



A Preliminary Petrographic Investigation of Gboko Formation Limestone around Ukogh middle Benue Trough

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Article Information

Article # 0905
Received date: 6th March., 2019
1st Revision 10th May, 2019
2nd Revision: 16th May, 2019
Acceptance: 24th May, 2019
Published: 30th May, 2019

Key Words

Limestones, pellets, sparite
Petrographic, fossils,
microcrystalline calcite,
detrital quartz

Abstract

Limestones of the Gboko Formation, outcropping around Ukogh were studied for their allochemical compositions. Core samples of the limestone were described, logged and subjected to thin sectioning. Quantitative and qualitative petrographic examinations of ten thin sections were performed on selected samples using petrological microscope (ML 9300). The allochemical components identified from thin section include fossils (55 %), pellets (10%), ooids (2 %), microcrystalline calcite (45 %), sparite (28 %) and detrital quartz (av. 45%). Petrographic data and stratigraphic analysis showed that the areas of study is dominated by three facies of limestones; oobiopelsparite, oobiopelmicrite and biopelmicrite, deposited in a shallow agitated subtidal environment. However, this study has provided good petrographic features of the limestone for consideration of other researchers and investors.

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INTRODUCTION

Limestone deposits in the middle Benue Trough are extensive and largely unexposed. Quarrying activities by Dangote Company exposes the outcrops under investigation due to limestone exploration and exploitation. However, various researchers have investigated the geology of the basin. Owonipa *et al.* (2016) describes the microfacies and biostratigraphy of limestone – shale sequences of Gboko Formation and suggested a shallow marine – shelf lagoonal environment. Depositional environment (Adekeye and Akande, 2002), geochemistry of Tse-kucha limestone (Bolarinwa and Idakwo, 2013), sedimentology and stratigraphy (Nair and Ramanathan, 1984; Okosun, 1999), origin (Benkelil, 1989) among others. However, the petrofacies characteristics of the limestone near Ukogh (Fig.1) have not been given attention and the geological information concerning the limestone remains superficial. This study will unravel the petrographic

information and therefore serves as a preliminary springboard for other researchers

Synopsis of Geology of the middle Benue Trough

The Benue Trough was initiated during the lower Cretaceous tectonic episodes and in connection with the failed arm of the rift – rift – rift triple junction (Benkhelil, 1989) that led to the separation of African and south American continents. Sedimentary sequence begins with Asu River Group (Fig.2), comprises Arufu Formation, Uomba Formation and Gboko Formation (Reyment, 1965). Gboko Formation is considered as the oldest marine sediment (Reyment, 1965) deposited during on land transgression that took place during first tectonic cycle (Murat, 1972). The limestone under investigation falls within the Gboko Formation and dated Late Aptian - middle Albian in age (Okosun, 1999) on the basis of foraminifera. It consists of limestone (fine and medium grained), shale, siltstones and sandstones (Okosun, 1999).

