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Solid mineral potential in the southern Benue Trough: A review

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Abstract: *The Nigerian Southern Benue Trough has a wide variety of metallic, non-metallic, and energy minerals, making it a promising major mineral resource corridor. The solid mineral potential of the area is evaluated by this review, which synthesizes the geological, geochemical, and economic data currently available. It emphasizes the impact of intricate stratigraphy, hydrothermal processes, and Cretaceous rift tectonics on mineralization patterns. High-grade barite in Azara and Ishiagu, limestone in Gboko and Mfamosing, lead-zinc deposits in Abakaliki, and coal in the Lafia-Obi axis are important resources. Limited geological data, inadequate infrastructure, environmental degradation, and lax regulatory frameworks continue to impede development despite their strategic importance. Artisanal businesses currently dominate mining activities, although industrial-scale investments are starting to appear. Modernizing exploration, luring investment, and advancing sustainable mining methods are the goals of government programs like the MinDiver Project and growing private sector involvement. In order to fully realize the economic potential of the Southern Benue Trough and make a significant contribution to Nigeria's objectives for energy transition and economic diversification, this analysis emphasizes the urgent need for integrated geological mapping, infrastructural development, and regulatory reform.*

Keywords: *Southern Benue Trough, solid minerals, lead-zinc, barite, hydrothermal mineralization, economic geology, artisanal mining, Nigeria.*

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1.0 Introduction

1.1 Overview of solid minerals and their economic importance

Global economic development is largely dependent on solid minerals, which are vital raw resources for sectors including industry, technology, energy production, and construction (Adekoya et al., 2019). These minerals are essential for building infrastructure, creating jobs, and generating national income. They include industrial minerals like barite and limestone, metallic ores like lead and zinc, and energy minerals like coal (Obaje, 2009). A major contributor to the GDP of resource-rich countries, especially in Africa, where mineral exploitation continues to be a major engine of economic expansion, is the mining industry, according to the World Bank (2021).

Nigeria has long relied heavily on solid minerals for economic growth; the country's early industrialization was aided by significant coal, tin, columbite, and gold resources (Nwachukwu et al., 2010). But since the mid-1900s, when petroleum was discovered, the solid minerals industry has been mainly ignored, which has resulted in a lack of use of its enormous potential (Ogunleye et al., 2017). As the need for vital minerals utilized in renewable energy technologies continues to climb globally, interest in solid minerals has increased due to recent economic diversification initiatives by the Nigerian government (U.S. Geological Survey, 2022).

The discovery and extraction of lead-zinc ores in the Abakaliki region by British geologists during colonial times marked the beginning of mineral exploration in the Southern Benue Trough. With operations concentrated on the Ishiagu and Ameri mining districts, the area had emerged as a major supplier of lead and zinc to British industries by the 1940s and 1950s (Offodile, 2002). Small-scale, mostly manual mining operations were encouraged by a colonial administrative structure that gave export-oriented resource extraction precedence over domestic beneficiation. As focus switched to oil production after independence, interest in mineral prospecting declined. However, the Nigerian Geological Survey Agency (NGSA) and private organizations conducted new geological mapping and research in the 1980s and 1990s, which resulted in the rediscovery of a number of underdeveloped or abandoned mineral deposits (Mucke & Mucke, 2001). Salt and barite have drawn more attention in recent decades, particularly because barite is essential to the drilling mud industry in Nigeria's petroleum sector. Even though the area has a lengthy history of exploiting its mineral resources, lack of infrastructure, lax regulations, environmental damage, and restricted access to geological data have all hindered exploration and mining activities. However, continuous improvements in the mining industry in Nigeria—including the establishment of the Nigerian Mining Cadastre Office and improved licensing processes—are aimed at repositioning regions like the Southern Benue Trough as strategic mineral development corridors (Ministry of Mines and Steel Development, 2016).

