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Geology Of Adankolo: Lithologies In Adankolo And Surrounding Villages And To Interpret The Depositional History And Geological Significance Of The Mapped Area.

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Abstract
This project investigates the petrography, geochemistry, structural fabrics, and economic significance of geological features exposed in Adankolo, Lokoja Sheet 247, south of the Bida Basin, Nigeria. The Lokoja Sandstone, a basal Cretaceous unit, forms the dominant lithology in the study area. Field mapping, petrographic thin section analysis, and geochemical techniques were employed to characterize the rocks and assess their provenance, depositional environment, and potential applications. The sandstones are predominantly coarse- to medium-grained, with poorly sorted to moderately sorted textures. Petrographically, they are composed mainly of quartz (60–70%), feldspar (10–15%), lithic fragments (5–10%), and ferruginous cement. Geochemical analysis indicates a silica-rich composition (SiO_2 > 75%) with appreciable Fe_2O_3 content, consistent with a continental fluvial depositional system. Structural mapping reveals joints, fractures, and minor faults with dominant NW–SE and NE–SW orientations, reflecting regional tectonic influence. Economically, the rocks possess strong potential as construction materials (dimension stone, aggregates, road base), while the overlying laterites provide raw material for engineering fill and possibly bauxite exploration. However, the study also raises environmental and Medical Geology concerns, particularly dust-related respiratory issues and groundwater vulnerability to contamination through structural conduits. The project identifies critical knowledge gaps regarding the hydrogeochemistry and health implications of Adankolo's geology. While this study provides baseline petrographic and geochemical data, further research integrating geology and public health is recommended to assess risks such as fluorosis, silicosis, and heavy metal contamination. Thus, the work not only contributes to basin stratigraphy but also highlights the emerging role of Medical Geology in Nigeria.

Keywords: *Petrography, Geochemistry, Bida Basin, Medical Geology, Trace Element*

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I. Introduction

The relationship between geology, natural resources, and human livelihood is most visible in Nigeria's sedimentary basins. These basins host groundwater aquifers, mineral deposits, and petroleum resources, making them crucial to national development. Among them, the Bida Basin, an intracratonic Late Cretaceous basin in central Nigeria, holds significant geological and economic value. Stratigraphically, it comprises the Lokoja Sandstone, Patti Formation, and Aganebode Formation, reflecting fluvial to deltaic depositional environments (Adeleye, 1974; Obaje, 2009).

The Lokoja Sandstone, exposed around Lokoja town and the Adankolo area, represents the basal formation of the basin. It is characterized by conglomerates, coarse sandstones, and lateritic cappings. These rocks not only provide insights into depositional environments but also form important raw materials for local industries. Quarrying activities in Lokoja supply aggregates, building stone, and road construction material to nearby urban centers. However, the significance of Adankolo's geology goes beyond economic utilization. The interaction of geological processes with the environment can directly affect human health a central concern of Medical Geology. For instance, sandstone-derived aquifers can be vulnerable to contamination by iron, fluoride, or other trace elements, while quarrying and blasting release dust that contributes to respiratory diseases. These linkages remain poorly studied in the Lokoja region.

The aim of this study is to investigate the petrography, geochemistry, structural fabrics, and economic potential of the Lokoja Sandstone in Adankolo. The objectives are to:
Document the lithological and mineralogical characteristics of the sandstones.
Assess geochemical composition for provenance and industrial application.

Map and analyze structural fabrics to determine tectonic influence and hydrogeological significance.
Evaluate the economic and environmental implications, including potential Medical Geology concerns.

By addressing these objectives, this work contributes to both academic knowledge and societal needs. It establishes a baseline dataset for the Lokoja area while revealing knowledge gaps that justify future interdisciplinary studies on geology and health.

