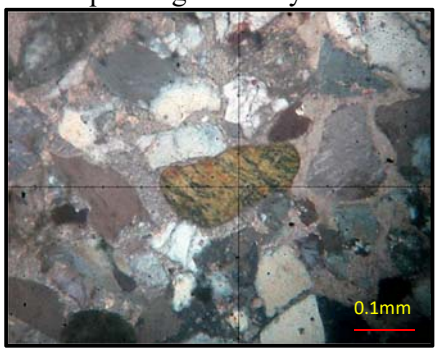

Fig. (12)

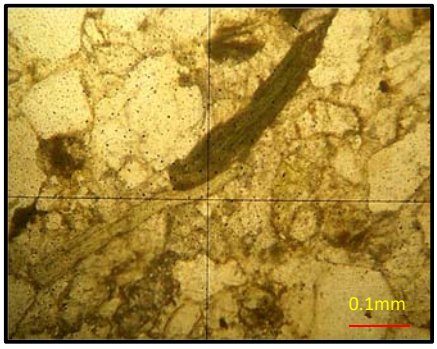

Fig. (13)

Figure (12). Photomicrograph showing the glauconite grain in Okhmintaung Formation. Between X.N

Figure (13). Photomicrograph showing the mica flake deformed by compaction in Pyawbwe Formation Under PPL.

Fig. (14)

Fig. (15)

Figure (14). Photomicrograph showing the emplacement of calcite within the detrital grain and corrosion nature at the edge of detrital grain in Pyawbwe Formation Between X.N

Figure (15). Photomicrograph showing the replacement of calcite within the fossil chamber in Pyawbwe Formation. Between X.N

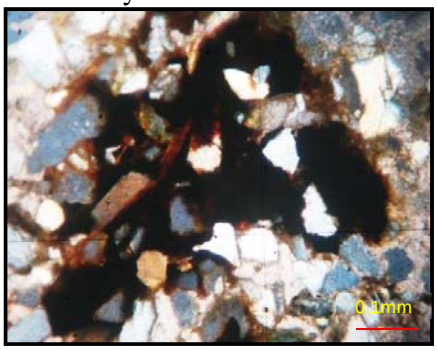

Fig. (16)

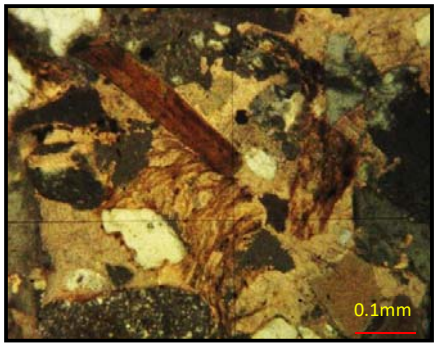

Fig. (17)

Figure (16). Photomicrograph showing the iron-oxide cement in Kyaukkok Formation Between X.N.

Figure (17). Photomicrograph showing the emplacement of calcite along the cleavage of biotite mica in Pyawbwe Formation Between X.N.

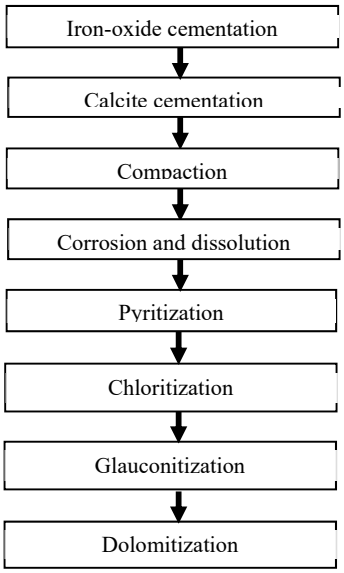

Figure (18). Flow chart showing the diagenetic stages of the study area.

Table (2). Facies related diagenetic features of the study area

Facies Association / Diagenetic features	Offshore Facies association	Subtidal Facies association	Intertidal Facies association
Calcite Cementation			
Compaction			
Pyrite			
Replacement			
Chloritization			
Glauconitization			
Iron oxide cementation			
Dolomitization			

Explanation

= very poor
= poor
= moderate
= well

Conclusions

The study area is situated in the Tanchaungbin village, west bank of the Ayeyarwaddy River, Pakokku Township, Magway Region. In the study area, mainly constituted of Tertiary mollassic clastic sedimentary rocks of the Pegu Group and Irrawaddy Formation. There are three Formation which are Okhmintaung Formation, Pyawbwe Formation and Kyaukkok Formation. Okhmintaung Formation is unconformably overlain by Pyawbwe Formation. There is a well defined paleotological break between the Okhmintaung Formation and Pyawbwe Formation. Kyaukkok Formation is unconformably overlained by the Irrawaddy Formation. The boundary between Kyaukkok and Pyawbwe Formation is transitional.

