Petrographical Studies Of Okeluse Limestone

Boluwade E. A., Nenuwa O.B. and Ogunleye O.

Abstract: Five samples of limestone collected from different locations at the Okeluse forest reserve, were petro graphically studied under the microscope at x80 magnification. Samples showed shell fragments of echinoderm, brachiopods surrounded by micrite envelope which indicate a low energy environment of formation .The presence of brachiopods indicate that the Okeluse Limestone belongs to the group of rocks of ancient marine of the Palaeozoic-Mesozoic era. Mudstone matrix in some samples could have caused the greyish colouration of the Okeluse Limestone since the detritus (sand or mud) was excreted by the constituent organism. Bivalves and gastropods are identified. They are made of aragonite and preserved as casts.

Keywords: Aragonite, Casts, Limestone, Matrix, Micrite, Mollusc, Petrographically

1. INTRODUCTION

Limestone is a sedimentary rock composed primarily of Calcium Carbonate ($CaCO_3$) in the form of the mineral calcite. It is most commonly formed in clear, warm, shallow marine waters. It is usually an organic sedimentary rock that forms from the accumulation of shell, coral, algae and fecal debris. It can also be a chemical sedimentary rock formed by the precipitation of calcium carbonate from lake or ocean water. Limestone is calcareous sedimentary rock composed of the Calcite ($CaCO_3$), which upon calcinations would yield lime (CaO) that can be used for commercial purposes. In its broadest interpretation, the term includes any calcareous material such as marble, chalk, travertine, tufa, limeshell, coral and marl each possessing different and distinct physical properties. The crystalline equivalents of limestone that are having the same chemical composition are calcite and aragonite. In nature, the limestone bed is found to occur in varying purity, generally a part of the calcium molecules being replaced by magnesium would tend towards magnesium limestone or dolomitic limestone. Limestone with more than 10% of mineral dolomite is termed dolomitic limestone and that with 5 to 10% is magnesium limestone. The rock containing more than 95% of calcium carbonate is termed high-calcium limestone. Recrystallised limestone takes good polish and is used as decorative and building stone. It is then called 'marble'. A variety of other names is associated with limestone depending upon the modes of occurrence, texture, and the remains of foraminifera, molluscs and other shell-forming creatures, for example, oolitic and pisolitic limestones, reostone, crinoidal limestone, foraminiferal limestone, calcareous ooze, bryozoa limestone, argillaceous and hydraulic limestones and the like. Oolitic limestone is the name given to granular limestone of which each grain consists of a series of concentric layers of calcium carbonate resembling the eggs of the fish. When it resembles the eggs of Roe fish, it is called Roestone. The name Pisolite-limestone is given when the grains are of the size of peas. Crinoidal limestone is a rock composed of encrinites with the remains of foraminifera-molluscs and their lime forming organism. Such beds are commonly found in lower Carboniferous formations. Most limestones are formed in shallow, calm, warm marine waters. That type of environment is where organisms capable of forming calcium carbonate shells and skeletons can easily extract the needed ingredients from ocean water. When these animals die their shell and skeletal debris accumulate as sediment that might be lithified into limestone. Their waste products can also contribute to the sediment mass. Limestone that is formed from this type of sediment are biological sedimentary rocks. Their biological origin is often revealed in the rock by the presence of fossils. Limestone is one of the most abundant rocks in Nigeria and of great economic potentials hence the need to study them petrographically to further help in their identification and exploration for building construction and quarry operations. The present global drop in the sale of crude oil is a pointer to the fact that Nigeria needs to urgently diversify her economy. Hence the need by our various government to invest heavily on the solid minerals sector of the nation's economy. This study is aimed at identifying the mineral and biological content plus the structural and textural features of Okeluse limestone under microscope in order to assess its origin, formation and industrial potentials. Dissolve salts may be precipitated to form bed of rock salt, gypsum e.t.c. or they may be absorbed by organisms to form their skeletons. These skeletal materials may accumulate in large quantities to form different types of sedimentary rock e.g. chalk and limestone (Fayose, 2002). According to Fayose (2002), in Nigeria, the limestone quarry at Ewekoro, Ogun state contains moulds and cast of molluscs as well as echinoderms. He reported that living representatives of echinoderms, cephalopods, brachiopods and coelenterates live in the sea just as they have always done. Therefore, their presence in ancient rocks suggests a marine origin for that rock. Also reef building corals most probably lived in warm shallow, well aerated water in the past as they do now; Coral reef and thick limestones are usually associated with warm climates. Calcite is the stable form of calcium carbonate at ordinary temperatures, and may be regarded as the principal mineral of limestones. Aragonite is the form which calcium carbonate normally adopts when inorganically precipitated from sea water. The older limestones normally contain no aragonite, and any shells which originally consisted of this mineral are found to be

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represented by open moulds or by coarsely crystalline (sparry) calcite (Greensmith, 1978).

