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PETROGRAPHIC STUDY OF AMASIRI SANDSTONE IN OZARA UKWU AND ITS ENVIRONS, AFIKPO BASIN,NIGERIA

Oloto, I.N[1] Iwueke L.E[2]

Senior Lecturer, Dept of Geology, university of Port Harcourt, Nigeria [1]

Graduate Researcher, Dept of Geology, university of Port Harcourt, Nigeria[2]

Abstract: Petrographic analysis were carried out on sixteen samples obtained from Amasiri, Ozara Ukwu, Asaga-Amangwu, Iyioka and Macgregor college area of Afikpo, located in part of the Abakaliki in the Southern Benue Trough. The study area lies between latitudes $5^{0}50$ N and 55^{1}N and longitude $7^{0}52^{1}30^{11}$E and $7^{0}55^{1}$E within the Abakaliki anticlinorium in the South Benue Trough, Nigeria. The samples represent the sedimentary infills in the South Benue Trough and are composed of quarter arenite, arkosic sandstone, siltstones, greywacke, ferruginized bioclastic sandstone, and shale. They form part of the formations of the Asu Rivers Group, Eze-Aku and Agwu shale deposited during cenomanian-Turonian-Santonian period and affected by Santonian orogeny and magnetism. The lithology had undergone progressive metamorphism based on the textural documentation of features in thin section. Petrographic analysis and photomicrograph indicate changes to hornfels of shale showing finely crystallized quartz, arkosic sandstone and siltstone with exsolved globules, rods and perthites, buchite of quartz arenite with elongate, lenticular and rounded grains aligned in preferred orientation, glass matrix, ferromagnesian minerals, the boundaries are not distinct but transit with margins of reaction rims and web texture.

Keywords: Ozara Ukwu, Afikpo Basin, Abakaliki Anticlinorium, Petrography.

I. INTRODUCTION

This study is based on the lithostratigraphic, sedimentologic, and petrographic analysis of sixteen rock samples obtained from various locations in Ozara Ukwu and environs in Afikpo Basin, Nigeria located in southern Benue Trough. The Afikpo basin is located at the South West end of the Benue Trough and was initiated during the late Cretaceous tectonic movements in the Benue Trough. The Benue Trough of Nigeria formed as a result of series of tectonism and repetitive sedimentation in the Cretaceous time when South America separated from Africa. Afikpo is located in the southern Benue Trough [4], between the Abakiliki Anticlinorium running northeast and the Cameroon Line in the southeast. Ridges of sandstones, and plains and valleys of shales form prominent and extensive topographic features in the study area [1]. Sandstones and shales are very important constituents of sedimentary processes and are therefore very crucial in the understanding of stratification history of their environments of deposition. Also the mineral and organic compositions, texture, and structure of the sedimentary sequences usually suggest their provenance characteristics. These constitute the characteristics investigated.

II. AIM AND OBJECTIVES

This study is aimed at carrying out petrographic study of Amasiri Sandstone and intrusives in the area of Ozara ukwu and it's environs, in order to ascertain their progressive changes in metamorphism of the rocks in the study area.

III. LOCATION AND ACCESSIBILITY

The mapped area lies between latitudes 5^{0}50'N and 5^{0}55'N longitude 7^{0}52'30"E and 7^{0}55'E. The topographic map of the area covers Amasiri, Ozara Ukwu (Okangwu), Iyioka, AsagaAmangwu, Mag-gregor college all in Afikpo local government area of Ebonyi state, south eastern Nigeria.

Geological Setting and Stratigraphy:. The sedimentary fill in the south Benue Trough is divided into three tectonic - stratigraphic mega sequences, the Asu River Group, Eze-Aku Group, the campanian maastrichtian and proto-Niger Delta succession. The detailed stratigraphic succession **(See figure 1)**. The Nkporo formation in the Afikpo syncline area thins towards the NW and SE at the trough margins of the basin [4,6]. The Mamu formation lies conformably upon the Nkporo Formation. The Nkporo Formation is the basal formation of the Campanian-Maastrichtian sediments, and is relatively undisturbed but intruded by igneous rocks [8,9].

