Mineralogical & Petrographic Microfacies Study of the Zahraa formation (Pliocene– Pleistocene) in Sawa Lake Surrounding area- IRAQ

Saleh A. Lazam

College of science/ Muthanna University

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*Corresponding Author: *sala@mu.ed.iq*

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Abstract : Mineralogical, Petorographic Microfacies study has been done on (16) samples of Zahraa formation (Pliocene – Pleistocene) of outcrop in Surrounded Sawa Lake area. The mineralogical study showed that Calcite is the main mineral within the rock formation, whereas the upper rocks of Zahraa Formation consist silty or sandy claystone is dominant in the middle and the upper portion, in addition to quartz, clay minerals, iron oxide and organic matter as insoluble residues. From thin sections study, Three main microfacies have been identified which are: Charophyte shelly bioclastic wackestone, Charophyte shelly bioclastic dolowackestone and Algal wackestone. Based on microfacies study and its fossils content, it has been possible to determine the depositional environment of Zahraa Formation which deposits in the area of the presence of Charaphytes, indicates fresh water environment. From the depositioal situation and the large extension in the project area, the type of fresh water environment is ephemeral freshen water lakes.

Keywords: Petrography, Zahraa Formations, Sawa lake, X-ray, Insoluble Residue, Facies, Depositional Environment.

Introduction.

with calcite crystals, due to high recrystallization.The reddish brown silty or sandy claystone beds cropped out in limited places, in many locations only the upper bed of pinkish white limestone was observed in the research area.Al-Mutter (1983) in Najaf area mentioned the Late Miocene age to the formation. Raji and Said (1984) in South Samawa give the formation Pliocene-Pleistocene age. Muniem (1984) in West Nukhaib area mentioned the Late Miocene-Pliocene age to the formation. Behnam (1984) in Bahr En Najaf area give the formation the Late Miocene age. Salman (1984) in North Busaiya area claimed Pliocene-Pleistocene age for the formation. Salman (1993) claimed Pliocene-Pleistocene age according to its lateral relation with Dibdibba Formation. Jassim and Buday in Jassim and Goff (2006) claimed Late Miocene- Pliocene age.

In this study were collected rocks Zahraa formation from areas around Sawa lake south-

The Zahra Formation was introduced by Williamson (1941) in Belen *et al*., (1959) from the type locality in Faidat al Zahra, 7 Km south of the Salman – Bussaiya track, 65 Km west of Bussayia town. It is defined at the following coordinates (Al-Khateeb, 2008)

Longitude: 45 27 54 E
Latitude: 30 13 12 N

Zahra Formation consist of three cycles, while in the area of the second stage, the first cycle only is exposed as scattered isolated hills in the whole area, and consists of the following: At the base, it is composed of a red to reddish brown silty or sandy claystone, medium tough, conchoidally fractured, slope forming, about (2–3) m thick. Gradationally overlain by green sandy claystone, medium tough, fragmented, slope forming, with secondary gypsum and rusty materials with black dots, 2 m in thickness. Capped by 1.0 m of pinkish white limestone, fine crystalline, medium tough, splintery fractured, This study petrographic and mineralogic for both formation aims to infer depositional environment and Diagensis processes.

western part of the province of Muthanna (25 kilometers) west of Samawa City Centre & Euphrates River, and trapped between latitudes (31.19°- 31.17°) north "and longitudes (44.59-45.0120") to the east," to represent the study area (Fig. 1).