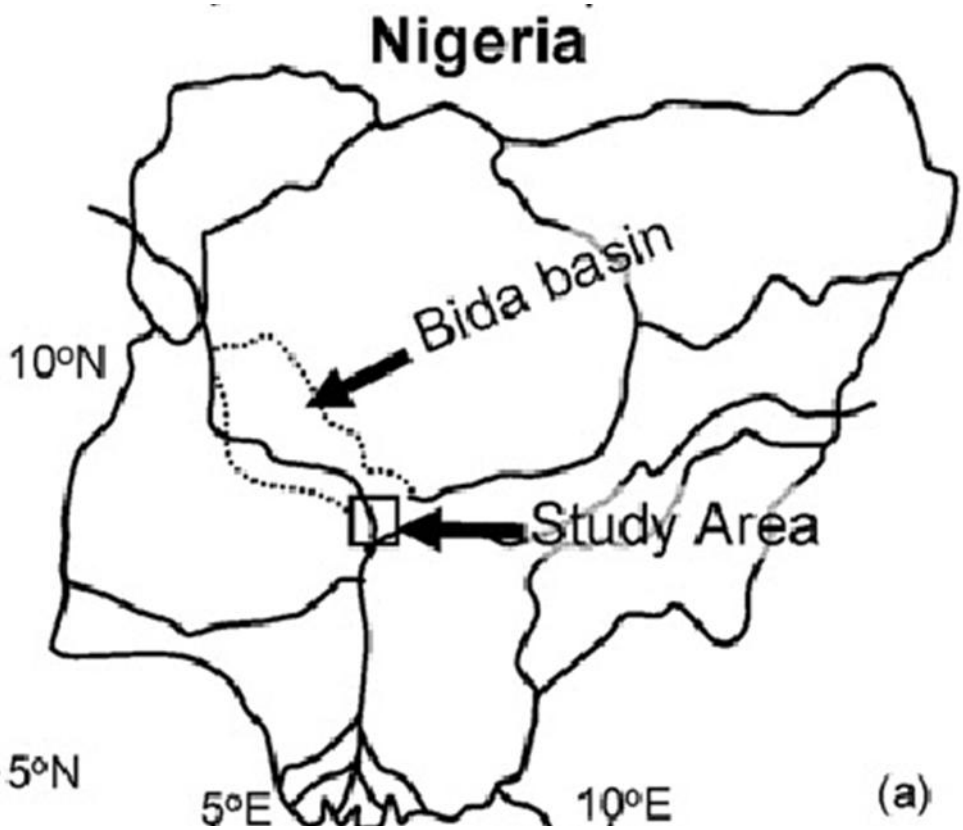

Figure 1: Map of Nigeria showing study area Adankolo within Lokoja Sheet 247

II. Methodology

The study employed a combination of fieldwork, laboratory analysis, and desk study:

Fieldwork

Geological mapping was conducted to document lithological variations and structural features.

Measurement of attitudes (strike, dip, and plunge) was taken using a compass clinometer to establish bedding and fracture orientations.

Rock sampling involved systematic collection of representative sandstone and laterite samples from fresh outcrops and quarry sites.

Petrographic Analysis

Samples were cut, polished, and thin sections prepared. Optical microscopy was used to identify minerals (quartz, feldspar, lithics, oxides) and assess textural features such as grain size, sorting, and cementation.

Geochemical Analysis

Rock samples were subjected to X-ray fluorescence (XRF) analysis. Major oxides (SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O) and selected trace elements were determined.
Results were compared with global sandstone averages for provenance interpretation.

Structural Analysis

Structural data (joints, fractures, faults) were plotted on rose diagrams to identify dominant trends.
Correlation was made between structural fabrics and regional tectonics of the Bida Basin.