2. METHODOLOGY

The study area (Fig. 1) is located at the Forest Reserve, Okeluse in Ondo State, Nigeria. The terrain is at elevation of 68 meters above sea level at latitude 06^{o} 47^{1} 21.804^{11} and longitude 05^{o} 41^{1} 27.13^{11}. Five samples of limestone (Plate 1 - 5) were collected from different locations of the study area with the aid of a geological hammer. The samples were labelled (L1 - L5) with marker and kept in a sample bag while noting the respective coordinates of each location.

Plate 1: *Sample L1 in hand specimen*

Plate 2: Sample L2 in hand specimen

Plate 3: Sample L3 in hand specimen

Plate 4: *Sample L4 in hand specimen*

Plate 5: *Sample L5 in hand specimen*

Table 1: *Location of samples from Okeluse*

S/N	Sample Number	Coordinates
1	L1	$N6^0\ 47.510^1$ $E5^0\ 41.749^1$
2	L2	$N6^0\ 47.367^1$ $E5^0 41.450^1$
3	L3	$N6^0\ 47.344^1$ $E5^0\ 41.455^1$
4	L4	$N6^0 47.520^1$ $E5^0 41.430^1$
5	L5	$N6^0 47.360^1$ $E5^0 41.425^1$

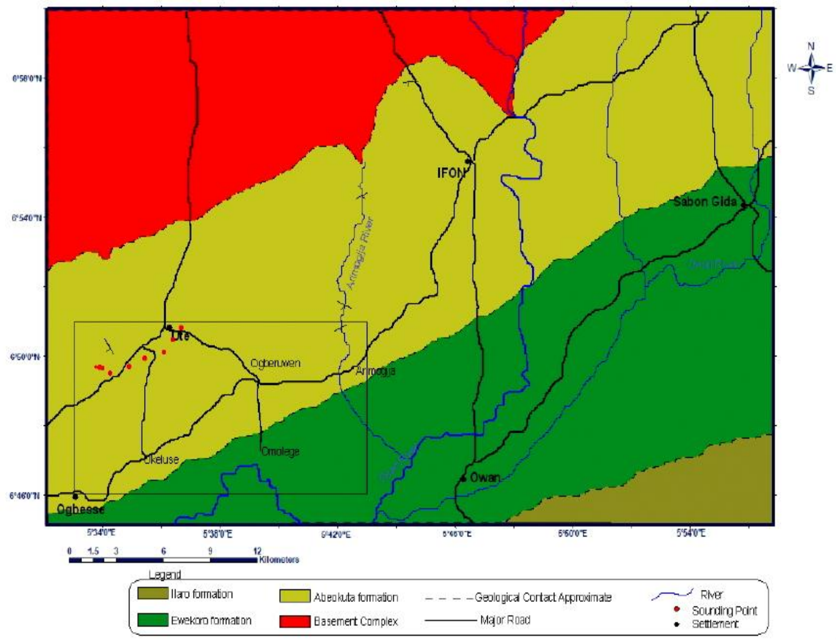

Fig. 1a: *Location map of the study area*

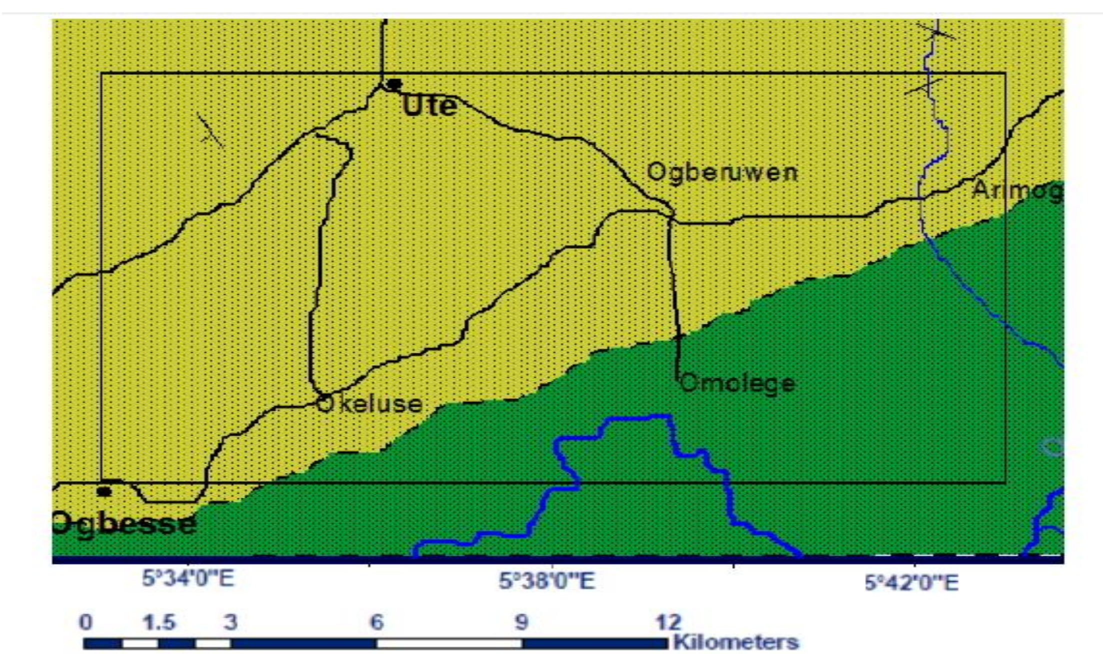

Fig. 1b: *Geological Map Showing the Study Area*

2.1 LABORATORY ANALYSIS

The samples were taken to the Geological Laboratory in the Department of Geology, Federal University of Technology, Akure, Ondo state (FUTA) where the samples were reduced to thin section of about 30micron thickness. The thin sections were analysed petrographically in the geological laboratory.

2.2 THIN SECTION PREPARATION

Samples of limestone were sectioned with diamond-coated cutting wheel and the section were set in epoxy resin and polished to a 1micron diamond paste finish. A fragment of the rock is obtained from the hand specimen. One surface of the chip is ground smooth by making use of 120, 220 and 3f grade carborundum abrasive. The surface is glued to a microscope slide that measure 30cm by 30cm and up to 1cm thickness by lakeside 70C cement which is supplied in short rolls and must be