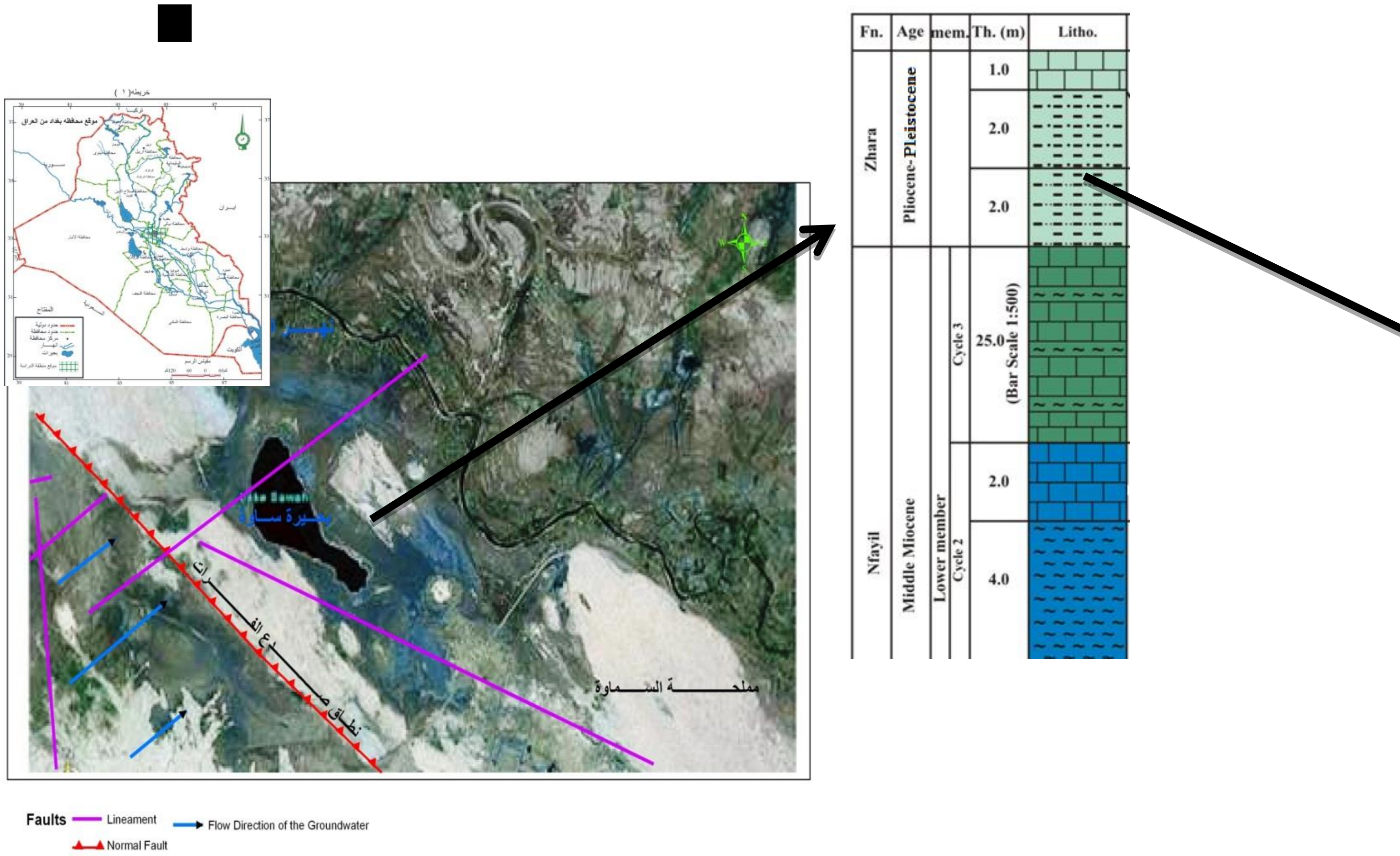


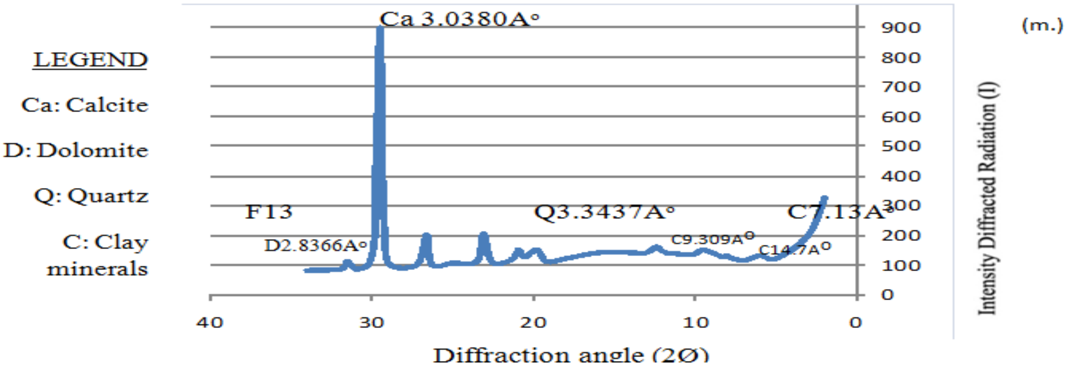
Fig. 1: The satellite image shows the study area with stratigraphic Section

Sampling & Methodology

Collected (16) rock samples the zahraa formation in thickness (5 m) in the vertical edges of the lake sawa periods. The thin slides for each samples in order to study petrographic work, were those segments dye (Alizarine Red-S) to distinguish between calcite and dolomite by the way (Friedman, 1971). Identified calcite and dolomite using the ratio method EDTA (Muller, 1967). And used X-ray technique for the study of rocks and metal content of calcite and dolomite. Identified the insolubles residues is dissolved using dilute hydrochloric acid by the way (Ireland, 1971).

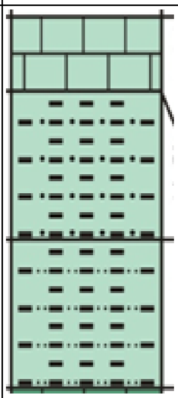
Mineralogy of Formation

The use of Diffraction X-ray (XRD) to identify the mineral nature and diagnosis of the constituent metals to form zahraa formation (Part limestone) and clastic (insolubles residues fraction), and to identify the mineral content of the total sample was selected range of models examined in the range 50° -2= 2 show zahraa formation The calcite and dolomite mineral are the components of the two presidents carbonate part of the configuration (Fig. 2), as the calcite be confined in the bottom of the composition while the mineral dolomite is common in the middle and upper parts of the configuration it has accounted amounted to 12.77% on average. As for the metals is carbonates (Residual insoluble) (where it