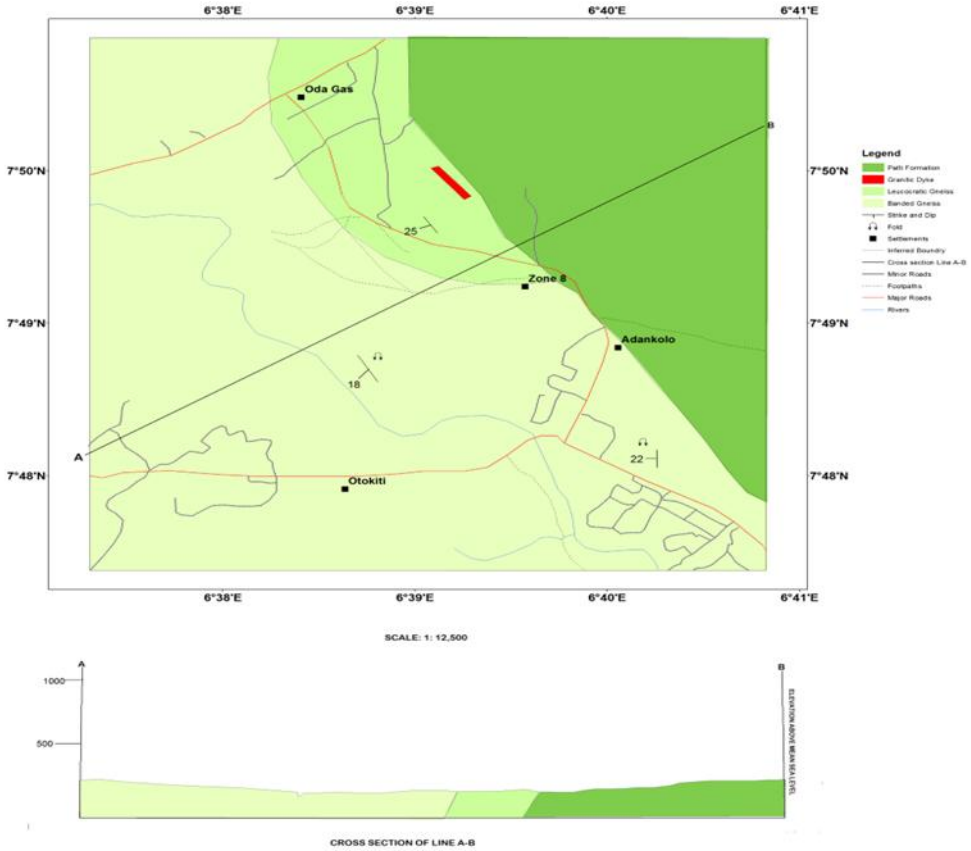

Figure 2: Geological map and cross section of the study area

III. Geological Setting

Regional Geology

The Bida Basin is an elongate intracratonic basin trending NW–SE and covering ~75,000 km². It is bounded by the Nigerian Basement Complex to the north and south and is tectonically linked to the Anambra Basin and Benue Trough (Obaje, 2009).