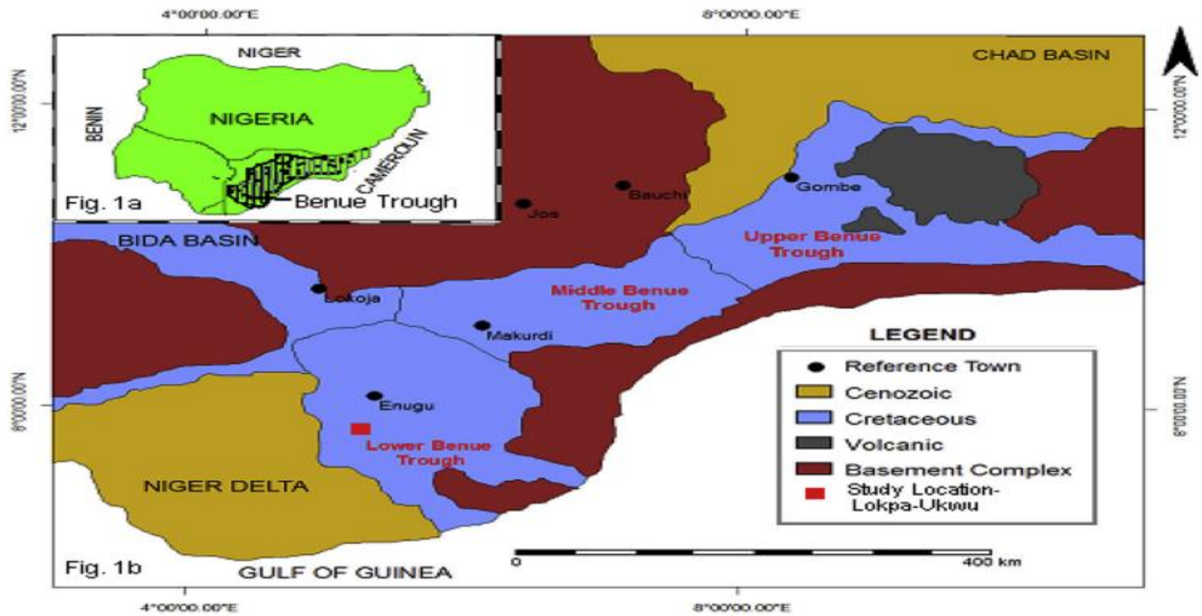

Fig 1: Map of Nigeria showing the Benue trough (Fatoye & Gideon, 2013)

1.2 Objectives and significance of the review

This review aims to provide a comprehensive synthesis of existing knowledge on the solid mineral potential of the Southern Benue Trough, with a focus on geological controls, spatial distribution, and economic viability. Specifically, the review seeks to:

(i) Evaluate documented mineral occurrences and their geological settings within the Southern Benue Trough.

(ii) Identify gaps in research and propose future directions for sustainable mineral exploitation.

This review is important because it can help investors, governments, and geoscientists make well-informed decisions about the development of Nigeria's mineral resources. A thorough evaluation of the mineral endowment of the Southern Benue Trough is essential for encouraging investment and sustainable mining methods, especially in light of the nation's present economic difficulties and the worldwide trend toward green energy (World Bank, 2021). Additionally, by highlighting the necessity of better geological surveys and value-added mineral processing, this assessment adds to the larger conversation on Africa's mineral resources (African Mining Vision, 2009).

2.0. Geological Setting

2.1 Tectonic evolution of the Benue Trough

A significant Cretaceous sedimentary basin in West Africa, the Benue Trough formed as a result of larger tectonic processes linked to the disintegration of the Gondwana supercontinent and the opening of the South Atlantic Ocean (Benkhelil, 1989). With the other arms developing into the Gulf of Guinea and the Equatorial Atlantic Ocean, it is an aulacogen, or failed arm, of a triple junction rift system connected to the Central African Rift Zone (Burke et al., 1971; Olade, 1975). In order to create a complex network of depocenters and structural highs, the trough underwent several phases of rifting, subsidence, and transtensional deformation between the Albian and Maastrichtian periods (Guiraud & Maurin, 1992).

Intense syn-sedimentary tectonism, typified by NW-SE trending faults and basin inversion events, affected sediment deposition and mineralization, especially in the Southern Benue Trough (Nwachukwu et al., 2010). The emplacement of metallic and industrial mineral deposits was made easier by the hydrothermal fluid routes that these tectonic processes produced (Farrington, 1952). The trough is comparable to other mineral-rich rift basins worldwide, like the Rhine Graben in Europe, since its geodynamic history fits models of intracontinental rifting (Ziegler, 1992).