is carbonates rocks more types of rocks being out like this examination), and know Residual is dissolved as those remaining material after digest form in the solvent liquid (often acid) such as hydrochloric acid, acetic and formic acids may be used in other various concentrations, according to the purpose of the search. Contain Residual insoluble regular and mainly on a metal quartz and granite as well as the possible presence of other metals and the proportions slim usually like pyrite, fossils ,silica and clay minerals and proportions less other metals size of silt and sand, such as gypsum and Anhydrite, mica, iron oxides, and other metal resistance to acids (Ireland, 1971). Appointed percentage of the weight of the total residual non-soluble Total IR% based on the method proposed by (Ireland, 1971).



(Fig. 2): X-ray diffraction of Mineralogy Zahraa formation

(Table 1): proportion of Insoluble residual (Ireland, 1971) and Ratio Calcite- dolomites

Zahraa formation				INSOLUBLE RESIDUE I.R%	CALCITE %	DOLOMITE %
age	Th.(m)	Lithology	Description			
Pliocene-Pleistocene	1m 2m 3 m		Limestone, pinkish, white, medim tough, fine crystalline, splintery fractured with calcite crystallization. Sandy claystone, green ,medium tough, fragmented ,secondary gypsum, rasty material with black dots. Silty claystone, red and reddish brown ,medium tough, conchoidally fractured.	1 1.5 1.4 0.8 1 1.1 1.2 11.2	90.88 95.58 94.66 94.32 90.81 86.07 88.14 92.83	2.2 2.3 2.1 1.9 2.4- 2.5 1.7 1.5

Petrographic & Depositional Environments:

