International Journal of Environmental Studies and Safety Research
ISSN: 2536-7277 (Print): 2536-7285 (Online)
Volume 6, Number 3, September 2021
http://www.casirmediapublishing.com

GEOLOGY AND ENVIRONMENTAL IMPACT OF FLOURITE (CaF_2) MINING IN GOMBE INLIER, GONGOLA BASIN UPPER BENUE TOUGH NIGERIA

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ABSTRACT

Fluorite (CaF2), also commercially known as fluorspar, is an important industrial mineral that is used as a raw material in the metallurgical, ceramic and chemical industries apart from optical and lapidary uses. It is the source of fluorine in the production of hydrogen fluoride or hydrofluoric acid, which is used as the feedstock for numerous organic and inorganic chemical compounds. Fluorite is present in a diverse group of mineral deposits ranging from epithermal to high temperature and high salinity magmatic deposits in varied host lithologies. Detailed field studies of the Fluorite occurrences have shown that Mineralization within the Inlier is structurally controlled and is localized within a deep-seated fracture zones that truncate both the Basement and Stratigraphic successions. Two major rock types coexist with Mineral veins in the area, these include Pale-grey, trough cross-bedded conglomeratic arkosic sandstones with interbedded mottled clay, Mylonitic granites and orthogneisses. The activities of artisanal miners have produced pits/gullies in the area. For the sake of environmental protection, all most all the mined-out pits and gullies produced do not undergo any reclamation and with time this can give way to deep ponds or lakes. However, if this problem goes unchecked it will result to large scale degradation of the environment

INTRODUCTION

Fluorite (CaF2), also commercially known as fluorspar, is an important industrial mineral that is used as a raw material in the metallurgical, ceramic and chemical industries apart from optical and lapidary uses (Murty, 1973). It is the source of fluorine in the production of hydrogen fluoride or hydrofluoric acid, which is used as the feedstock for numerous organic and inorganic chemical compounds. Fluorite is present in a diverse group of mineral deposits ranging from epithermal to high temperature and high salinity magmatic deposits in varied host lithologies (Williams-Jones et al., 2000; Bühn et al., 2002; Bosze and Rakovan, 2002). An endeavor is made in this paper to evaluate the occurrences of the fluorite and the environmental effect of its mining in the study area.

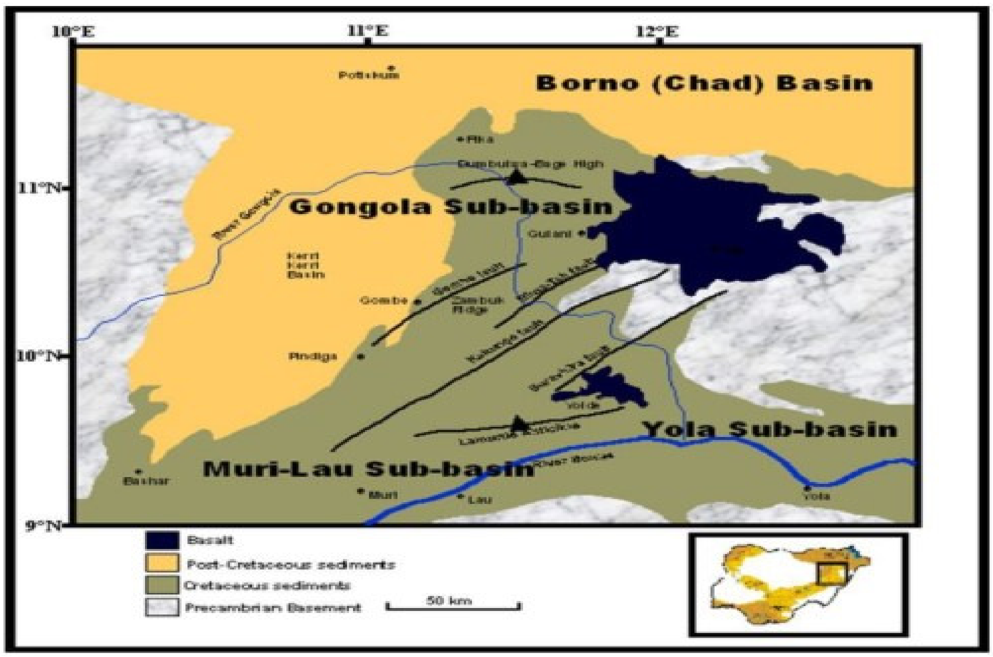

Fig 1: Geologic map of the upper Benue Trough (Modified after Sulaiman, 2016)