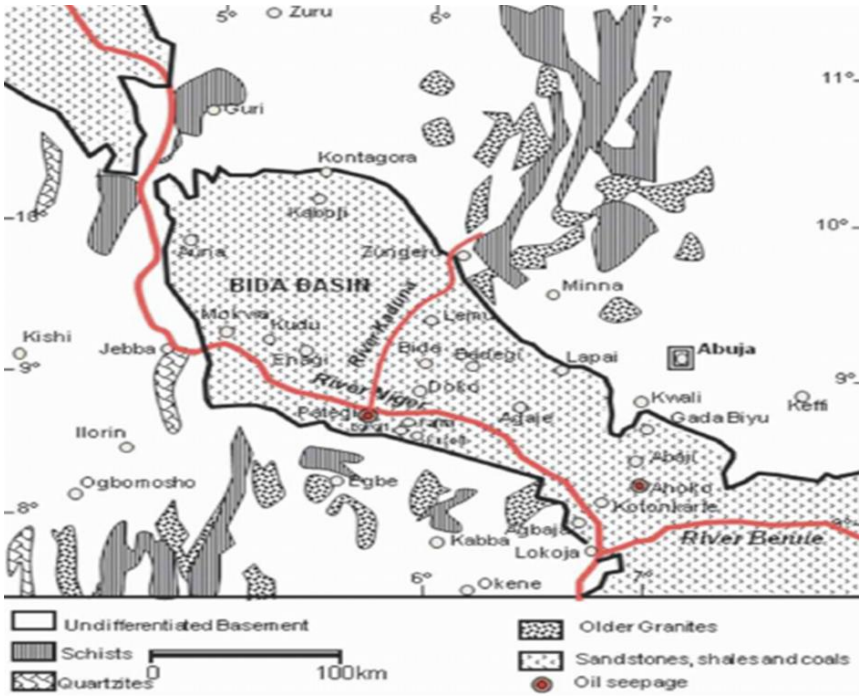

Figure 3. Geology and location of Bida Basin and environs

Stratigraphy of the Basin (Adeleye, 1974):
Lokoja Sandstone – basal, fluvial conglomerates and sandstones.
Patti Formation – alternating shales, siltstones, and sandstones of deltaic to shallow marine origin.
Aganebode Formation – fine sandstones and claystones capped by laterites.

Depositional environments reflect Late Cretaceous fluvial-deltaic systems with tectonic control from the underlying basement.

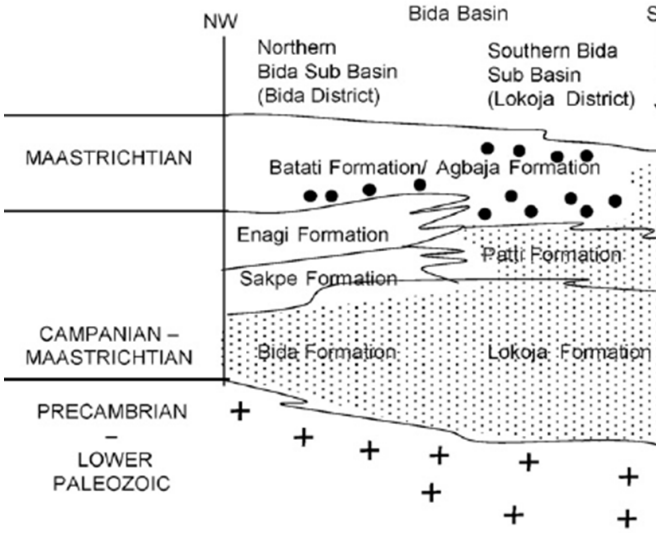

Figure 4. Stratigraphic Successions of the Bida Basin (Akande, 2005: Obaje 2009)

Local Geology (Adankolo Area)

The Adankolo area exposes coarse- to medium-grained sandstones, often ferruginized and capped by laterite. Pebbly horizons suggest episodes of high-energy fluvial deposition.
Petrographic analysis confirms:
Quartz (monocrystalline and polycrystalline).
Feldspar (plagioclase and K-feldspar).
Iron oxides as cementing agents.

Lithic fragments from basement rocks.

This composition suggests a mixed provenance, possibly from granitic and metamorphic sources of the nearby Basement Complex

Field photography of a coarse-medium banded gneiss with a micro fault. $7^0 48' 28'' N, 6^0 41' 17'' E$

IV. Structural Geology

Structural fabrics in Adankolo reveal significant tectonic influence: Joints and fractures occur in NW–SE and NE–SW orientations, consistent with regional stress fields.

Hand specimen of a sample of coarse-medium grained gneiss

Minor faults with small displacements indicate localized deformation. Bedding planes dip gently SE, reflecting basin subsidence patterns

These fabrics are geologically and economically significant because:
1. They enhance aquifer recharge and flow paths, making groundwater more accessible.
2. They increase quarrying potential, as fractured rocks are easier to extract.
3. They create pathways for contaminants such as iron and fluoride to enter groundwater, raising Medical Geology concerns.