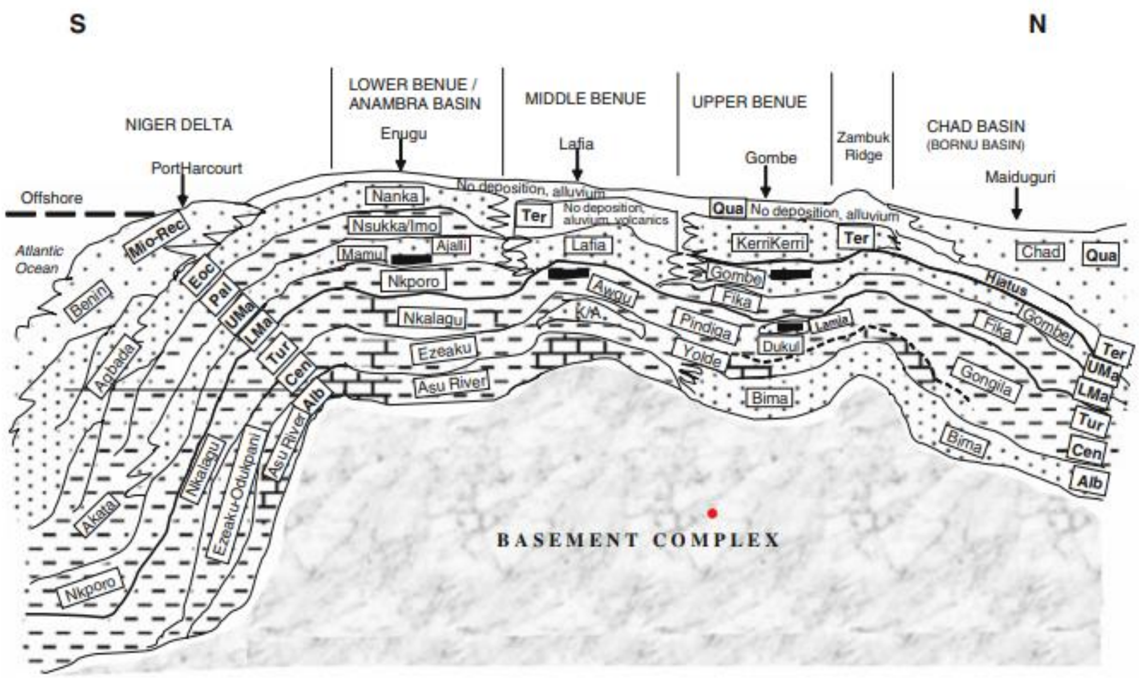

Fig 2: Regional geological and stratigraphic correlation across the southern Benue Trough (Modified after Obaje et al., 2009)

2.2 Stratigraphic units and their relevance to mineral formation

Although there have been few reports of Aptian–Early Albian pyroclastics, sedimentation in the southern Benue Trough began with the marine Neocomian–Albian Asu River Group (Ojoh, 1992; Benkhelil, 1989) (Fig. 2). In the southern Benue Trough, the Asu River Group sediments are primarily shales with scattered sandstones, siltstones, and limestones (Murat, 1972). Additionally, there is extrusive and intrusive material from the Abakaliki Formation in the Abakaliki area and the Mfamosing Limestone in the Calabar Flank (Umeji, 1983; Petters, 1982; Olade, 1975; Farrington, 1952) (Nwachukwu, 1972). The Asu River Group is also composed of limestone, siltstones, volcaniclastics, marine shales, and arkosic sandstones that cover the Pre-Cambrian to Lower Paleozoic crystalline basement rocks, according to Offodile (1976). The main source of the arkosic sediments was the severe weathering of the basement rocks, which were invaded by alkaline basaltic rocks before the Middle Albian periods' first fast sea flooding. The Asu River Group is thought to be sediments from the Lower Benue Trough's first transgression cycle.

Both the interfingering regressive sandstones of the Agala and Agbani Formations (Cross River Group) and the coastal Cenomanian–Turonian Nkalagu Formation (black shales, limestones, and siltstones) are situated on the Asu River Group. However, during the Late Albian, calcareous sandstones of the Odukpani Formation were formed in an unconformable manner on the basement rocks of the Calabar Flank, together with sequences of sandstones, limestones, and shales (Reyment, 1965).