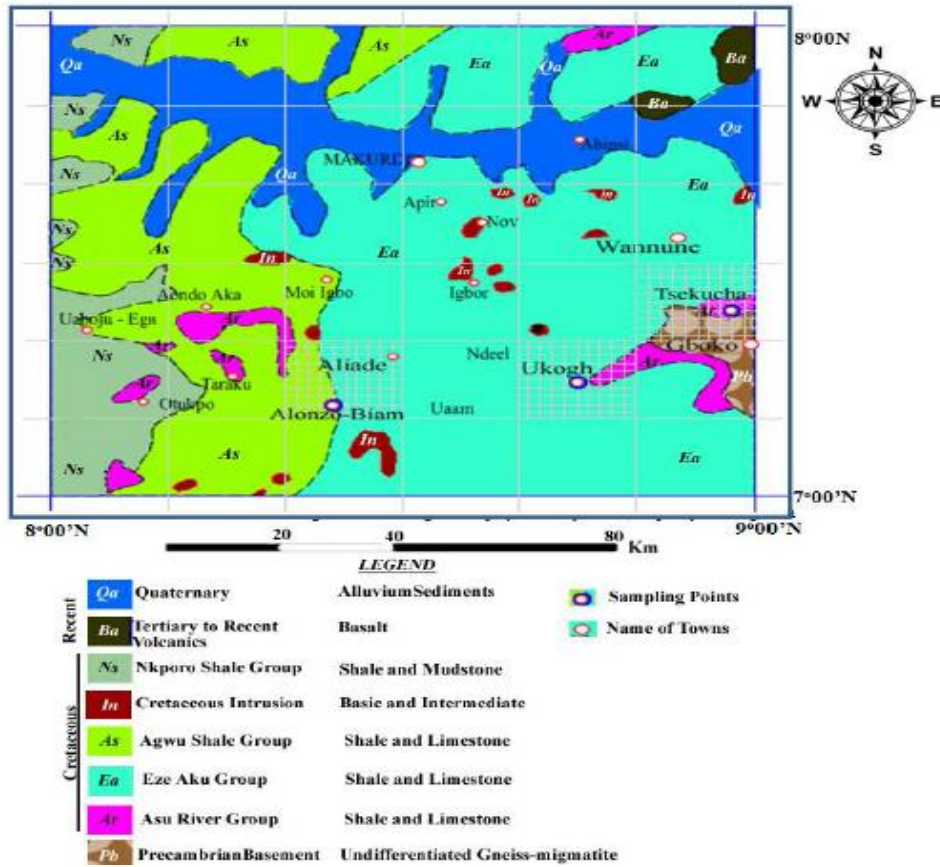


Fig. 1: Geological map of the Middle Benue showing the location of Ukogh (modified after Geological Survey Agency of Nigeria, 2010; Owonipa *et al.* 2016).

AGE	FORMATION
Tertiary-Quaternary	Alluvium Volcanics
Maastrichtian	Lafia
Campanian	
Santonian	Awgu
Coniacian	
Turonian	Ezeaku
Cenomanian	Keana Awe
Albian	Arufu, Uomba and Gboko Formations (Asu River Group)
Pre-Albian	Basement Complex

----- Unconformity
 ----- Major unconformity

Fig.2: Stratigraphic succession in the Middle Benue Trough (after Offodile, 1976)

Methodology

Ten (10) core samples collected from the limestone deposit around Ukogh, Gboko Formation were examine sedimentologically and further subjected to thin sectioning at the Department of Geology Laboratory, University of Ibadan. Ten thin sections were examined using a petrological microscope (ML 9300) and various monographs of Tucker (2003) were utilized to aid in the identification, description of textures and identification of allochemical components. Folk (1959; 1962) classification scheme of carbonate rocks was also use to classify the limestone.

Geology of the Study Area

The section exposed around Ukogh is about 50 metres in thick (Fig.3). It is characterized by alternation of shale and limestone. The sequence begins with laminated, greyish, shale overlain by fossiliferous limestone unit. Overlying the limestone unit is thinly laminated shale. Limestone, laminated, shale and brownish clay top the sequence. Generally, the shale – limestone motifs indicate unstable carbonate shelf platform (Tucker, 2003 Owonipa *et al.* 2016).