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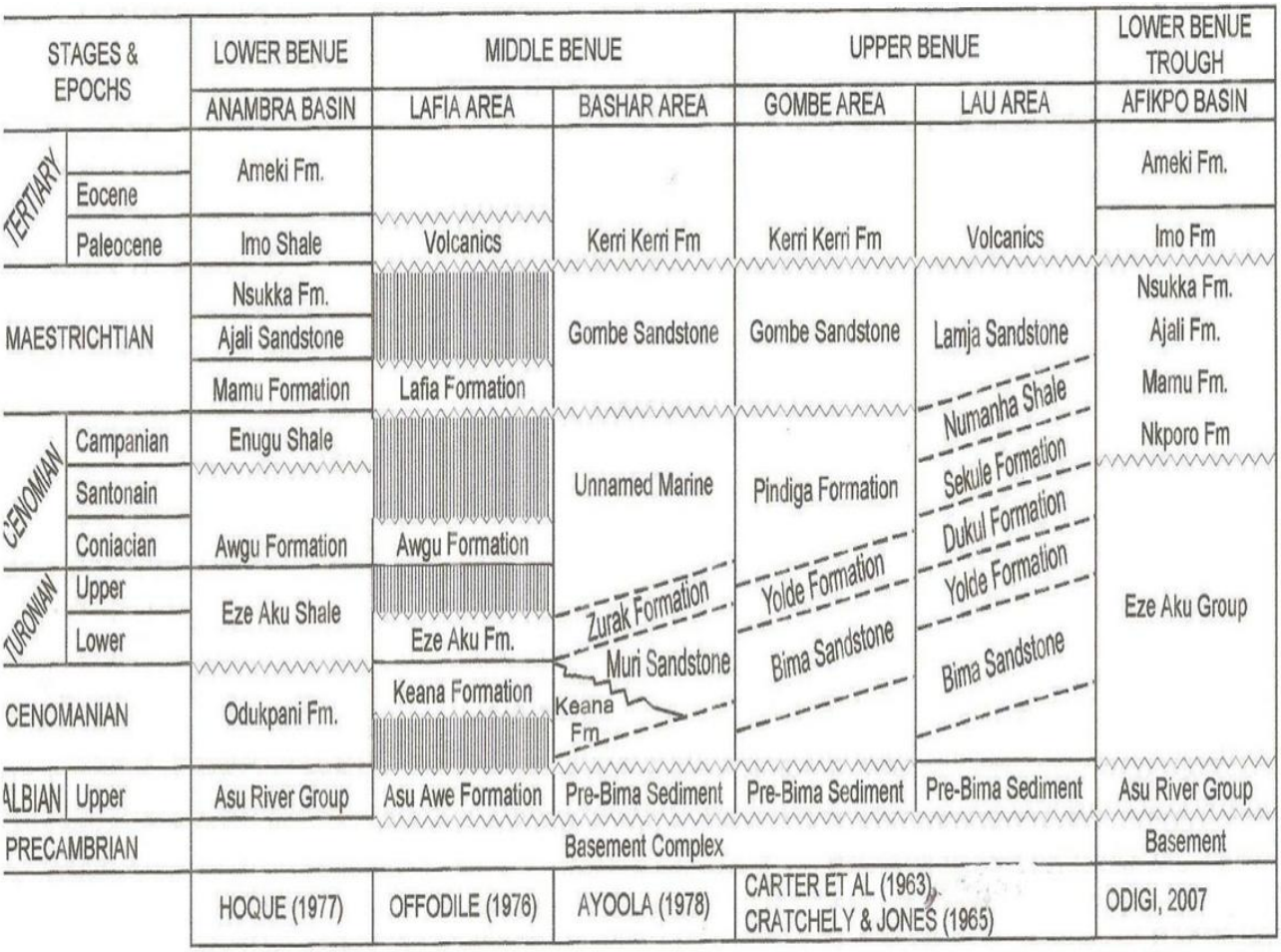

Fig 1.Stratigraphic succession in the lower Benue Trough.(Odigi 2007).

IV. METHODOLOGY

The method of analysis carried out on the study area was in two stages; fieldwork and laboratory analysis.