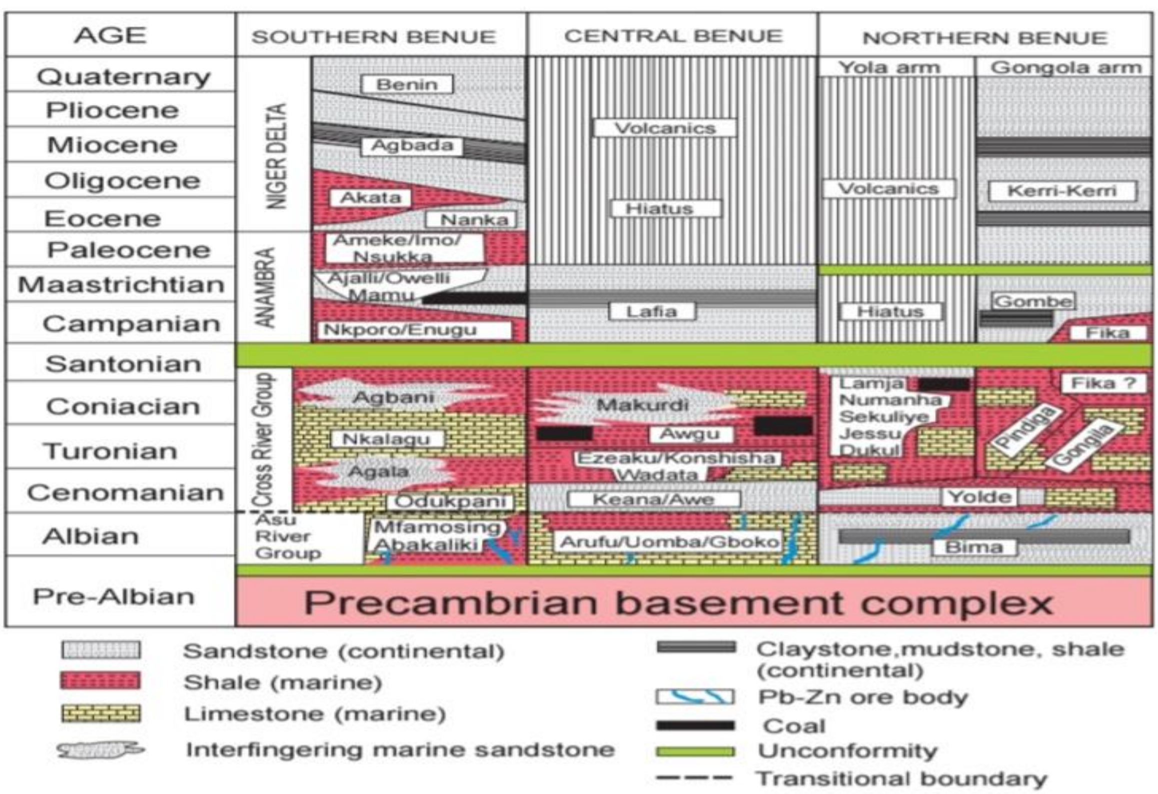

Fig 3: Stratigraphic successions in the Nigerian Benue Trough showing the mineralized ore body (Abubakar, 2014)

2.3 Structural features influencing mineralization

Numerous structural characteristics, such as faults, folds, and fractures, are prevalent in the Southern Benue Trough and significantly influence the distribution of minerals. The Abakaliki and Ogoja faults, two significant NE-SW trending faults, serve as channels for hydrothermal fluids, directing mineralizing solutions into advantageous host rocks (Ofoegbu, 1985). Particularly for lead-zinc sulfides, syn-sedimentary folds like the Abakaliki anticlinorium produced structural traps for ore deposition (Farrington, 1952).

As demonstrated by the barite veins of Ishiagu and Azara, which are located in extensional fractures in shale units, fracture systems linked to Santonian compressional events further localized mineralization (El-Nafaty, 2015). The Mississippi Valley-Type (MVT) deposits and other sediment-hosted mineral systems exhibit similar structural controls (Leach et al., 2005).

2.4 Igneous intrusions and hydrothermal activity

Even though the Southern Benue Trough is primarily sedimentary, it does have isolated igneous intrusions from the Late Cretaceous to Paleogene periods, such as syenites, dolerites, and alkaline basalts (Umeji, 2000). These intrusions are connected to the Cameroon Volcanic Line, which crosses the southeast edge of the trough, and mantle-derived magmatism (Ngako et al., 2008). Tectonic stress and magmatic heat drove hydrothermal activity, which was essential in remobilizing metals from source rocks and precipitating them in pore spaces and fractures (Oden, 2012). Moderate-temperature (120–200°C) saline hydrothermal fluids enriched in Pb, Zn, and Ba are found in fluid inclusion studies from the Abakaliki lead-zinc deposits (Akande et al., 1998). Similarly, sulfate-rich basinal brines and metal-bearing hydrothermal fluids are said to have mixed to cause barite mineralization in the trough (El-Nafaty, 2015).