melted on a hot plate at temperature of between 85^{o}C and 100^{o}C. The other side of the limestone fragment is now cut from its original thickness of 5 – 10mm to about 1mm with diamond saw. This latest size is later reduced to 200µm by using 100micron size carborundum. A 60microns size carborundum is later used to reduce the size from 0.2mm to 0.1mm, a stage where Quartz as an index mineral was identified under microscope to achieve the standard thickness of 30microns. At such thickness, a Canada Balsam diluted in xylene is used in mounting the transparent rock to the microscope slide. One must ensure that no air or gas bubble are trapped between the cover glass and the rock. The slide were then washed thoroughly with water and allowed to dry.

3. RESULTS AND DISCUSSION

Most of the slide revealed the presence of carbonaceous mud matrix with calcite remains that could have been of those of calcitic organism (Plate 6, 9, 11, 15). According to Greensmith (1978), possibly the carbonate of any original aragonitic organisms has been dissolved, redistributed in solution and reprecipitated in pores and cavities as early diagenetic sparite cement. Shell debris of brachiopods, bivalves in biosparites are identified in some of the slides (Plate 7, 9, 13) and they could have been modified in the sea bottom prior to final incorporation into the rock (Greensmith, 1978). Micrite envelopes (Plate 13) developed on brachiopod shell (the foliated structure) indicating a low energy environment of formation and presence of brachiopods. This reveals that the Okeluse Limestone belongs to the group of rocks of ancient marine of the Palaeozoic-Mesozoic era. The carbonaceous mud matrix in some samples could have caused the greyish colouration of the Okeluse Limestone since the detritus (sand or mud) was excreted by the constituent organism. Bivalves and gastropods are identified and most of them are made of aragonite, the aragonite molluscs are preserved as casts.