The Zahra Formation according to Bellen *et al*. (1959), Amer (1980) and Salman (1984), is of fresh water environment, the fossils evidence confirm their opinion. Al-Mubarak and Amin (1983) indicated that the formation was deposited in fresh water fluviatile environment. From paleogeographical points of view, the Zahra Formation may have been deposited in water logged marshy area, at the margin of the floodplains of the Dibdibba Formation (Jassim *et al*. 1984). Behnam (1984) claimed that the formation was deposited in continental environment, the salinity range from brackish to fresh water (Dunhum, 1962) Raji and Said (1984) claimed that the formation is deposited in fresh water. Salman (1993) mentioned that the formation seems to be deposited in fresh water lacustrine conditions. The Zahra Formation is considered by Jassim and Buday in Jassim and Goff (2006) as fluvio- lacustrine and karst fills facies, due to the presence of reed stalks.

Microfacies of the Zahra Formation

The main microfacies identified in this formation is wackestone. This microfacies is divided into submicrofacies depending on microfaunal contents. These are:

Charophyte shelly bioclastic wackestone

The rocks of this submicrofacies are white, pinkish white, pink and grayish pink color, medium tough to very tough and some of them enclosing large numbers of biomolds and shell fragments. Petrographically, it is mainly composed of bioclasts (Charophyte, thin shell fragments of osrtacods, pelecypods, gastropods such as *Vivapara* sp.,and *Planiorbis* sp., algae and worm tubes). These fossils are embedded in a micritic groundmass that is partially recrystallized to microsparite in some samples and partially dolomitized in other sample (plate.1.1). This submicrofacies contain scattered quartz grains (about 2%). They are anhedral to slig htly subhedral and euhedral, rounded and mostly of silt to very fine, fine and medium. The essential diagenetic changes affect this submicrofacies are neomorphism, selective dedolomitization, dissolution and cementation. This submicrofacies is comparable to LMF 7of Flugel (2004) and characterizes the shore region of humid and semiarid lakes, Al-Mubarak and Amin (1983).

Charophyte shelly bioclastic dolowackestone

Only one sample is present within this submicrofacies. This rock is whitish gray and pinkish at parts, very tough, chalky and enclosing cavities filled with secondary calcite. Petrographically, this submicrofacies is characterized by the presence of fossils>10% embedded in a micritic groundmass that completely dolomitized by very fine dolomite. The identified fossils are charophyte and abundant molds of ostracods and pelecypods. The diagenetic processes affect this submicrofacies are dolomitization and dissolution. This submicrofacies relates to (Pomar,2001; Ghosh, 2002) and characterizes the shore region of semiarid lakes.(plate 1.2.3).

Algal wackestone

Only one sample is found within this submicrofacies. The rock is beige and very tough.

Petrographically, the rock is characterized by the presence of algal debris associated with few thin-shelled recrystallized ostracods, pelecypods and few charophyte. These fossils are present within micritic groundmass that selectively dolomitized by very fine dolomite.

This submicrofacies is affected by recrystallization of fossils and cementation. This submicrofacies relates to (Hallock, 1999) and occurs in shore lake-floor areas affected by waves. (plate 1.2)**.**

iagensis Processes

- Dedolomitization

It is a diagenetic replacement of dolomite by calcite (Dunham,R.J.,1962). This process is very limited in the study area. In Zahra Formation, this process is selectively replaced the micritic groundmass. It is indicated by the presence of rhombohedra isolated crystals of fine size floating porphyrotopically within a micritic or microsparitic groundmass. This process is formed under the influence of meteoric freshwater in lacustrine environment. In Euphrates Formation, the dolomite crystals are completely replaced by fine and rhombic interlocking crystals of calcite in one sample and in other sample are indicated by the presence of poikiliotopic coarse calcite enclosing finer crystals of dolomite. It is associated with iron oxides reflecting deposition during late subaerial exposure (epigenetic changes) Salman (1993).(plate 2.1).