A. FIELD WORK

Mapping of the study area was carried out. Sixteen rock samples were collected randomly from different locations, such as Ozaraukwu, Asaga Amangu Iyioka, Amaseri and Macgregor College.

B .LABORATORY WORK

The following analysis were carried out on sixteen sandstone samples collected from the field. These include; Lithostratigraphic, Petrographic and Sedimentologic analysis.

(i) *Lithostratigraphic Analysis*: This analysis was carried out on all the sixteen samples collected from the field. It is based on physical description of rock features such as type of rock, colour, grain size, sorting, etc.

(ii) *Petrographic Analysis*: This was carried out on eight indurated sedimentary rock samples for thin section, to study the various mineral components and their grain to grain relationship using the petrographic microscope. Photomicrographs of the different parts of the vertical and horizontal sections were documented **(See plate A-C**).

(iii) *Sedimentologic Analysis:* This is based on identification of mineral composition, grain size, sorting, grain shape, and percentage distribution of different minerals and organic matter such as rootlets, feacal pellets etc. Materials used for this analysis include; oven or hot plate, sodium bicarbonate, spatula, filter paper, weighing balance, distilled water, set of sieves(90um, 75um, 53um).

V. RESULTS AND INTERPRETATION

Lithostratigraphic, sedimentologic, and petrographic analysis were carried out on the sixteen rock samples obtained from Amasiri, Ozara Ukwu, Asaga-Amangwu, Iyioka and Macgregor college area of part of Afikpo Syncline and Abakiliki Anticliorium, Located in the southern Benue Trough. The samples were obtained from the Afikpo sandstones, Amasiri sandstone and intrusives. The data generated from the study are discussed under various caption.

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Lithostratigraphy

(i) **Location 1**: Amasiri, along Asaga-Amaseri, Sandstone, coarse- grained, arkosic ferruginized,

Petrography; Quartz arenite hornfels containing impurity. Feldspathic arenite consisting of 10-15% orthoclase and microcline and 85-90% quartz. Note that feldspar is found only among the smaller grains, coarser layers of the same deposit contain very little. Grains subrounded but not so well sorted. Both quartz and feldspar grains have been enlarged by clear antigenic outgrowths (quartz on quartz and feldspar on feldspar) constituting a firm cement. Porosity is negligible, although the detrital grains are loosely packed.

(ii.) Location 2: Quarry Site, left side of Amasiri Ozara ukwu Road compose of Shale, light gray dolerite intrusive in shale and sandstone , calcareous, Dolerite

Petrography: Buchite hornfels in state of inequillibrium Showing web texture in buchite, colourless corroded relicts of quartz surrounded by glass (finer-grained).Grains partly angular and lensoid in perfect parallel orientation. Vitrified sandstone. Spongy relicts of "frittled" plagioclase and of potash feldspar, partially vitrified along cleavages. Corroded grains of quartz, matrix of pale brown glass,long fibrous fragment of brachiopod shells with spines, globularexsolved texture and reaction rims. Coarse grained quartz in matrix of calcite and plagioclase.

(iii.) Location 3. Quarry Site, Left Side of Amasiri –Ozara Ukwu Road compose light grey indurated shale and sandstone Calcareous,wavy foliation indicated on the rock,

Petrography: Buchite argillaceous hornfels with web texture andnex-solution features of globular inclusions.Grains of quartz and frittled plagioclase and potash feldspar,grains angular,elongate,lenticular,partially aligned parallel to foliation grains surrounded by glass

(iv.) Location 4. Ozara Ukwu, compose of Sandstone, Indurated arkosic, calcareous Hornfels – Buchite, partially elongate and irregular .Boundaries reaction rims

Petrography Grains of quartz,fieldspar with fritted surface,irregular interlocking granoblastic texture. Twinning of feldspar. Matrix of glass.