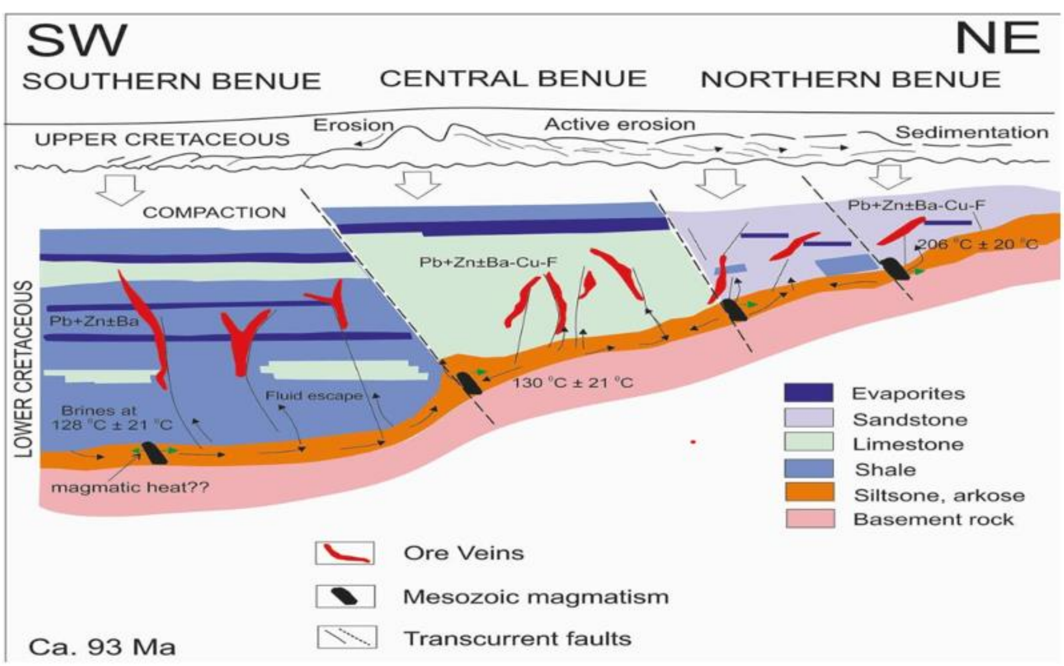

Fig 4: Simplified schematic ore genesis model for the Nigerian Benue Trough deposits (Modified from Akande et al., 1989; Bute et al., 2023)

2.5 Comparison with other mineralized belts in Nigeria

The Southern Benue Trough shares geological similarities with other Nigerian mineral belts but exhibits unique mineralization styles:

(i) Jos Plateau Tin Fields: Unlike the hydrothermal-sedimentary deposits of the Benue Trough, the Jos Plateau's cassiterite and columbite mineralization are linked to Pan-African granitic intrusions (Wright, 1985).

(ii) Niger Delta Basin: While the Delta is hydrocarbon-rich, the Benue Trough's mineral wealth lies in its metallic and industrial minerals, reflecting differences in depositional environments and thermal maturation (Reijers, 1996).

(iii) Schist Belts of SW Nigeria: The schist belts host gold and rare-metal pegmatites formed during Precambrian orogenies, contrasting with the Benue Trough Cretaceous rift-related mineralization (Garba, 2003).

3.0 Major solid minerals and their distribution

Numerous solid mineral resources, including metallic, non-metallic, and energy minerals, are abundant in the Southern Benue Trough, which makes up a sizable portion of Nigeria's Cretaceous sedimentary basin. Parts of the states of Ebonyi, Nasarawa, and Benue are included in this region, which is important for resource exploration and economic geology. Magmatism, basin subsidence, rift-related tectonism, hydrothermal activity, and other intricate geological processes all influence the mineralization in the trough and have a combined effect on the region's metallogenic profile (Obaje, 2009; Mallo et al., 2013).

3.1 Metallic minerals

Lead-Zinc

Known for its lead-zinc (Pb-Zn) deposits, the Southern Benue Trough is primarily found in the Lower Benue region, especially in Ebonyi State (e.g., Abakaliki, Ishiagu, and Enyigba). The Albian–Cenomanian shales and sandstones of the Asu River Group contain these deposits as stratabound and vein-type mineralization (Farrington, 1952). Barite and pyrite are frequently found in the ores, which are mostly composed of galena (PbS) and sphalerite (ZnS) (Akande et al., 1998). High-grade zones are found by geochemical investigations, with Pb-Zn concentrations in some locations over 10% (El-Nafaty, 2015).

Iron Ore

The Southern Benue Trough contains iron ore deposits in Benue State (e.g., Gboko and Katsina-Ala), where lateritic cappings of hematite (FeO(OH)) and goethite (FeO(OH)) are found on top of Cretaceous sandstones (Obaje, 2009). Although these deposits have the potential for small-scale industrial usage, their low iron concentration (less than 50% Fe) and high silica impurities make them generally sub-economic (Nwachukwu et al., 2010).

Manganese

Manganese mineralization is sparse but documented in Cross River State, where psilomelane (Mn-oxide) and pyrolusite (MnO_2) occur as fracture fillings in Turonian limestones of the Eze-Aku Formation (Ezeh & Anike, 2009). These deposits are minor compared to Nigeria's larger manganese reserves in the Birnin Gwari belt (NW Nigeria) but indicate regional metallogenic diversity.