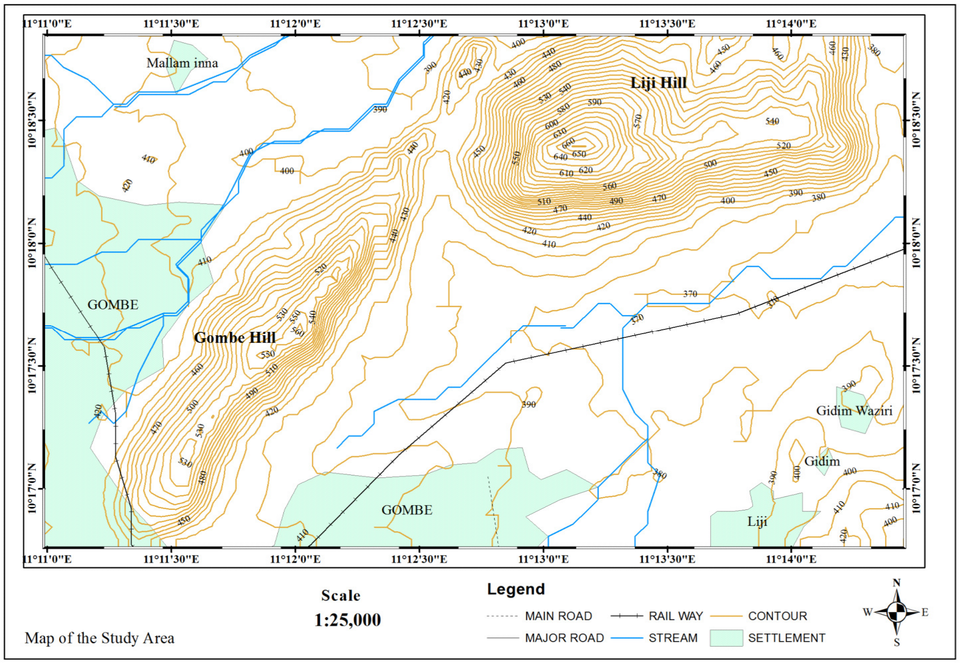

Fig 2: The topographic map of the study area

LITERATURE REVIEW

(Strong et al. 1984) have classified fluorite deposits into two genetic types as: (a) those associated with sedimentary, dominantly carbonate, rocks, and similar in many respects to Mississippi Valley type deposits; and (b) vein-type deposits related to felsic alkaline-peralkaline rocks. They have, however, not considered the deposits associated with carbonatites and also the other occurrences where fluorite occurs as accessory minerals. 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).

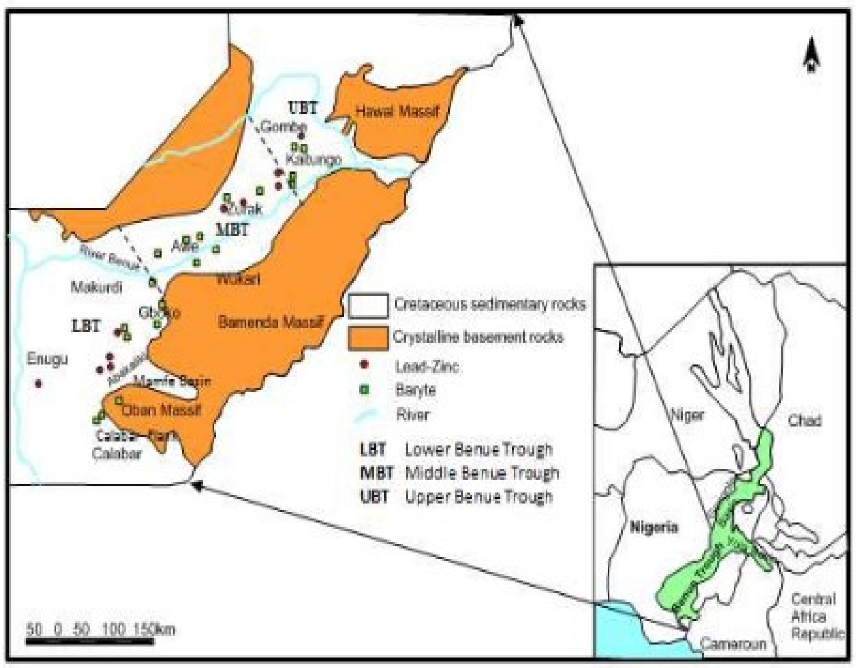

Fig3. The Distribution of lead-zinc-baryte and fluorite mineralization along the Benue Trough (Inset sketch map of Nigeria showing the Benue Trough) (modified from Ene *et al.*, 2012).