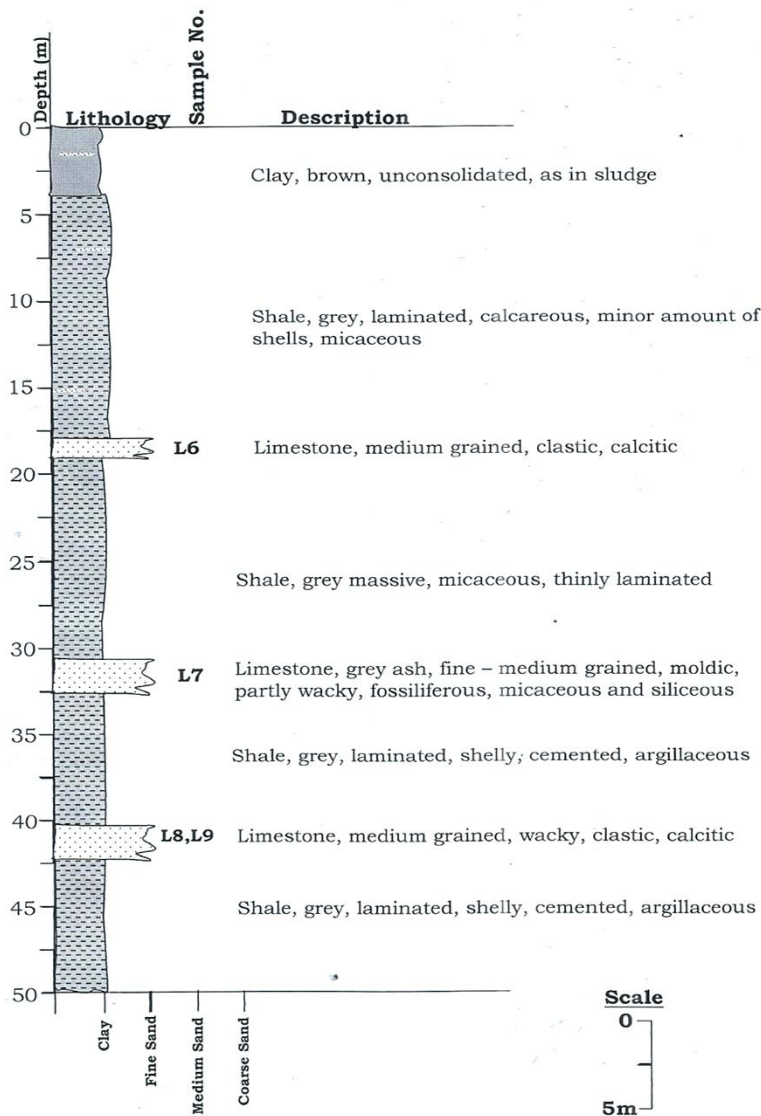


Fig 3: Litholog of Gboko Formation outcropped around Ukogh

Petrography and paleoenvironmental implications

Allochemical compositions, textural description and modal analysis of ten (10) thin sections of limestone samples from the area of study were undertaken. Petrographic analysis shows that fossils fragments (foraminifera and gastropods), non-skeletal grain (sparite, micrite, pellets and ooids) and quartz were present in all the samples. Fragments of foraminifera and gastropods were encountered (Fig. 5b - d) and indicate shallow marine environment (Tucker,

1988; Owonipa, *et al.*, 2016). Terrigenous quartz (Fig. 5c) recorded high relief and monocrystalline. Micrite formed the ground mass and sparite occurring as cement with an average of 28%. (Table 1). The ooids are not well defined due to micritisation of endolithic algae (Tucker, 1988). Three facies of limestone were recognized based on the petrographic attributes (Table 1).