3.2 Non-Metallic minerals

Barite

A vital mineral for the oil and gas sector, barite ($BaSO_4$) is widely available in the states of Ebonyi (Ishiagu) and Nasarawa (Azara). El-Nafaty (2015) states that the mineralization takes the form of white to milky veins that are hosted in fractured Cretaceous shales. In high-grade zones, the purity of $BaSO_4$ surpasses 90%. The geographical association of barite and Pb-Zn sulfides suggests that they have a common hydrothermal origin (Offodile, 2014).

Limestone

The states of Benue (Gboko, Yandev), Cross River (Mfamosing), and Ebonyi (Nkalagu) are home to extensive limestone resources. Cement is made from high-purity (>85% $CaCO_3$)

limestone found in the Eze-Aku and Awgu Formations (Ezeh & Anike, 2009). For example, Nigeria's cement industry has been driven by the Nkalagu deposit since the 1960s.

Gypsum

Gypsum ($CaSO_4 \cdot 2H_2O$) occurs in Benue State (Okpokwu), where it forms evaporite layers within the Eze-Aku Formation. These deposits are linked to restricted marine basins during the Turonian, with thicknesses reaching 2–3 m in outcrops (Nwajide, 2013).

Clay

Kaolinitic and bentonitic clays are abundant in Ebonyi (Isiagu) and Nasarawa (Awe) States. These clays, derived from weathering of Cretaceous shales and volcanic ash layers, are utilized in ceramics, construction, and drilling muds (Adekoya et al., 2019).

3.3 Energy minerals

Coal

Sub-bituminous coal deposits occur along the Lafia–Obi axis in Nasarawa State, within the Awgu Formation (Coniacian–Santonian). The coal seams, averaging 1–3 m in thickness, exhibit moderate calorific values (5,000–6,500 kcal/kg) and low sulfur content, making them suitable for power generation (Ogunleye et al., 2017).

Table 1: Distribution of minerals within the states of the southern Benue trough (Fatoye & Gideon, 2013)

State	Metallic Minerals	Non-Metallic Minerals	Energy Minerals
Ebonyi	Lead-Zinc (Abakaliki)	Clay, Limestone	Not significant
Nasarawa	Iron Ore, Manganese	Barite (Azara), Gypsum, Clay	Coal (Lafia–Obi region)
Benue	Iron Ore, Manganese	Limestone (Gboko), Clay	Coal (Lower Benue Trough)
Cross river	Manganese	Limestone	Not significant

3.5 Mineral associations and geochemical characteristics

Lead-Zinc-Barite assemblages in Abakaliki and Azara point to a low-temperature hydrothermal origin, with mineralizing fluids migrating through fault-controlled fractures in shale. Iron and manganese frequently co-occur with cherty and ferruginous layers, indicating sedimentary exhalative (SEDEX) or diagenetic deposition in anoxic basins. Barite in Nasarawa exhibits high $BaSO_4$ purity (>95%), low silica, and the absence of toxic heavy metals, making it suitable for export. Limestones in Gboko and Yandev show low MgO and high CaO, indicating their suitability for Portland cement. Coal in Lafia–Obi has a moderate ash content and high volatile matter, suggesting the possibility of clean coal technologies if properly harnessed (Fatoye & Gideon, 2013; Bute et al., 2023).

4.0 Economic potential and challenges

4.1 Economic value of identified minerals

A wide variety of economically valuable minerals that are essential to the expansion of industry and the advancement of the country can be found in the Southern Benue Trough. In Nigeria's oil and gas industry, for example, barite is a vital mineral that is used as a weighing component in drilling muds. Even though Nigeria has some of the best barite reserves in the world (at Azara and Ishiagu, the deposits surpass 90% $BaSO_4$ purity), the country currently imports more than 90% of its barite needs, which costs the country an estimated $300 million a year (El-Nafaty, 2015; Nigerian Mining Growth Roadmap, 2016). This contradiction highlights unrealized potential for employment development and import substitution. Another essential commodity, limestone, powers Nigeria's booming cement sector and accounts for around 10% of the country's industrial GDP. To supply local and regional demand, major producers such as Dangote Cement and Lafarge Africa rely on limestone reserves in Benue (Gboko) and Cross River (Mfamosing) States, generating more than 30 million metric tons yearly (Ezeh & Anike, 2009; World Bank, 2021). Although underutilized, the coal reserves along Nasarawa State's Lafia–Obi axis have potential for industrial uses, especially in cement kilns and steel production, as well as electricity generation. Coal could be used as a temporary solution to close the electricity gap in Nigeria, where the energy shortfall is more than 30,000 MW (Fatoye & Gideon, 2013). Furthermore, Abakaliki's lead-zinc deposits, which have grades higher than 10% Pb-Zn, offer prospects for alloy and battery production, lowering dependency on imported metals (Akande et al., 1989). Collectively, these minerals form a critical foundation for industrialization, yet their full potential remains unrealized due to systemic challenges.