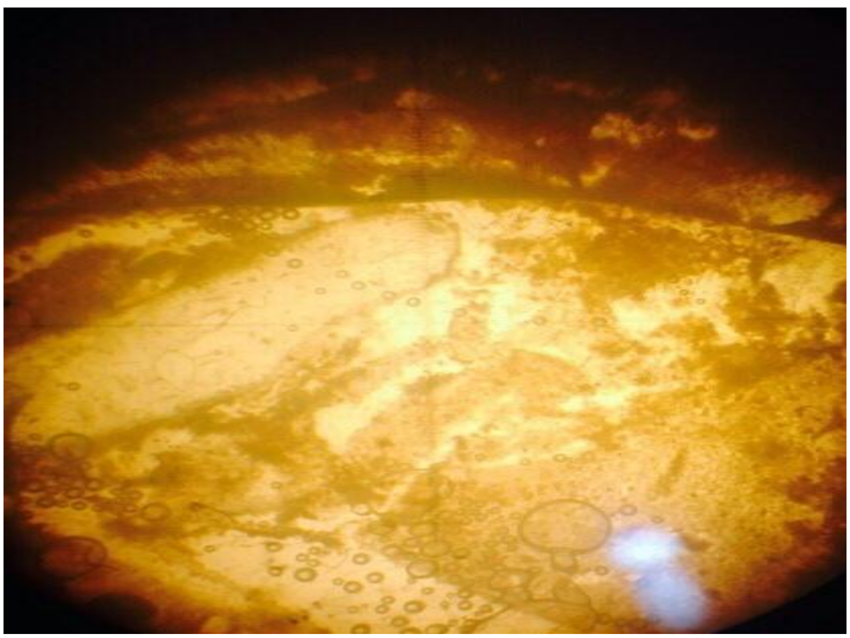

Plate 6: *Petrographical view of sample L1 under plane polar (x40)*

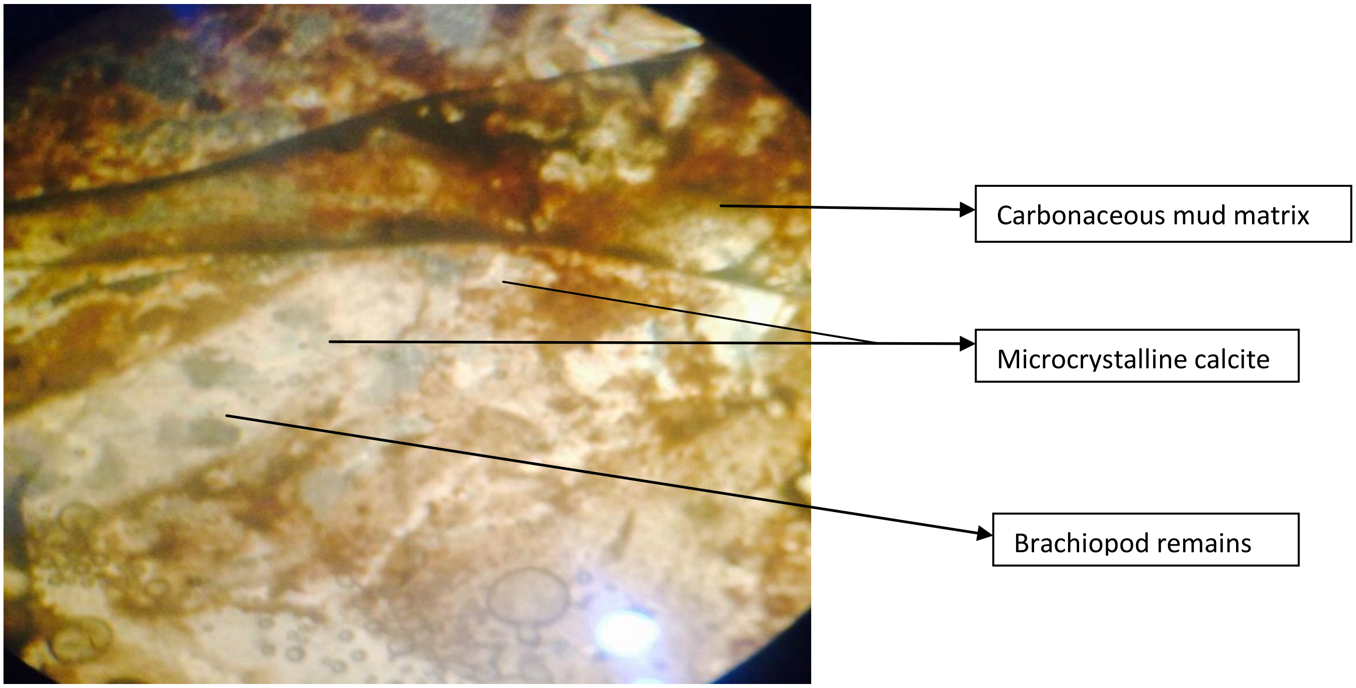

Plate 7: *Petrographical view of sample L1 under cross polar (x40)*

Plate 8: *Petrographical view of sample L2 under plane polar (x40)*

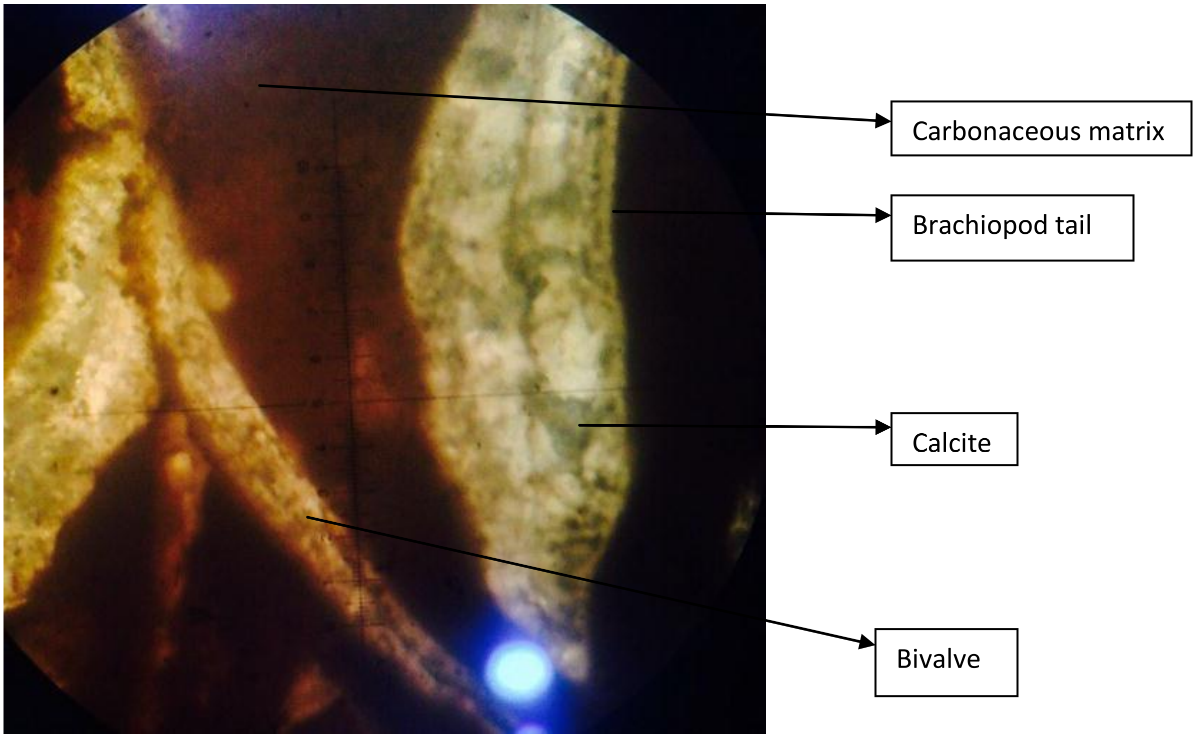

