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Geological Investigation of Chalcopyrite Occurrences in Gombe Inlier, Gongola Basin Upper Benue Trough Nigeria

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Abstract: Gombe Inlier is Naturally Endowed and Rich in variety of solid Mineral include Chalcopyrite, that are spatially distributed across the area and the Sustainable Exploration and Exploitation of these Minerals have the Potential to add to the Economy of the state. Chalcopyrite ($CuFeS_2$) is a major Ore of Copper which is common in sulfide veins and disseminated in both Igneous and Sedimentary Rocks. Weathering of Chalcopyrite may lead to the formation of Malachite, Azurite and numerous other secondary copper Minerals. The extensive field mapping and thin section analysis has revealed that the Mineral occurred within the individual vein hosting the Chalcopyrite and is forming a kind of pinch and swell structures. The veins hosting the Mineral are generally trending in NE-SW direction which is conforming to major trend of the structures in the area. There are three stages of sulfide mineralization within the Benue Trough, the pre-sulfide stage, the sulfide stage and the post-sulfide stage.

INTRODUCTION

Gombe Inlier is Naturally Endowed and Rich in variety of solid Mineral include Chalcopyrite, that are spatially distributed across the area and the Sustainable Exploration and Exploitation of these Minerals have the Potential to add to the Economy of the state, one of such Mineral is Chalcopyrite. Chalcopyrite ($CuFeS_2$) is a major Ore of Copper which is common in sulfide veins and disseminated in an Igneous Rock ((Henckel, 1725; Cabri, 1973). Weathering of Chalcopyrite may lead to the formation of Malachite, Azurite and numerous other secondary copper Minerals (Hall and Stewart, 1973 and Harris et al,. 1984).