4.2 Current exploration and mining activities

The prevalence of artisanal and small-scale mining (ASM) in the Southern Benue Trough contrasts sharply with intermittent industrial operations. The formal sector is dominated by industrial-scale limestone quarrying; in Benue and Ebonyi States, organizations such as Dangote Cement and Lafarge Africa run sizable mechanized mines. These businesses play a major role in creating jobs in the area; Lafarge alone employs over 1,000 people at its Nkalagu factory (Adekoya et al., 2019). But most mineral extraction, especially for lead-zinc and barite, is done informally by artisanal miners with crude gear. Over 5,000 artisanal miners, for instance, physically extract barite in the Ishiagu district of Ebonyi, frequently selling raw metal to middlemen at below-market prices (Nigerian Mineral Development Commission, 2020). Coal mining follows a similar pattern: while ETA-Zuma Group operates a mechanized mine in Nasarawa, most production comes from unregulated artisanal pits, where unsafe practices and environmental neglect are rampant (Ogunleye et al., 2017). This duality highlights a sector in transition, where formal investment coexists with deeply entrenched informal practices.

4.3 Contribution to local and national economies

Although its economic contribution to Nigeria is still small, the solid mineral sector has the potential to revolutionize the country. Less than 0.3 percent of the country's GDP comes from mining, compared to 8% from the petroleum industry (World Bank, 2021). However, at the subnational level, minerals like limestone and barite are lifelines for states like as Ebonyi and Benue, where mining royalties contribute 15–20% of internally generated revenue (Nwachukwu et al., 2010). Though these employment are sometimes informal, and poorly compensated, the sector also supports over 500,000 Nigerians, mostly through ASM (ILO, 2019). While coal production in Nasarawa supports nearby power plants and brick-making businesses, limestone mining in Nkalagu has fueled ancillary sectors in Ebonyi State, like as trucking and logistics. Despite these benefits, the sector's impact is constrained by inefficiencies. For instance, Nigeria's cement industry, though thriving, relies heavily on imported equipment due to limited local manufacturing capacity, reducing the multiplier effect of mineral wealth (Maduaka, 2014).

4.4 Economic Analysis

The mineral resources within the Southern Benue Trough—particularly barite, limestone, lead-zinc, coal, and clay—hold significant economic value with increasing national and international demand. For example, Nigeria's demand for barite, driven largely by the oil and gas sector for drilling operations, exceeds

50,000 tonnes annually, while domestic production remains insufficient to meet this demand (Ameh et al., 2020). Similarly, the limestone market supports Nigeria's growing cement industry, which had an output of 30 million metric tonnes in 2022, positioning the country as a regional cement hub (National Bureau of Statistics, 2023). A comparative cost-benefit analysis indicates that local processing and beneficiation of these minerals can increase revenue by up to 40%, reduce foreign exchange loss through import substitution, and create direct and indirect employment opportunities (Obaje, 2009; Musa et al., 2018). The artisanal mining sector, if formalized and properly incentivized, could contribute over ₦500 billion annually to Nigeria's GDP (Ministry of Mines and Steel Development, 2021).

4.4 Key challenges

4.4.1 Limited geological data and modern exploration

A significant impediment to unlocking the Benue Trough's mineral potential is the lack of up-to-date geological data. Nigeria's last major geological survey was undertaken in the 1970s, and less than 5% of the trough has been studied using advanced geophysical or geochemical methods (Maduaka, 2014). Because mining companies are hesitant to commit capital without reliable resource estimations, outdated maps and inadequate exploration drilling discourage investors. For instance, large-scale development is hampered by the lack of comprehensive reserve calculations and metallurgical studies, despite the fact that lead-zinc deposits in Abakaliki are well-documented (Akande et al., 1998).

4.4.2 Inadequate infrastructure

Poor road networks force miners to transport barite ore from Ishiagu to Port Harcourt a 300-kilometer journey for grinding, adding 30 to 40 percent to production costs (El-Nafaty, 2015). Errors in power supply exacerbate these issues: only 45 percent of mining sites in Benue and Ebonyi States have access to grid electricity, forcing reliance on costly diesel generators (Nigerian Mining Report, 2022). The Lafia–Obi coal axis lacks rail links, limiting bulk transport to trucks, which damages roads and costs more to transport.