Inversion

This process is only observed in the rocks of Zahra Formation. It is indicated by the preservation of the original aragonitic fossils by radial calcite as in ostracods, (plate 2.2). This process caused mainly by the unstable nature of aragonite and occurred meteorically in freshwater vadose environment.

-Dissolution and porosity development

This process is gained through solution and dolomitization and reduced through cementation (Choquette and Pray, 1970). It is the most diagenetic extensive and dominant in the study area and divided into two main groups according to Choquette and Pray (1970). These are:

Fabric-selective pores

Both primary and secondary fabrics control fabric selective pores. These pores are of several different types.

Intraparticle porosity

This porosity is developed within individual particles or grains, particularly within the chambers of skeletal fragments (e.g. intragranular pores in foraminifera) and dissolution of the nuclei of some ooids and composite ooids. In the study area, most of the recognized submicrofacies are affected to various extents by this process. This type of solution is formed under the influence of meteoric phreatic and meteoric vadose environment.

Interparticle porosity

This porosity is primary and occurred between individual particles (skeletal and non-skeletal grains). Most of These pores are reduced by sparry calcite and silica cement.

Fenestral porosity

It is open space irregularly distributed in micrite or microsparite that mostly replaced by dolomite. It is very common in most rocks of the study area, mostly filled either partially or completely by sparry calcite cement (granular, drusy and isopachous cement) and mostly associated with supratidal and intertidal, algal-related and mud-dominated sediments (plate2.3)

Moldic porosity

This is caused by solution of whole fossils or ooids (biomoldic and oomoldic). Most of the shells in the study area are dissolved especially mollusks and causing moldic porosity as metastability of aragonite (plate 2.4). This type of porosity is widespread in shallow marine carbonate and commonly occurs in meteoric-phreatic environment (James and Choquette, 1983) and in hypersaline waters.

Intercrystalline porosity

These pores are developed between dolomite crystals in crystalline dolostone. The intercrystalline porosity has more likely resulted from dolomitization, which caused an increase of pore space when limestone changed to dolomite. These pores are mostly reduced by calcite cement.

Dolomolds

This process is very limited in the rocks of the studied formations and only recognized in Zahra Formation. This is indicated by the presence of rhombic pores randomly scattered throughout the groundmass (plate 2.5). It is commonly produced by solution of calcite or by dedolomitization through contact with meteoric groundwater (Evamy, 1967).

Drusy calcite cement

This type occurs in an intraskeletal pores, molds and fenestral porosity as fine lining the interior of the walls and then increased in size towards the center of the pores. The increase in size of calcite crystals was interpreted as arising from competitive growth (Bathurst, 1975). In Zahra Formation, it occurs within dissolved aragonitic ostracods and worm tubes indicating freshwater meteoric vadose environment. In Euphrats and Nfayil Formations, it is formed in the carbonate sediments that were deposited in the intertidal or supratidal or that they were brought into the subaerial environment shortly after deposition.

Results

Most of the limestone rocks environmental Interpretations depends on the examination and study of thin sections and the adoption of the descriptive system Microfacies, and facies sedimentary group is contiguous deposited in the basin precipitation, and as a result of progress and retreat sea can move facies adjacent and change their positions in the basin precipitation as deposited in one sequential top of the other according to the law liter (Maill, 1984).

The age of Zahra Formation is claimed to be probably Late Miocene (Thompson, 1957 in Bellen *et al.*, 1959); Late Miocene or younger is claimed by Bellen *et al*. (1959). This formation is the youngest stratigraphic unit exposed in the studied area. It is consist of massive whitish and reddish recrystallized limestone, slightly sandy, fossiliferous dolomitic limestone and dolomitic limestone. (Perry, 2000).

From the depositioal situation and the large extension in the study area, the type of fresh water environment is ephemeral freshen water lakes.