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).

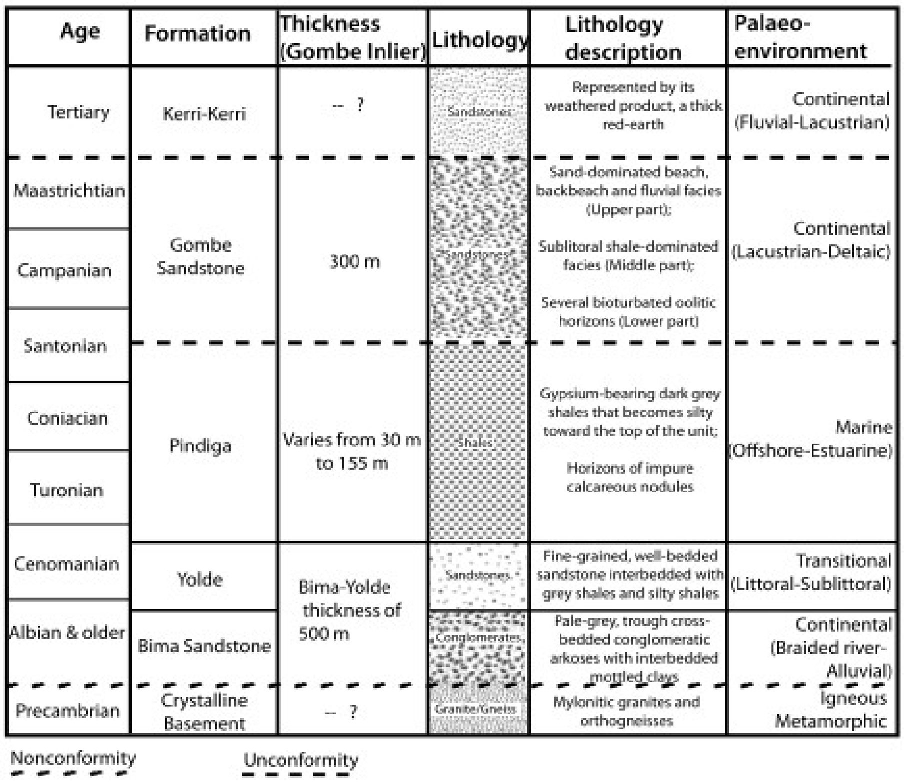

Fig4. The stratigraphic successions of the Gongola Basin upper Benue Trough Nigeria (modified from Byami *et al*, 2015)

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.

RESULTS AND DISCUSSION

Detailed field studies of the Fluorite occurrences have shown that Mineralization within the Inlier is structurally controlled and is localized within a deep-seated fracture zones that truncate both the Basement and Stratigraphic successions. Two major rock types coexist with Mineral veins in the area, these include Pale-grey, trough cross-bedded conglomeratic arkosic sandstones with interbedded mottled clay, Mylonitic granites and orthogneisses. The contact between Mineral ores and the host rock is sharp and devoid of observable wall rock alterations in some places. There are notable absence of the host rock fragments in almost all the Fluorite ore samples, despite their crosscutting field relations. The lithologic association of the different rock types and the Mineral ores indicates that the Mineralizing veins are distributed in the Basement Rocks and the indurated sandstone. Textural evidence from samples clearly show that fluorite deposition was later than both the Basement and stratigraphic successions in the area.

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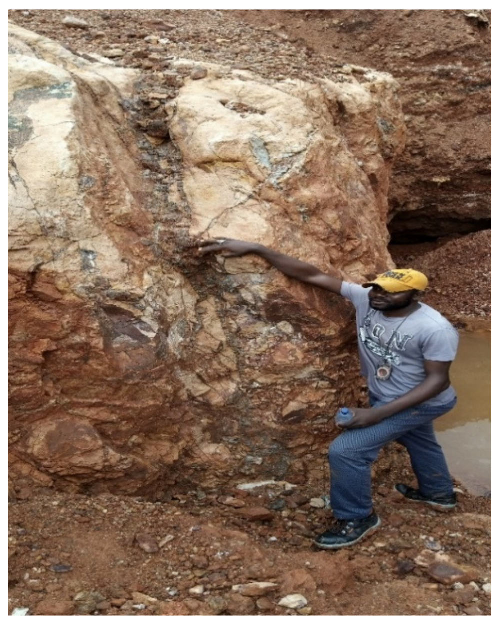
Two giants and persistent Fluorite veins occurred at the surface that extend to about 150 meters showing the evidence of whole Rock alteration in the study area