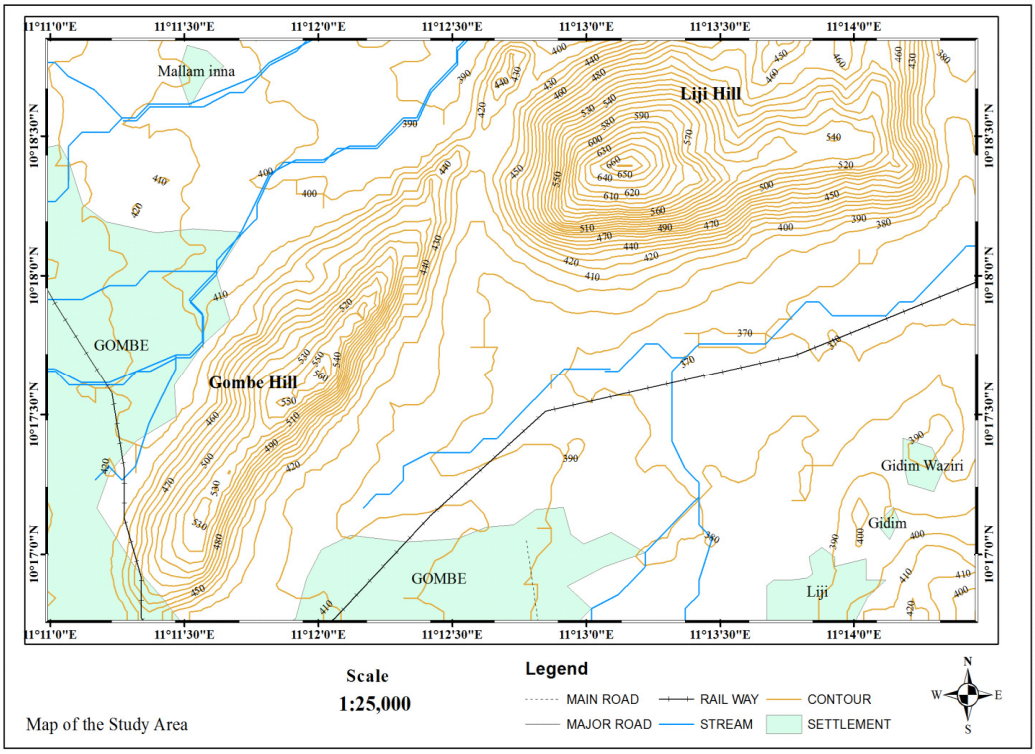

Fig1. The topographic map of the study area

LITERATURE REVIEW

Lead-zinc-fluorite-barite veins in the lower and middle Benue Trough (Nigeria) are located within the Lower Cretaceous (Albian) carbonaceous shales, limestones, and arkosis sandstones of this intracontinental rift structure (Akande et al., 1989). The veins in the lower Benue Trough consist of sphalerite + galena + marcasite_+ chalcopyrite _+ barite in a gangue of siderite and quartz hosted by carbonaceous shales, whereas in the middle Benue Trough, fluorite, barite, quartz, and similar sulfide minerals are hosted by limestone and sandstone (Akande et al., 1989). The epigenetic lead-zinc-barite fluorite deposits of the Benue Trough are localized in N-S trending fractures developed within the lower Cretaceous Albian shales, limestone and arkosic sandstones (Akande and Mucke 1989; Ogundipe and Obasi, 2016).

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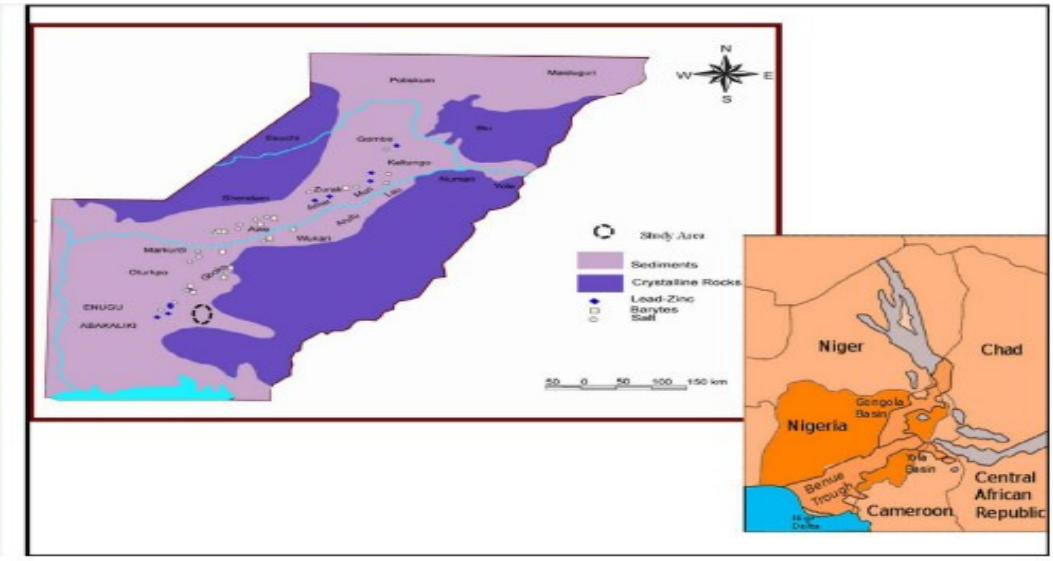

Fig.2. Distribution of lead-zinc-barite and salt mineralization along the Benue Trough (Modified after Cratchley and Jones 1965). Insert sketch map of Nigeria showing the Benue Trough)

The mineralogy of the sulfide deposits consists mainly of sphalerite and galena, with minor chalcopyrite and marcasite, with quartz and siderite being the dominant gangue minerals. The ores of the Abakaliki-Isiagu deposits consist of massive sphalerite, galena, chalcopyrite, marcasite, siderite, calcite and quartz in descending abundance. Fluorite, quartz and minor galena disseminations are the mineral assemblages of the Arufu-Akwana-Azara mineral district. Sulfide minerals, such as sphalerite, galena and chalcopyrite are dominant in the Zurak-Wase deposits (Akande et al,. 1988).

