

## Original Research Article

### INDUSTRIAL ROCKS AND MINERALS OF SOUTHERN BENUE TROUGH, NIGERIA.

Some part of the southern Benue trough (Afikpo and Anambra basins) has been mapped to determine the areas of occurrence of industrial minerals and to determine their lateral extent. The result shows that southern Benue trough is enriched with mostly industrial minerals of sedimentary and magmatic origin, the magmatism that occurred in the study area and its evolutionary processes led to mineralization of the study area. Interaction of the magma with host some of the host rocks gave rise to mineral genesis. The contamination and assimilation processes that occurred in the magmatic stage resulted to enrichment of minerals in in the study area. The contact relationship of the magma with the host rock created a contact aureole though the resultant minerals (metamorphic minerals) of the contact aureole are not significant and exposed. The repetitive transgressive-regressive sedimentary cycle that occurred in the southern Benue trough probably resulted to the massive deposition of industrial minerals of sedimentary origin. The dominant and significant industrial minerals in Afikpo and Anambra basins are sandstones (ferruginized sandstone, calcareous sandstones and carbonaceous sandstones), clay mineral (kaolinite), pebbles, igneous rocks of diverse levels of emplacement (intrusive/extrusive), megascopic occurrence of Feldspar, mica and quartz, in the igneous rocks, olivine and hematite.

Key words: Industrial, Rocks, Minerals, Benue trough.

#### INTRODUCTION

Benue trough is a failed arm of triple rift (RRR) that formed in the Santonian during the separation of South America from Africa. Benue trough is subdivided into three segments, the southern Benue Trough, the middle Benue trough and the Northern Benue Trough. The southern Benue trough is enriched with lots of industrial minerals.

The southern Benue trough are enriched with industrial minerals ranging from syenitic-dioritic rocks and basaltic rocks (Onwualu-John and Ukaegbu 2009), sandstones, kaolinitic clay, pebbles. Sediment thickness in Benue trough is estimated 6500m (Kogbe, 1974) which were generated by repetitive transgressive-regressive sedimentary cycle which also suffered deformation in the Santonian. The deformation of the pre Santonian sediment gave rise to Abakaliki Anticlinorium which has two synclines (Afikpo basin and Anambra Basin)

#### FIELD CHARACTERISTICS AND GEOLOGIC SETTING

**Comment [K1]:** Trough

**Comment [K2]:** With no location and geologic map, this statement is not justified

**Comment [K3]:** delete

**Comment [K4]:** Delete repeated word

**Comment [K5]:** Said who? The separation occurred in Early Cretaceous. The Santonian episode terminated the first phase of basin formation (Benue Trough) and initiated the Anambra and Afikpo basin

**Comment [K6]:** Cite Ref

**Comment [K7]:** Trough

**Comment [K8]:** Trough

**Comment [K9]:** Basin

The southern Benue trough is characterized by pre Santonian and post Santonian Sediments (Onwualu-John and Nwozor, 2016) In the Anambra syncline, the geologic Formation are the Asu River group, Nkporo Formation, Mamu Formation, Ajali Sandstone, Nsukka Formation and some magmatic rocks which were emplaced during Santonian tectonism.

**Comment [K10]:** Trough

**Comment [K11]:** Group

In the Afikpo basin, the field relation consist mostly of Asu River Group, Eze-Aku Formation, Afikpo Sandstone, clays and igneous rocks of mostly basaltic origin. The magmatic rocks in the southern Benue trough are structurally controlled to the Abakaliki Anticlinorium. The magmatic rocks form the topographic high in the basins.

**Comment [K12]:** The Enugu Cuesta is a dominant topographic feature and the core is made up of sedimentary rocks. Pls review

## EXPERIMENTAL PROCEDURE

### Physical description

The magmatic rocks were collected at different pockets of igneous suites in the study area. The basaltic rocks at the Anambra and Afikpo basin are aphanitic to phaneritic in texture. The presence of mica (biotite) is visible to unaided eye.

**Comment [K13]:** in

The syenitic –dioritic rocks of the Anambra basin is porphyritic in texture. Micaceous minerals (muscovite and biotite) are pronounce. Quartz and potassium feldspar are among the megascopic minerals in the rock.

Sandstones are dominant at both Afikpo and Anambra basin, most of the sandstones are ferruginized (rich in iron) but Amasiri area of Afikpo basin has massive deposits of calcareous sandstones.

Clay minerals are much at Afikpo basin. Ibioziza has deposits of kaolinitic clay and pebbles.

### THIN SECTIONS

Thin section of the magmatic rocks were carried out in the following procedure, the rocks were trimmed with the use of cutting machine. The trimmed rocks and the slides were polished on a glass plate that contains mixture of caborandum and water. The rocks were polished to thickness of 0.03mm as to allow light from the microscope to penetrate the rocks during the interpretation of the minerals in the rocks. The slides were polished to create a rough surface for holding the rocks when it will be glued to the slides.