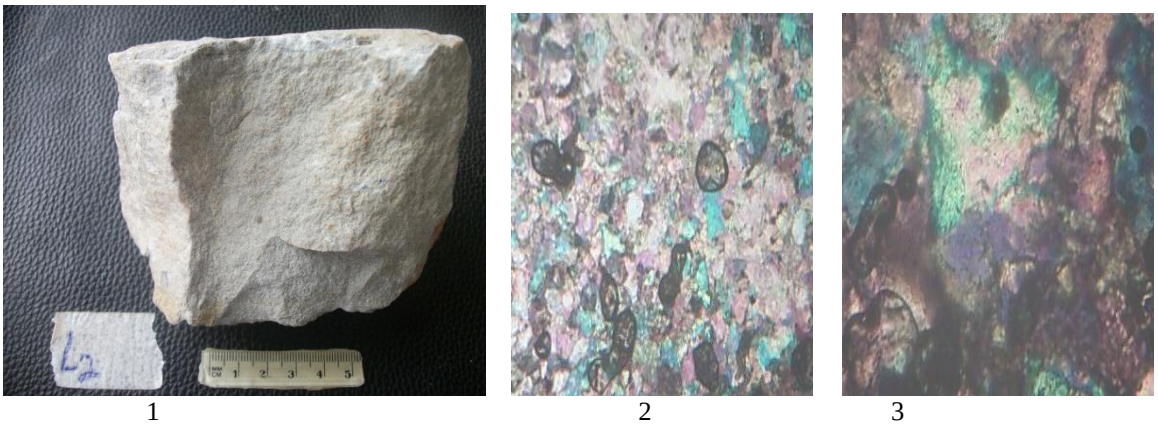
(v.) Location 5.Asaga Amangwu compose Fine grained sandstone with borings, friable, arkosic crystalline Gypsum embedded in shale

*Petrography:*Quartz-Muscovite –Gravite Phyllonite,elongate,aggregates of quartz and feldspar showing su-parallel orientation.graphite drawn out along shear zones ,bound by muscovite

(vi.) Location 6 Macgregory College compose of Ferruginized sandstone overlain with pebbly sandstone.

Petrography: Clastic-bioclastic greywacke/arenite Poorly sorted angular and subrounded grains, d with partially corroded sharp margins. Matrix of poorly sorted angular grains floating in clayey, ferruginized ground-mass. Grains elongate in an alignment with the bedding lineation.Bioclast of benthonic calcareous foraminifera abundant. Some grains are granoblastic being bound or annealed with calcite cement

PLATE A



1 2 3

1. Hand specimen of sandstone. **2** Photomicrographs of 1 showing Quartzo-feldsparthic hornfels,. Note alignment and enlongation of minerals top to bottom, vertically. The irregular dark grains are hornblende. There are also biotite and iron ore.

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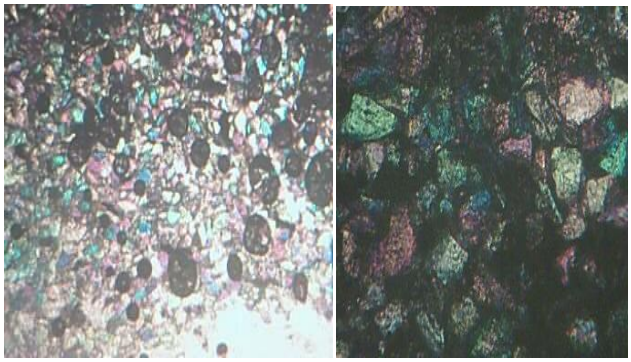
PLATE B