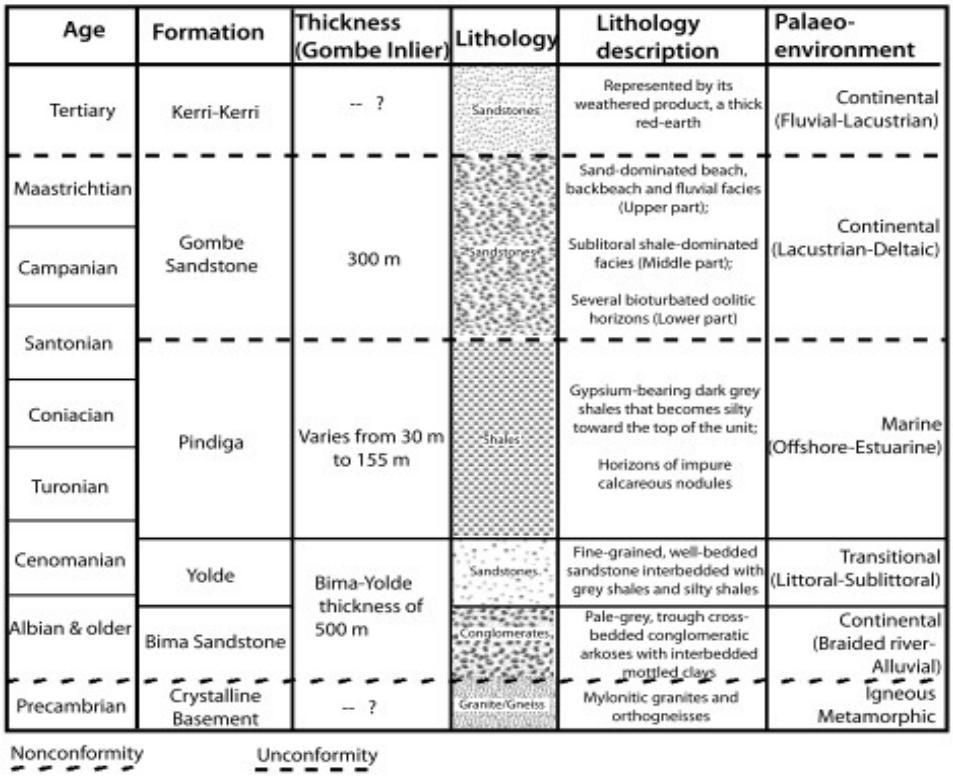

Fig.3: The stratigraphic successions of the Gongola Basin upper Benue Trough Nigeria (modified from Byami et al, 2015)

According to Ogundipe (2017), there are three stages of mineral deposition namely, the pre-sulfide stage, the sulfide stage and the post-sulfide stage. During the pre-sulfide stage, there was extensive tectonic brecciation of the country rocks and dissolution of the wall rocks resulting in the development of pervasive vugs and cavities. This episode was succeeded by the deposition of siderite at Isiagu, Ameri, Enyigba and Ameka. At Arufu, Akwana and Zurak, quartz was deposited primarily by silicification of the wall rocks. The sulfide stages started with the deposition of sphalerite followed by galena which together constituted the principal sulfide ores. Pyrite and chalcopyrite were deposited as complements to the base-metal sulfide minerals. The third stage is the post sulfide stage which marks the waning stage of the hydrothermal activities. During this stage late stage-gangue minerals were deposited as barite, fluorite, quartz, calcite and marcasite Ogundipe (1987).

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	Pre-Sulfide Stage	Sulfide Stage	Post-Sulfide Stage
Breciation	Dissolution		
Siderite	---------		
Quartz	Silicification		
Sphalerite			
Quartz		----------	
Galena			----------
Pyrite		----------	
Chalcopyrite		----------	
Barite		----------	
Fluorite			----------
Calcite			----------
Marcasite			----------

Table 1: Paragenetic sequence in the Benue valley (Modified from Ogundipe and Obasi, 2016.