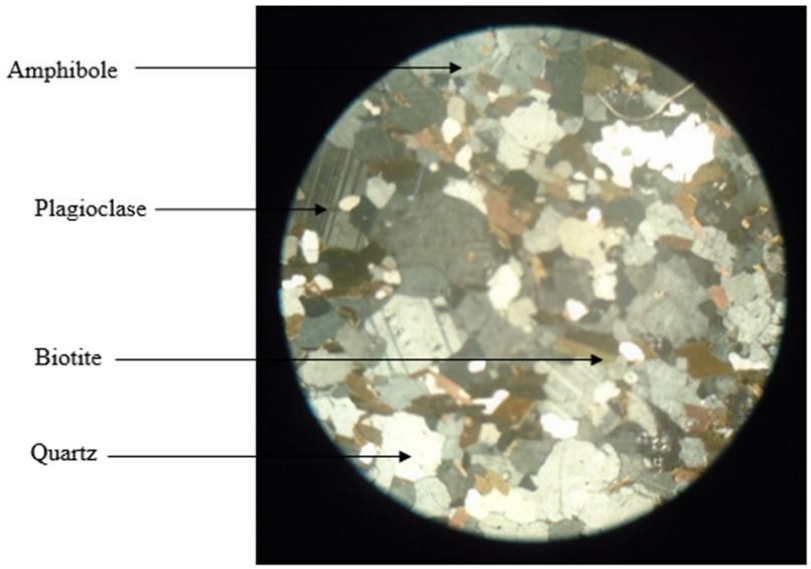

Photo micrograph of a coarse-medium banded gneiss observed under plane polarized light (XPL) of magnification X10

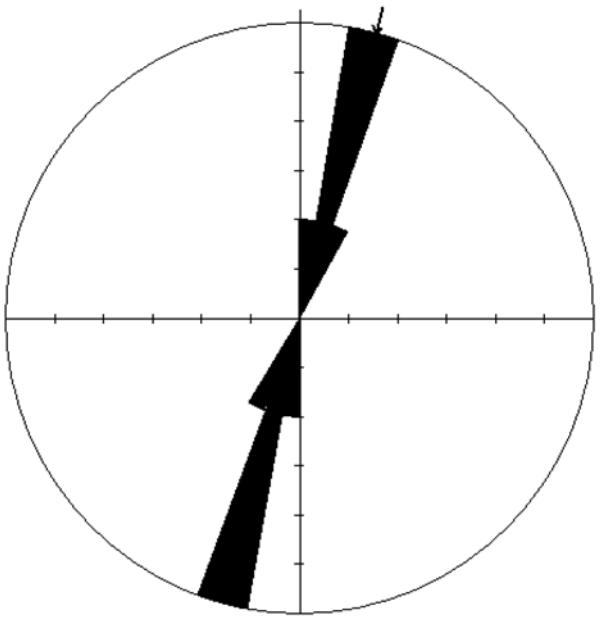

Figure 5: Rose diagram of joint orientations in Adankolo

V. Result Analysis

Thin section studies reveal dominance of quartz, feldspar, lithic fragments, and ferruginous cement. The presence of angular grains and poor sorting suggests proximity to source rocks.

Table 1: Modal composition of Lokoja Sandstone in Adankolo (thin section analysis)

Mineral	Percentage (%)
Quartz	60–70
Feldspar	10–15
Lithic Fragments	5–10
Iron Oxides / Cement	5–8
Accessories (mica, zircon)	< 2

Geochemistry

XRF analysis shows silica dominance and significant iron oxide enrichment.