The polish rocks and slides were placed on a hot plate for twenty minutes to dehydrate the water content in them. Araldite gums were placed on the slides and the polished rocks are mounted on the slides. The glued rocks on the slides are placed back on a hot plate of about 250<sup>0</sup>C to dry the gum and also remove air bubbles. After the rock samples and the slides are glued together, Canada balsam are spread on another slide to serve as cover slip over the thin sectioned rock.

The thin section with the cover slip are washed with methylated spirit to remove any remnant of the Canada balsam, after which they are washed with clean water and allow to dry, then labelled for easy identification. These thin sections were then studied using petrological microscope.

### PETROGRAPHIC ANALYSIS

Table one shows the average mineral compositions of basaltic rocks in Afikpo and Anambra basin. The magmatic rocks in Afikpo and Anambra basin has mineral assemblage of olivine+pyroxene+amphibole+biotite+plagioclase±quartz.

Comment [K14]: Table 1

Table 1. Average mineral composition of minerals in basaltic rocks of Afikpo and Anambra basins

Samples	olivine	pyroxene	amphibole	biotite	plagioclase	Iron ore(Hematite)	quartz	Total
AFB	20	12	10	15	35	5	3	100
AFD	15	20	5	10	40	7	2	99
AFG	20	15	10	5	45	5	-	100
ANB	10	25	8	10	37	8	2	100
AND	15	20	10	8	40	7	1	101

AFB= Afikpo basin basalt

AFD= Afikpo basin dolerite

AFG= Afikpo basin gabbro

ANB= Anambra basin basalt

AND= Anambra basin dolerite

The mineral paragenesis of the syenitic–dioritic rocks of Anambra basin are potassium feldspar + plagioclase feldspar + amphibole +biotite + muscovite + quartz, (Table2).

Table 2: showing the average mineral compositions of syenitic-dioritic rocks of Anambra basin

Sample	Potassium feldspar	plagioclase	pyroxene	Amphibole	Biotite	Muscovite	Quartz	Total
ANS-D	30	15	20	10	5	9	10	99

ANS-D= Anambra basin syenitic-dioritic rocks.

## DISCUSSIONS

The magmatic rocks of the southern Benue trough also contains some industrial minerals (feldspar, quartz, mica, olivine, hematite). In the southern Benue trough, industrial minerals are mostly magmatic and sedimentary origin. The industrial minerals of the study area can be used as filters, abrasives and refractories.

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Magmatic rocks: The magmatic rocks of the study area can serve as excellent aggregates for construction of buildings, bridges and highways.



A



B



C



D

Plate A and B represents outcrop of rocks in Anambra and Afikpo basin while C and D represents aggregates of the rocks used for construction.

**Comment [K16]:** What types of rock. Where in Anambra Basin, mention locality

Pebbles and sands: most concretes in constructions, decorative stones and roofing slates are made with sands and pebbles.

Sand/or sandstones and pebbles of the southern Benue trough are rich in quartz, tables 1 and 2 show also the average concentrations of quartz in the rocks. Quartz is used in glass making, silica bricks, paint and soap scouring (Kogel et.al 2006), jewelry and porcelain making. Quartz is also used in construction industries.



Plate E= Pebbles, F = Sandstone with a sharp contact of kaoline and G= Sand

**Comment [K17]:** Pebbly sandstone? Indicate location please

**Comment [K18]:** Kaolin

Clays (kaoline): clays are used in ceramics paint pharmaceutical and petrochemical industries. Clays as well serve as filter for impurities.



Plate H and I=Kaoline

**Comment [K19]:** Same applicable as above

Feldspar: feldspar is used as a constituent in making ceramics, pottery and tiles. It is also used as insulator in electrical industries. Feldspar is used in paint, plastic and rubber industries. Feldspar is resistance to chemical corrosion and this makes feldspar valuable in metallurgical industries.

Mica: Muscovite is used by electrical industries. Muscovite can serve as an insulator to electrical appliances. Mica is used in paint industries. Due to the lustre nature of mica, it is used in cosmetics industry.

Hematite: hematite is an ore of iron. Iron ore is a raw material in the production of iron. It is used in steel and automobiles industries. Iron ores are also used in construction industries. Hematite is also used in paint industries.

Olivine: olivine is used as a refractory material. Olivine is used to make refractory bricks and also used as casting material(Hobert M.K. 2005). Olivine is as well used in metallurgical industries. Olivine can be used in petrochemical industries. Olivine has been discovered as one of the minerals that can act as a catalyst in converting organic matter to hydrocarbon (Jinq Q., 1988; Mango F.D.,1992)

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## CONCLUSION

Most of the industrial minerals in the southern Benue trough are of economic values, with adequate financing, provision of mineral processing equipment and power, few of the industrial minerals that are of sub-economic quantity will be enhance and mined. This research focuses on the surface mapping of the study area and there are evidences of sub surface mineral deposits.

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UNDER PEER REVIEW

**Comment [K29]:** Not cited in the body of the work