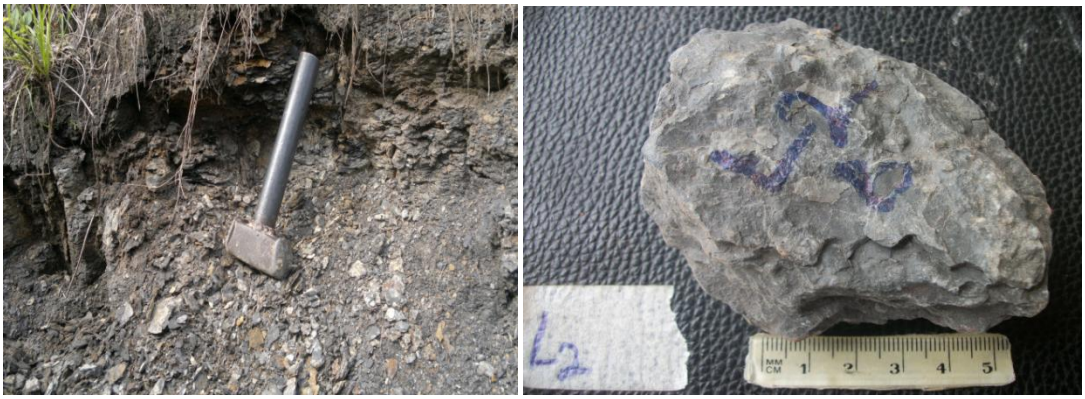
1 **2**



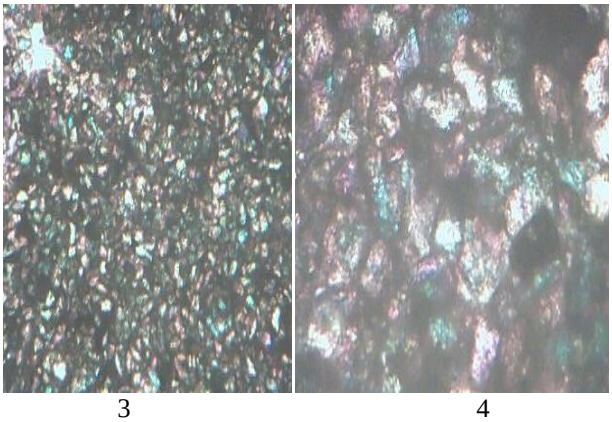
3 4

1. Calcareous Sandstone, quarry site at location .**2** along Amasiri-Ozara Ukwu Road: Calcareous Sandstone, quarry site at location 2 along Amasiri-Ozara Ukwu Road. **3 & 4** Photomicrographs of Buchite hornfels,. Note speckes of magnetite minerals and a granoblastic mosaic of quartz and feldspars, with web texture.

PLATE C



1 **2**



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1: Slate, quarry site at location along Amasiri-Ozara Ukwu Road.:**2** Hand specimen of Slate.: **3&4** Photomicrographs. Note porphyroblasts of sericitized chiastolite enclosed in a matrix of biotite, graphite and quartz.