Structurally, the study area is characterized by N-plunging major anticlinal fold. It is strongly asymmetric, with a steeply dipping at the east limb and gently dipping at the west. At the core of the anticline, where it is made up of Padaung Formation, which is the oldest formation .The east limb is cut by thrust fault Yenangyat-Chauk thrust (Khin, 1991). The western limb is composed of Okhmintaung Formation, Pyawbwe Formation and Irrawaddy Formation. Lithofacies studies and interpretation, Okhmintaung Formation yield four lithofacies :(1) Swaley cross-stratified sandstone facies, (2) Trough cross bedded sandstone facies (3) Lenticular bedded facies, (4) Hummocky cross stratified sandstone facies, (5) Sandstone with gypsum intercalated facies, (6) Small scale rippled sandstone facies and(7) Thick bedded sandstone facies. Pyawbwe Formation yield three lithofacies: (1) Thick bluish

grey shale facies, (2) Sand-mud intercalated facies and(3) Low angle cross bedded sandstone facies. Two lithofacies recognized in Kyaukkok Formation: (1) Sandstone with gypsum intercalated facies and (2) Thick bedded sandstone facies.

In the study area, three lithofacies association can be recognized: (1) Offshore Facies association (2) Subtidal Facies Association and (3) Intertidal Facies Association. Facies of the Okhmintaung Formation falls under Intertidal and subtidal environments. Pyawbwe Formation falls under offshore shelf, offshore transitional and intertidal environment. Kyaukkok Formation falls under Intertidal environment.

In the study area, distinct diagenetic features are noted. Calcite cementation, compaction, replacement, pyritization, glauconitization, iron oxide cementation and dolomitization respectively. These diagenetic features governed the depositional environment is well noted.

In offshore facies association, compaction is well defined and pyritization, replacement , chloritization, glauconitization, iron oxide cementation and dolomitization are poor . Glauconite appears the process requires a particular environment at the interface between minimum oxidizing seawater and slightly reducing interstitial waters. The formation of glauconite favoured in black mud and sands in anaerobic environment, where oxidizing may occur, at the surface of the sediments. Pyrite might have precipitated by the reduction between residual iron oxide and hydrogen sulphide expelled as by the products of bacterial process (Burlay, et.al, 1985). Chlorite probably derived from the breaking down of ferromagnesium minerals, alumina-silicate and iron oxides in reducing alkaline pore waters (Land and Dutton, 1978). So, it pointed out that over-burden pressure is high, under non-photic zone, low energy and it deposited under reducing environment .

In the subtidal facies association, pyritization, replacement and dolomitization are very poor, compaction, cementation, chloritization and glauconitization are moderately defined and iron oxide cementation is poorly defined. Glauconite are formed only in marine water and required slightly reducing (Cloud, 1955), and weakly oxidizing condition (Chilingar, 1956). Chlorite probably derived from the breaking down of ferromagnesium minerals, alumina-silicate and iron oxides in reducing alkaline pore waters (Land and Dutton, 1978). Chlorite is formed most commonly in soils with moderate leaching under fairly acidic groundwater conditions and in soils in arid climates (Nichols, 2009). It state that the over-burden pressure is moderate, the area of slow sedimentation , and depositional environment is under slightly reducing and weakly oxidizing environment.

For the intertidal environment, pyritization and replacement and dolomitization are very poor, compaction, cementation and iron oxide cementation are moderatly defined but chloritization and glauconitization are poorly defined. The evidence of oxidation is the formation of iron oxides and hydroxides from minerals containing iron. Therefore, intertidal facies favour the oxidizing condition that was experienced by subaerial exposure in tidal process.

Moreover, the present study point out the diagenetic prosess relative to depositional environment. Therefore, transgressive diagenesis and regressive diagenesis can be revealed. The evidence of trangressive diagenetic can be generally recognized by the rate of pyritization, glauconitization and chloritization. And also, evidence of regressive diagenetic can be recognized by iron oxide cementation. Pyritization is more favoured in offshore facies than in subtidal and intertidal facies and, glauconitization and chloritization also take place. So, it can be point out the trangressive condition. Intertidal facies showed more iron oxide cementation than subtidal and offshore facies. Hence, the regressive condition is dominant.

Pyritization is very poor in subtidal facies and, glauconitization and chloritization is moderatly defined. Therefore, the regressive condition is dominant. According to the facies related diagenetic features, offshore facies deposited under reducing environment. Subtidal facies deposited under slightly reduction and weakly oxidizing environment and intertidal facies deposited under the oxidizing environment.

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