Al-Mubarak and Amin (1983) claimed at late Pliocene age for the Zahra Formation, in the Southern Desert indicating by its occurrence in the central parts of the closed karsts depressions and it is accumulated after the karstifiction of the gypsum. Al-Ani and Ma'ala (1983a) reported that the Zahra Formation may be represent lateral facies of Dibdibba Formation, so they have the same age Pliocene-Pleistocene. Al-Ani and Ma'ala (1983b), suggested Pliocene-Pleistocene age in the north of Busaiya, according to its stratigraphic position because it overlies the Fatha Formation and passes laterally into Dibdibba Formation. Jassim *et al*. (1984) denoted that the presence of a tongue of limestone similar to those of Zahra Formation in Dibdibba Formation suggests that the two formations are laterally equivalent at least in parts. Muniem (1983) in West Samawa mentioned the Late Miocene age to the formation.

The recognized fossils in Zahra Formation are:

Charaphytes, *Planorbis sp*., *Vivapara sp*., Gastropods, Ostracods, shell fragments.

The suggested age of Zahra Formation is Pliocene– Pleistocene.

Plate1

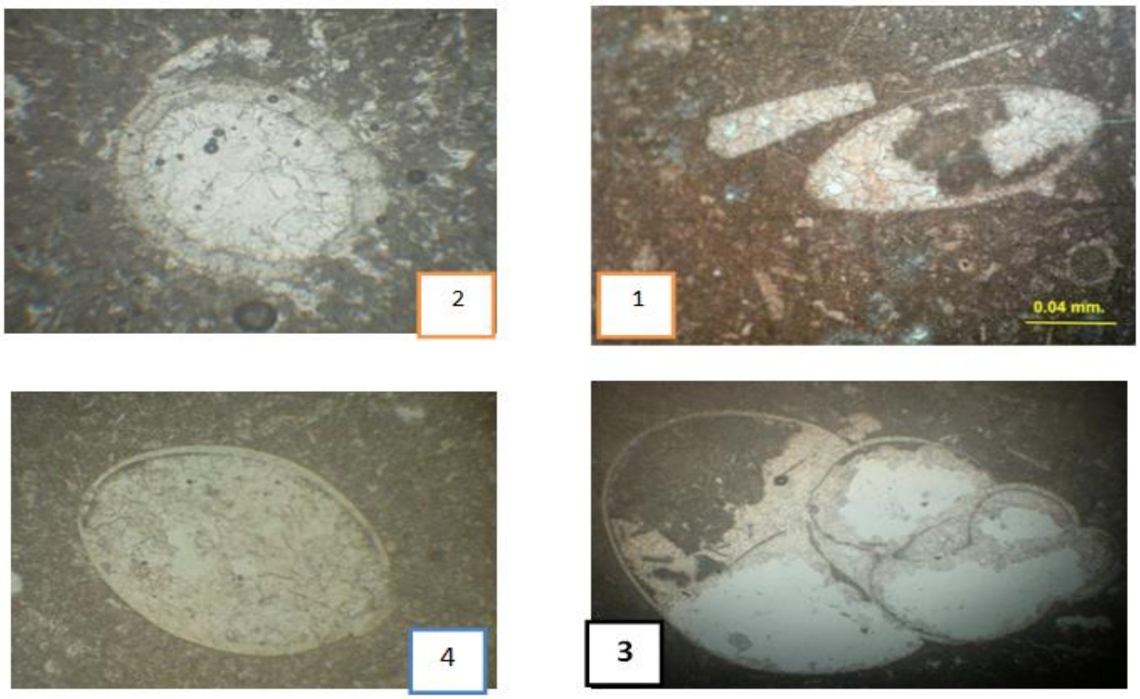


Plate 1.1 : Charophyte shelly bioclastic wackestone
Plate 1.2 Charaphytes, X10.
Plate 1.3 *Vivaparus* sp. (gastropods), X10.
Plate 1.4 Ostracods, X10.