VI. DISCUSSION AND CONCLUSION

Petrographic analysis were carried out on sixteen samples obtained from Amasiri, Ozara Ukwu, Asaga-Amangwu, Iyioka and Macgregor college area of Afikpo, located in part of the Abakaliki in the Southern Benue Trough, Nigeria. The samples represent the sedimentary infills in the South Benue Trough and are composed of quartz arenite, arkosic sandstone, siltstones, grey wacke, ferruginized bioclastic sandstone, and shale. They form part of the formations of the Asu Rivers Group, Eze-Aku and Agwu shale deposited during Cenomanian-Turonian-Santonian period and affected by Santonian orogeny and magnetism.. The lithology had undergone progressive metamorphism based on the textural documentation of features in thin section. Petrographic analysis and photomicrograph indicate changes to hornfels of shale showing finely crystallized quartz, arkosic sandstone and siltstone with exsolved globules, rods and perthites, buchite of quartz arenite with elongate, lenticular and rounded grains aligned in preferred orientation, glass matrix, ferromagnesian minerals,boundaries not distinct but transit with margins of reaction rims and web texture.Pelitic Hornfels has the characteristic feature of the argillites (mudstones, claystones, siltstones, pelites, shales) and is a fineness of grain and richness in clay minerals [9,11]. Elevation of temperature cause profound textural changes. Argillaceous rocks are recrystallized to tough, fine-grained hornfels, the simplest consisting of quartz and mica in approximately equal proportion. Quartz forms a granoblastic polygonal aggregate with randomly oriented mica flakes. The texture of a quartz – mica hornfels can be regarded as consisting of either polygonal quartz with mica flakes lying randomly oriented quartz-quartz grain boundaries or consisting of randomly oriented mica flake which have pinned the quartz grain boundaries. Triple-points between three crystals of the same species with low lattice anisotropy (quartz, feldspar, scapolite) are simple with approximately equal interfacial angles [3]. The texture of the original basic rock is dominated by plagioclase as a cris-cross or interlocking network with pyroxene fitting between to give an intergranular, intersctal or ophitic texture. The texture tend to be even grained in gobbros and dolerites, porphyristic in basalts where the phenocrysts are olivine, pyroxene or plagroclase. Other possible constituents are olivine in gabbro mesostasis in dolerites and amygdales containing calcite or zeolites in basalts. The rocks furthest from the intrusion may show the first stage of metamorphism involving changes to the ferromagnesians but not the plagioclase, thereby leaving the igneous texture intact [5,7]. The only macroscopic effect is a slight change in colour and luster. The pyroxene may simply show slight clouding and exsolution lamellae or may be altered to hornblende pseudomorphs whole olivine is pseudomorphed by serpentine or chlorite. At this stage, the plagioclase may become “chalky” and coloured with zircon are refractory and may retain their identity even in high-grade hornfelses, while tourmaline and zircon may develop oriented (Epitaxial) overgrowths.Three distinct non-equilibrium textures such as reaction rims or coronas, recognized in igneous hornfelses include:Simple imonomineralic reaction rims around a mineral which has acted either as a nucleus or as a source of material or both (for example, sphere around ilmenite or hornblende around magnetile). simple or compound, multi-layer polymineralic coronas. These are coronas that form around a ferromagnesian mineral (Olivine) and at olivine-plagioclase boundaries. Textured disequilibrium is also shown here by the retention of the igneous texture.Simple to complex, mono-orpolymineralic reaction rims around amygdales or phenocrysts.Some mineral species tend to form porphyroblasts to give a porphyroblastic, texture. Cordierite and andalusite form a few porphyroblasts,both of them also form spongy poikiloblastic crystals.Complete equilibrium textures are not common-Most Hornfels contain sufficient palimpsest features to indicate their origin except at highest grades. For instance a hornfels derived from a mudstone differs considerably in texture from one derived from slate. Bedding is preserved in most hornfels as compositional layering.A well developed shaly parting is enough to cause mimetic crystallization of mica along the bedding to produce a weak preferred orientation. The foliation in a slate or phyllite acts like bedding in a shale and controls the formation of mimetic mica flakes which may grow preferentially along both bedding and foliation[2,3].

REFERENCES

[1] L.C Amajor., Sedimentary facie analysis of Campanian- Maastrichtian Ajali Sandstone, South Eastern Nigeria. Bull. Niger. Min Geose. Soc. Vol 21 pp.54,1984
[2] E. Arumala,,Tectono-Petrographic relationship of Cretaceous sandstone in Afikpo Syncline. Unpublished B.sc Thesis, University of Port Harcourt, pp. 10-52, 1987.
[3] Burke, K.C et al., Geological history of the Benue valley and adjacent areas. (Ed) African GeologysUniversity of Ibadan press, Ibadan pp 187-202, 1970
[4] W.R, Dickson, and C.A Suczek, Plate Tectonics and Sandstone Compositions Bull Amer. Assoc. Petro geol. Vol. 63. pp 2164 – 2182, 1976
[5] Howel Williams et al., Petrography: An Introduction to the Study of Rocks in Thin Sections. pp 404, 1954
[6] C.A Kogbe,. Paleogeographic History of Nigeria from Albian Times. In Geology of Nigeria (Ed), Elizabethan Publishing Co. Lagos. pp 257-263, 1976.
[7] R.C Murat,. “Stratigraphy and Palaeogeography of the Cretaceous and Lower Tertiary in Southern Nigeria”. In *African Geology*, University of Ibadan press Ibadan. Pp. 411-419, 1970
[8] M.I. Odigi and L.C Amajor. Origin of Carbonate Cements in Cretaceous Sandstones from Lower Benue Trough, Nigeria: Evidence from Petrography and Stable Isotope Compostion. Scientia African, vol 7, pp123-139,2008.
[9] M.I. Odigi, and L. C. Amajor. Brittle deformation in the Afikpo Basin (Southeast Nigeria): Evidence for a terminal Cretaceous extensional regime in the Lower Benue Trough, Nigeria ,2009.