Table 2: Major oxide composition of representative sandstone samples

Oxide	Range (%)	Average (%)
SiO_2	70–78	74.5
Al_2O_3	10–14	11.8
Fe_2O_3	5–9	6.5
CaO	1–3	2.1
K_2O	1–2	1.4
Na_2O	<1	0.7

These values confirm a quartz-rich, ferruginized sandstone, consistent with fluvial deposition.Rose diagram analysis shows NW–SE and NE–SW joint sets, reflecting tectonic control

VI. Knowledge Gap And Future Research

This study identified several gaps in knowledge:

1. Hydrogeochemistry and Health: While petrography and geochemistry were analyzed, more detailed groundwater chemistry data are lacking, especially for trace elements linked to health (e.g., fluoride, manganese).
2. Medical Geology Linkages: Few studies explicitly connect Lokoja's geology with health outcomes such as fluorosis, silicosis, or heavy metal toxicity.
3. Structural Controls: The relationship between fractures/faults and groundwater contamination is not well understood in Adankolo.

4. Environmental Impact: Long-term health effects of quarrying dust and groundwater vulnerability require further study.

Future Research Recommendations:
Conduct hydrogeochemical surveys to map water quality.
Collaborate with medical researchers to assess disease prevalence in quarrying/mining communities.
Develop a framework for Medical Geology in Nigeria that integrates geology, environment, and public health.

VII. Conclusion

This study has revealed that the geology of the Adankolo area, Lokoja, is dominated by Precambrian Basement Complex rocks, particularly banded gneiss, leucocratic gneiss, and granitic dykes. The gneisses, characterized by alternating light and dark mineral bands, are of sedimentary origin that has undergone metamorphism and metasomatism during regional tectonic events. The structural features veins, joints, folds, and foliations demonstrate the imprint of the Pan-African orogeny, aligning with broader regional stress patterns observed across the Nigerian Basement Complex.

Petrographic and geochemical results indicate that the gneisses are silica- and alumina-rich, derived from pelitic precursors, and are comparable to similar basement rocks across Lokoja and other parts of the Nupe Basin. Trace element analyses reveal generally low to moderate concentrations, with zirconium (Zr) being the most enriched, pointing to acidic magma contributions and limited environmental risks. Economically, the rocks of the area hold significant potential as construction materials and dimension stones, contributing to local development.

The significance of this work lies in its contribution to the broader field of medical geology. By providing baseline data on the geochemistry and mineralogy of basement rocks in the Southern Bida Basin, it sets the foundation for evaluating the possible link between geology, environmental quality, and public health in Nigeria. Understanding the distribution of trace elements such as Ni, Cr, and Pb is particularly important, as anomalous concentrations could influence soil, water, and ultimately human health in the region. Thus, this study not only enriches academic knowledge on the geology of the Southern Bida Basin but also underscores its relevance to sustainable development and environmental health studies.

References

[1]. Adeleye, D.R. (1974). Sedimentology Of The Fluvial Bida Sandstones (Cretaceous), Nigeria. Sedimentary Geology, 12(1), 1–24.
[2]. Bala, A., Ajibade, A.C., & Ogunmola, J.K. (2018). Hydrogeochemical Evaluation Of Groundwater Resources In The Bida Basin, Nigeria. Journal Of African Earth Sciences, 145, 65–75.
[3]. Edet, A.E., & Okereke, C.S. (2014). Hydrogeochemical Studies In Nigeria: Implications For Groundwater Quality And Health. Environmental Earth Sciences, 71, 409–427.
[4]. Fashola, M.O., Ngole-Jeme, V.M., & Babalola, O.O. (2016). Heavy Metal Pollution From Gold Mines: Environmental Effects And Bacterial Strategies For Resistance. International Journal Of Environmental Research And Public Health, 13(11), 1047.
[5]. Obaje, N.G. (2009). Geology And Mineral Resources Of Nigeria. Springer, Berlin.
[6]. Oteze, G.E. (1989). Hydrogeology Of The Bida Basin, Nigeria. Journal Of Mining And Geology, 25(1–2), 157–163.
[7]. Selinus, O., Et Al. (2005). Essentials Of Medical Geology. Elsevier, London.
[8]. Petrography, Geochemistry, Structural Fabrics And Economic Importance Of The Geological Features In Adankolo, Lokoja Sheet 247, Nigeria