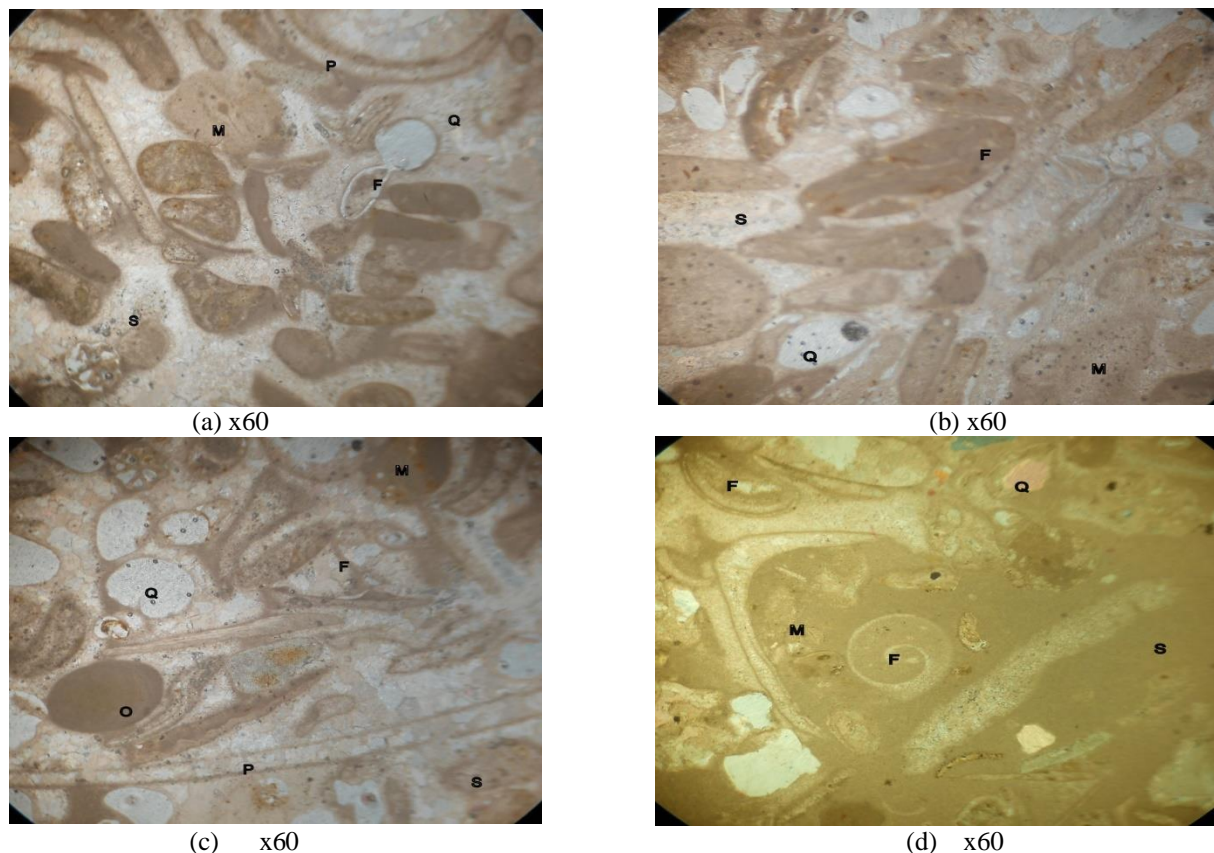


Fig. 4: Photomicrograph of major constituents in Gboko limestone near Ukogh (a) Micritised foraminifera shells (b) micritised fossil fragment with preserved structure (c) Ooids and corroded quartz due to alkalinity of the environment (d) Fossils fragments with well preserved foraminifera sp.

Table 1. Modal composition of limestone around Ukogh, Benue Trough

SAMPLES		L6	L7	L8	L9
Terrigenous constituents	Quartz (%)	45	15	10	25
	Allochems				
	Micrite (%)	10	45	28	42
	Sparite (%)	28	10	5	13
	Fossil fragments (%)	5	25	53	15
	Pellet (%)	10	5	2	5
	Ooids (%)	2	-	2	-
Rock type (After Folk (1959, 1962))		Oobiopelsparite	biopelmicrite	Oobiopelmicrite	biopelmicrite

DISCUSSION

The geology of the area of study consists of shale, limestones and clay sequence. The alternation of limestone, shale and clay units suggest a relatively unstable carbonate shelf (Tucker, 1988; Owonipa, *et al.*, 2016). Compositionally, the limestone is made up of terrigenous quartz, micrite, sparite, pellets of various sizes, ooids and fossil fragments that are highly micritised. The limestone units are mostly micritic in texture, characterized by fragments of foraminiferal and gastropods spp. These suggest a shallow marine environment (Tucker, 1988). Ooids have been reported to originate from different processes; precipitation from shallow agitated zones (Halley, 1977), micritisation of endolithic algae (Tucker, 1988). Both processes may be responsible for the formation of ooids seen in Ukogh limestone material. Tucker (1988) added that mechanical breakdown of skeletal grains through waves and currents produce microcrystalline calcite (micrite). The presence of fossil fragments (Fig.4) in all the samples indicates a normal marine environment that allows organic activities to flourish. Further evidence for marine environment, is the predominant of oobiopelmicrite, biopelmicrite and oobiopelsparite (Table 1) in the area of study. According to Tucker (1988) these suites of rocks are deposited in a shallow agitated subtidal environment. The present study supports this assertion and is in tandem with the interpretation of Tucker (1988) and Hobday and Eriksson (1977), based on sedimentary structures, bioclastic textures and stratigraphic characteristics.

CONCLUSION

Limestone of the Gboko Formation outcropping around Ukogh was investigated for their allochemical compositions. A sequence of shale – limestone predominate the entire section. Petrographic examination of the limestone revealed the presence of detrital quartz (av. 45%), fossil fragments (55 %), pellet variable sizes ranging from 2 - 10%, ooids (2 %), microcrystalline calcite (45 %) and sparite (28 %). Petrographic data and stratigraphic analysis showed that the areas of study is dominated by three facies of limestones; oobiopelsparite, oobiopelmicrite, and biopelmicrite, and deposited in a shallow agitated subtidal environment.

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