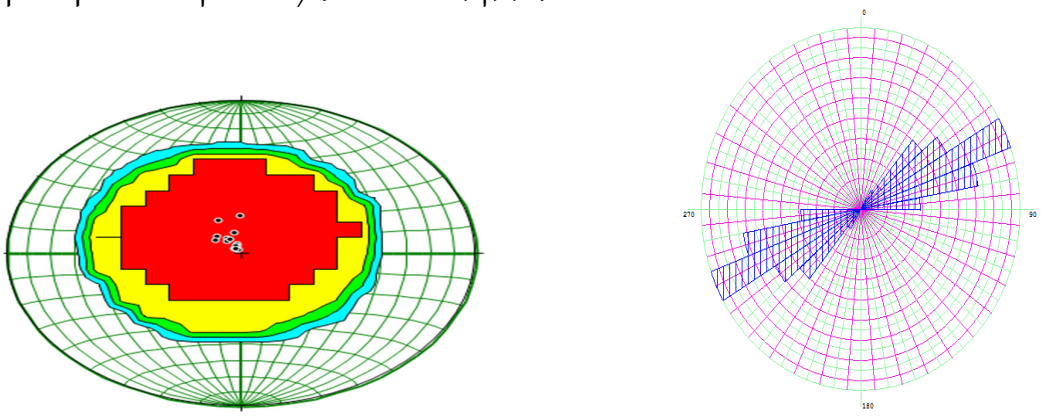
MATERIAL AND METHOD

The method of study to this research work was within the available materials and data acquired. The study area lies within topographic Map of Gombe NW sheet 152 with a scale of 1:50,000 which constitute parts of the Gongola Basin, Upper Benue Trough Nigeria. The mapping of the area is purely on foot; however, the traverse was taken along the study area. The rock units were mapped and interpreted. Contacts were delineated using lithologic difference. Measurement of strikes and dip of the Rocks formation was taking and carefully plotted in to the map with the aid of a protractor, ruler and pencil. Azimuth of the fractures was equally measured with their dip direction and dip amount. Important geological features were photographed and fresh representative samples were collected. During the mapping, the technique adopted was the use of global positioning system, compass and traverse method in which distance between locations were estimated on the map. Petrographic analyses of the few selected samples using thin section was conducted.

RESULTS AND DISCUSSION

Structural Styles of the Chalcopyrite Occurrences

Detailed field studies of the Mineral occurrences have shown that Chalcopyrite Mineralization within the Inlier is structurally controlled and is localized within a deep-seated fracture zones that truncate only the Basement rocks. The Mineral ores occurred within the individual vein hosting the Chalcopyrite and is forming a kind of pinch and swell structures. The veins hosting the Mineral are generally trending in NE-SW direction which is conforming to major trend of the structures in the area. According to Paradis et al (1998), the seemly minimal nature or complete non-existence of wall-rock modification obviously points to the low thermal conditions that prevailed during ore mobilization and precipitation from hydrothermal fluids.



The structural plots of the Chalcopyrite veins trending in NE-SW direction as their major trending direction

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The tiny Chalcopyrite veins localized within the Basement