Plate 2

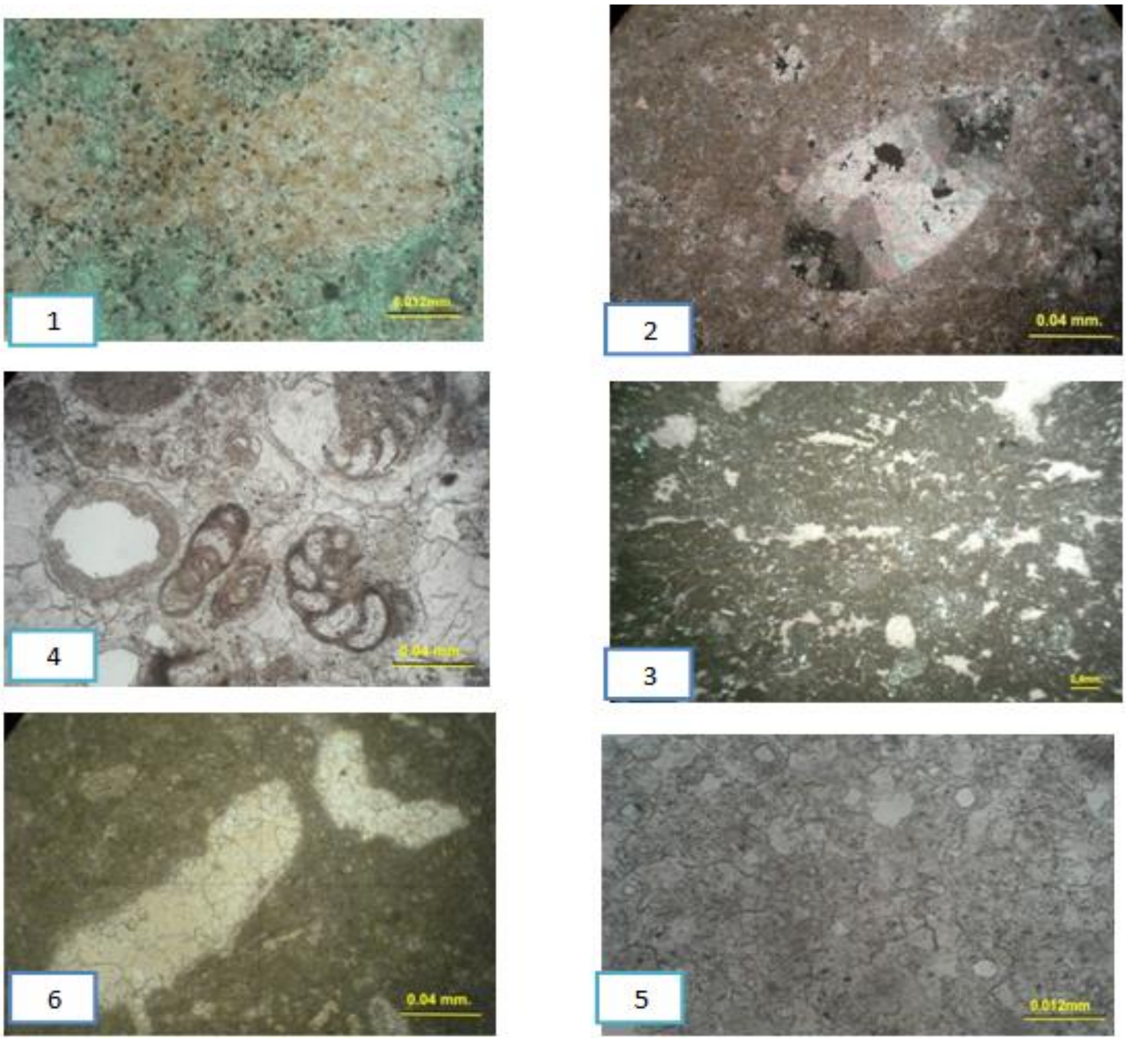


Plate 2.1 Dedolomitization
Plate 2.2 Inversion affects ostracoda
Plate 2.3 Fenestral porosity
Plate 2.4Moldic porosity.
Plate 2.5 Dolomolds

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