Plate 9: *Petrographical view of sample L2 under cross polar (x40)*

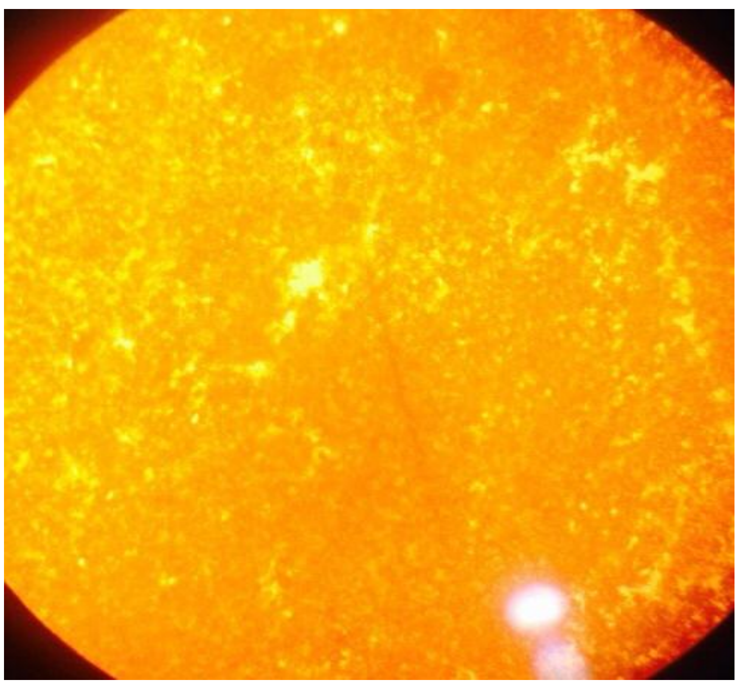

Plate 10: *Petrographical view of sample L3 under plane polar (x40)*

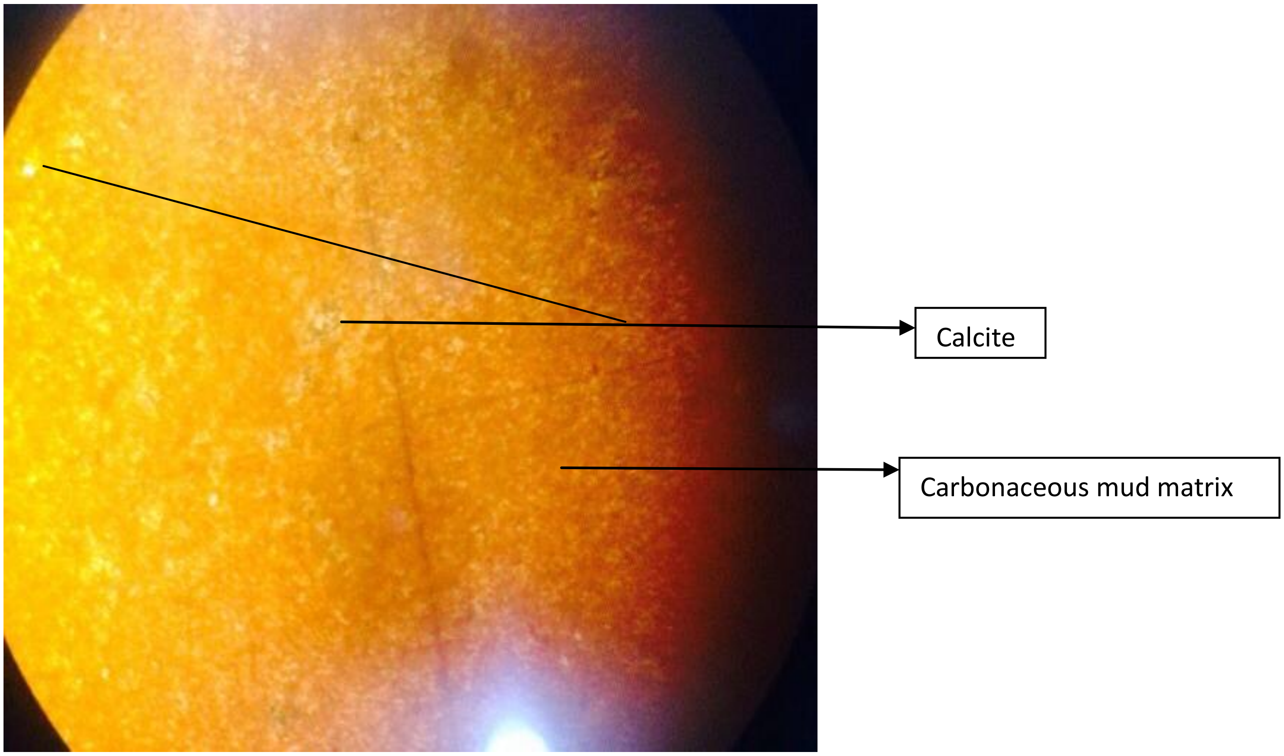

Plate 11: *Petrographical view of sample L3 under cross polar (x40)*

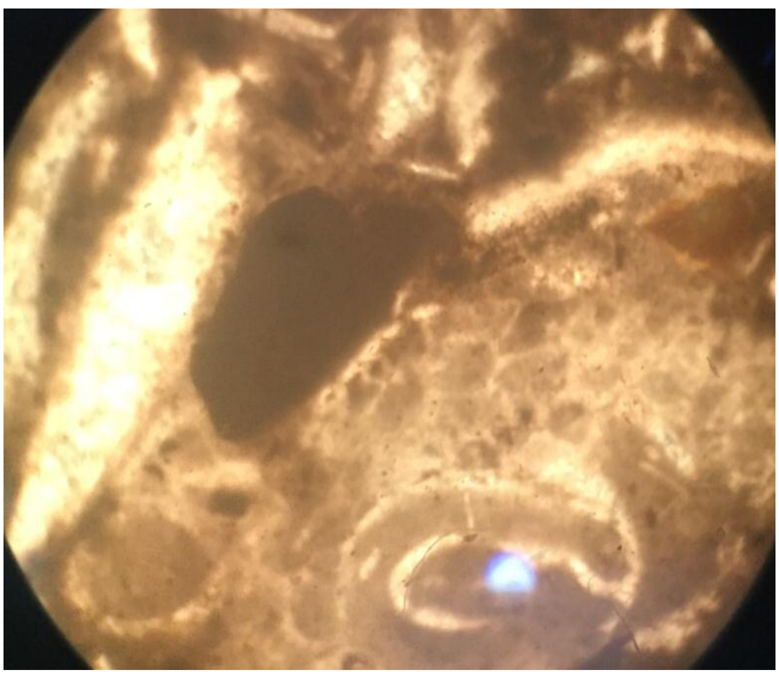