Two giant Chalcopyrite veins also within the Basement Rocks in the study

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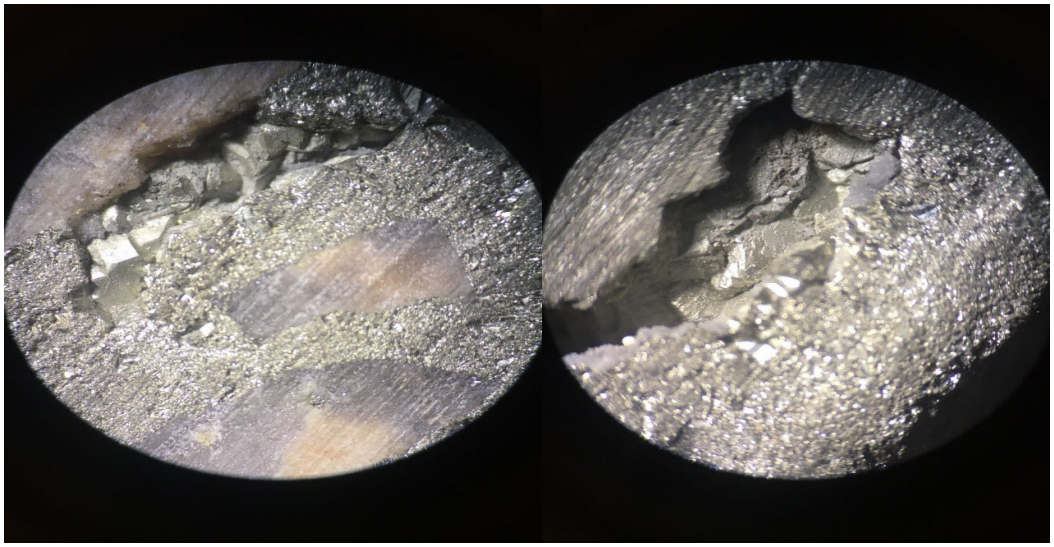

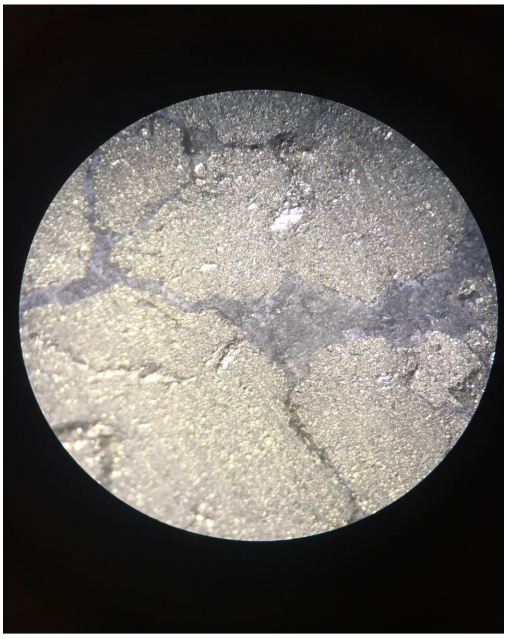

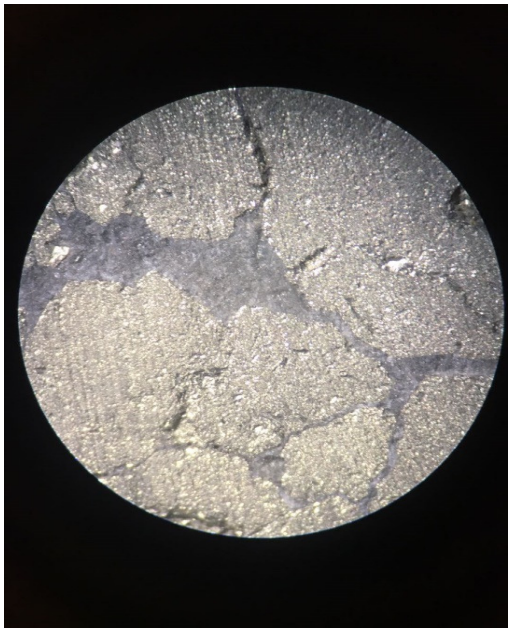

Photomicrograph of ppl and xpl of chalcopyrite samples from the study area

CONCLUSSION

From the result of field investigation and that of thin section analysis, it has revealed that the chalcopyrite occurred within the Basement Rocks of the study area in two different styles of Mineralization and all occurred within the Basement Rocks in the area (a) the ones that formed within a

giant vein (b) the ones that form a pinch and swell. Therefore, there is a need to investigate its Origin, abundance and the Economic viability.

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