The two different fluorite samples from the mining pits

The artisanal Miners working in both near surface and sub-surface part of the study area



The disseminated fluorite mineralization within the indurated Bima Sandstones in the study area

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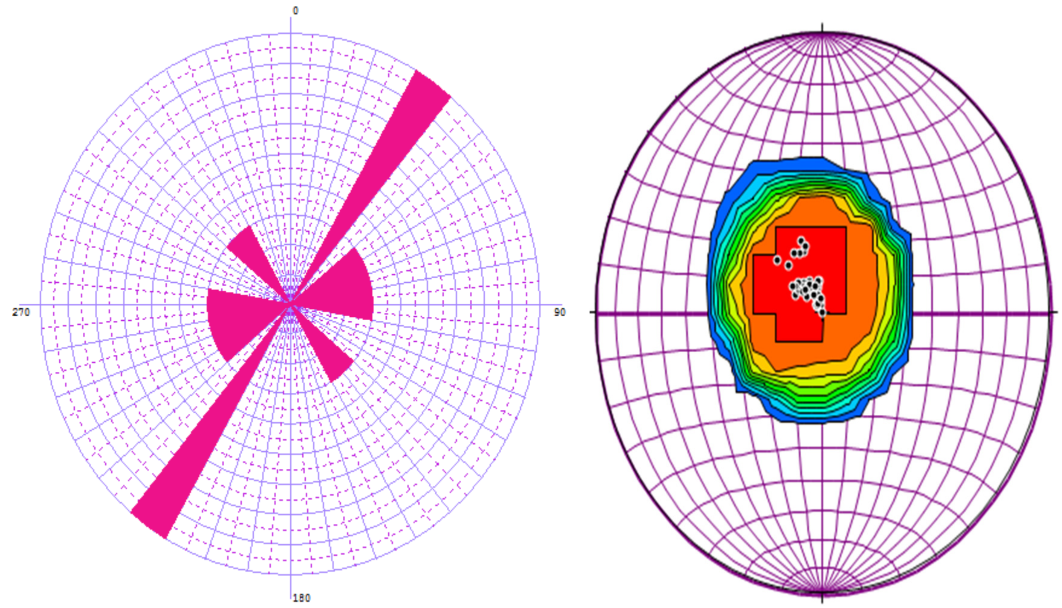
Two persistent veins about 200 meters trending in NE-SW directions.

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.

STRUCTURAL STYLES OF THE FLUORITE OCCURRENCES

This Mineral occurred in two forms within the inlier, it occurs as disseminated and Veins control deposits. The veins hosting the Mineral are generally trending in NE-SW direction which is conforming to major trend of the structures in the area.



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

ENVIRONMENTAL IMPACT RELATED TO FLOURITE MINING IN THE AREA

Most artisanal miner's usually carryout 'wild cat' mining activities in their search for fluorite in the area, which have produced pits/gullies in the areas. For the most part, these mined out pits or mine gullies do not undergo reclamation and with time, the shallow mine pits give way to deep ponds or lakes. And if this problem goes unchecked it will result to large scale degradation of the environment.

'wild cat' produced by the Artisanal Miners at the onset of their Exploration in the area.

Shallow Mine pits give way to deep ponds in the study area


The newly developed Gullies from shallow and deep Mining pits in the study area


The mined and unreclaim part of the study area


The abandon mine pits in the study area

CONCLUSION

Detailed field studies of the Fluorite occurrences in the study area has shown that the Fluorite Mineralization within the Inlier is structurally controlled and is localized within a deep-seated fracture zones that truncate both the Basement and Stratigraphic successions. Textural evidence from samples clearly shown that fluorite deposition was later than both the Basement and stratigraphic successions in the area. The activities of artisanal miners have produced pits/gullies in the areas. For the sake of environmental protection, all most all the mined-out pits and gullies produced do not undergo any reclamation and with time this can give way to deep ponds or lakes. However, if this problem goes unchecked it will result to large scale degradation of the environment

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