Plate 12: *Petrographical view of sample L4 under plane polar (x40)*

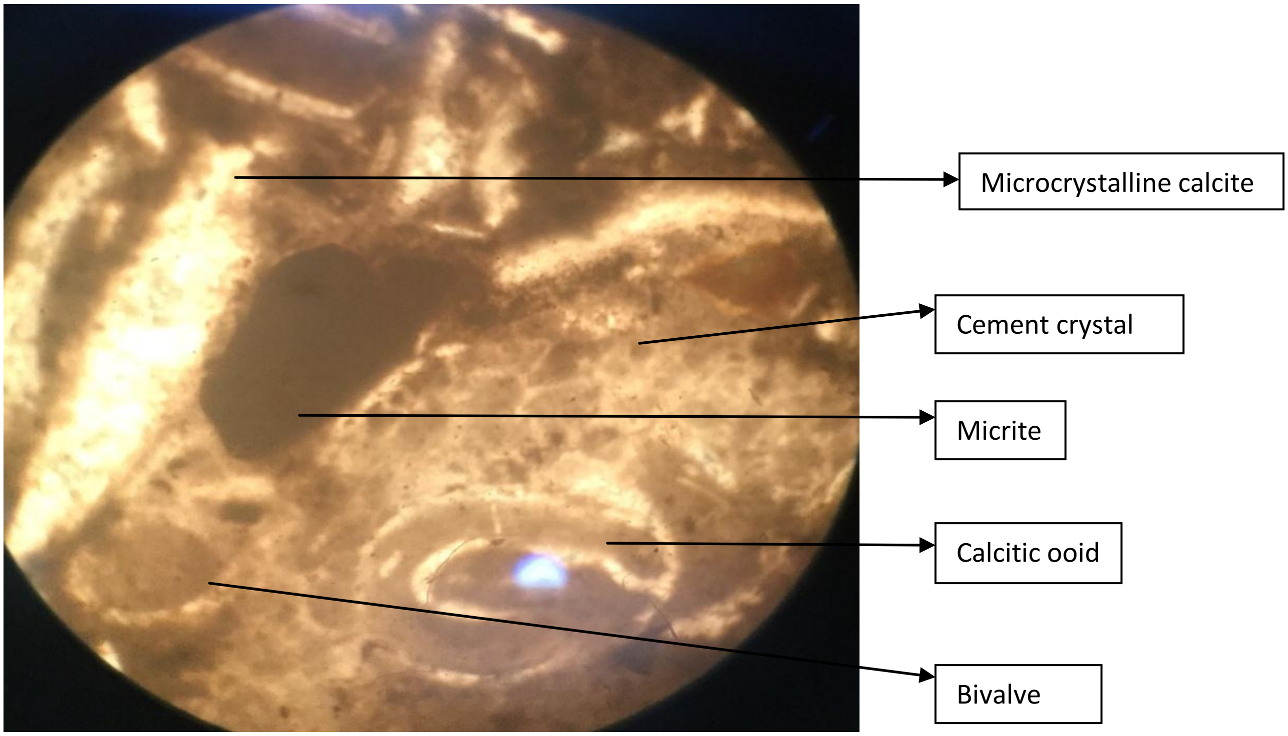

Plate 13: *Petrographical view of sample L4 under cross polar (x40)*

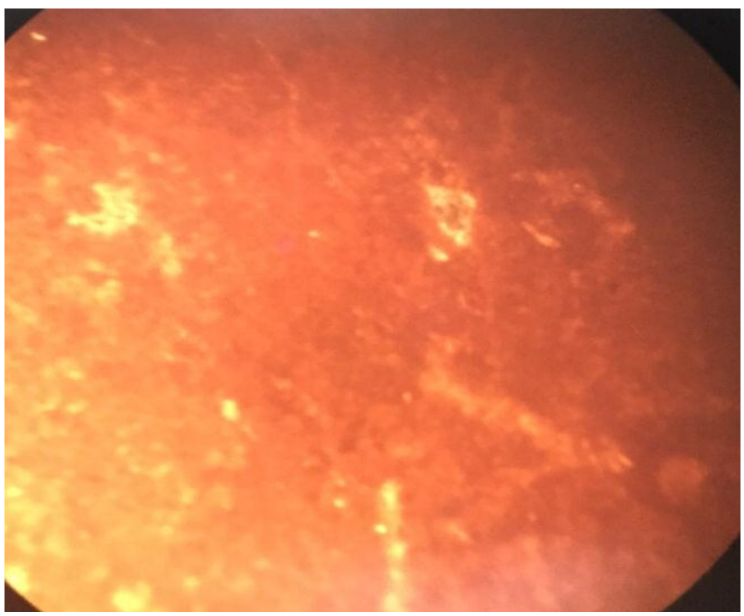

Plate 13: *Petrographical view of sample L5 under plane polar (x40)*

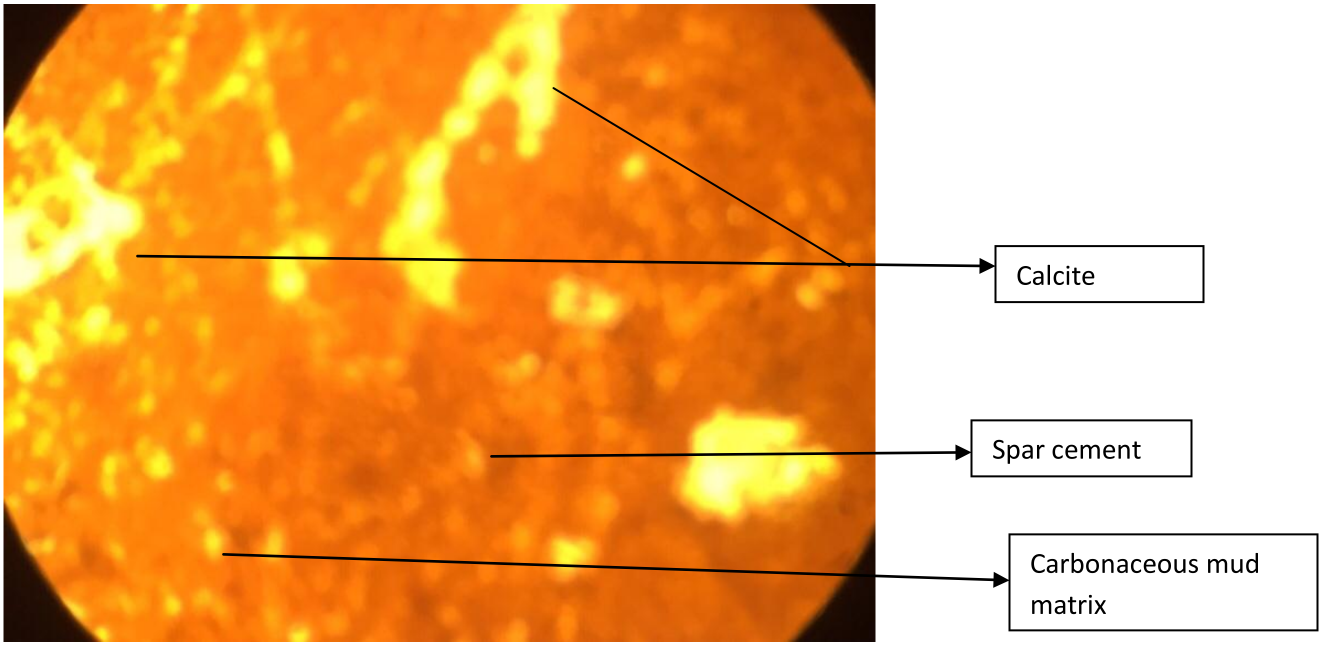

Plate 14: *Petrographical view of sample L5 under cross polar (x40)*

4. CONCLUSIONS

The presence of carbonaceous mud matrix in Okeluse limestone means ancient deposition in quiet water areas and the type of the marine sediment as calcitic with aragonite that must have been precipitated by algae and inorganic processes (David et al, 1971). Okeluse limestone is not white or very pale gray and this could be due to suspected trace of impurities of iron and finely divided carbonaceous matter. The presence of calcitic ooids could be an evidence of discrete carbonate aggregate most of which must have undergone transport at some stage in their history.

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