4.4.3 Environmental Impact

Environmental damage is a legacy of artisanal mining. Uncontrolled lead-zinc ore mining in Ebonyi has resulted in soil erosion and deforestation, and mercury used in unofficial processing contaminates streams, making agriculture unusable (Adekanmbi & Wolf, 2024). Over 1,000 hectares of land in Nasarawa have been deteriorated by open-pit coal mining, and the desertification has been made worse by insufficient restoration attempts. In an area where farming employs 70% of the people, these practices not only jeopardize biodiversity but also compromise long-term agricultural output (World Bank, 2021).

Mining operations in the Southern Benue Trough, especially unregulated artisanal and small-scale mining (ASM)—have caused extensive environmental degradation, including land scarring, deforestation, and water pollution. For instance, elevated levels of heavy metals such as lead (Pb) and cadmium (Cd) have been reported in water bodies near lead-zinc mining areas in Abakaliki and Ishiagu, often exceeding WHO permissible limits (Okorie et al., 2015; Ezeh & Anike, 2009). Satellite imagery analyses between 2010 and 2020 reveal a 25% loss of vegetation cover in mining-impacted areas, alongside increased soil erosion and sedimentation of rivers (Ibrahim et al., 2022). Additionally, abandoned mine pits serve as breeding grounds for disease vectors and have led to several accidental drownings and health hazards (Aigbedion & Iyayi, 2007). Despite these impacts, environmental management plans are rarely implemented due to weak enforcement mechanisms.

4.4.4 Weak regulatory enforcement and land conflicts

Nigeria's current mining regulatory framework is anchored on the Minerals and Mining Act of 2007, which provides for licensing, environmental protection, and the promotion of investment. While the Act is comprehensive in scope, enforcement remains weak due to underfunded regulatory institutions, bureaucratic delays, and lack of coordination between federal and state governments (Chindo et al., 2014; Ezezika et al., 2020). Moreover, the informal sector, which constitutes over 80% of mining activity, operates largely outside the legal framework, making environmental control and revenue capture difficult. Strengthening regulatory effectiveness requires the decentralization of oversight functions, digitization of licensing procedures, and provision of technical support to artisanal miners. Furthermore, establishing a Mineral Development Fund that mandates environmental rehabilitation and community development would align Nigeria's regulatory system with global best practices (World Bank, 2019).

4.5 Role of private investment and government initiatives

Government initiatives

Reviving the industry is the goal of recent policy changes. The Nigerian Geological Survey Agency (NGSA) is working with the World Bank to digitize archives and carry out aerial geophysical surveys as part of the Minerals Sector Roadmap (2016), which places a high priority on modernizing geological data (World Bank, 2021). Targeting important resources like coal and barite, the Nigerian Mineral Development Company (NMDC) was established in 2020 with the goal of luring private investment through joint ventures. In order to encourage safer and more sustainable practices, the $150 million MinDiver Project also sponsors capacity-building initiatives for ASM cooperatives and regulators (NMDC, 2020).

Private sector engagement

Slowly, private investors are joining the competition. While Canadian company Thor Explorations Ltd. is investigating lead-zinc deposits in Ebonyi through a public-private partnership, BUA Group has committed $500 million to expand the processing of gypsum and limestone in Benue (Nigerian Mining Report, 2022). Despite ongoing environmental concerns, Chinese companies, like as Shanghai Electric, have shown interest in building coal-fired power stations connected to Lafia–Obi deposits.

5. 0 Conclusion and recommendations

A vast range of solid minerals, including metallic minerals like lead, zinc, and iron ore, non-metallic minerals like barite, limestone, clay, and gypsum, and energy minerals like coal, are abundant in Nigeria's Southern Benue Trough. These minerals comprise a major mineral belt that can greatly promote industrial development and economic diversification. They are spatially scattered throughout three important states in the region: Ebonyi, Benue, and Nasarawa (Ahmed, 2022; Auwalu et al., 2020). The Southern Benue Trough is still mainly unexplored despite its abundance of minerals. Artisanal and small-scale mining enterprises with little mechanization, low productivity, and inadequate environmental controls predominate (Lar et al., 2015). Further limiting the sector's expansion have been the scarcity of current geological data, poor infrastructure, and lax implementation of regulations (Adekanmbi & Wolf, 2024). However, there is a great deal of unrealized economic potential in the area. Nigeria's oil and gas drilling industry, for example, could be entirely supplied by barite from Azara and Ishiagu, lowering reliance on imports. Similarly, coal resources along the Lafia–Obi axis might strengthen the power sector if adequately tapped, while limestone deposits in Benue and Nasarawa can sustain a flourishing cement industry (Olade, 2019). Realizing these potentials might boost industrialization, create jobs, and increase local and national incomes. mapping and laboratory analysis, drafted the manuscript and proof read the manuscript.

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Conflict of interest

All declare there is no conflict of interest

Ethical Consideration

Not applicable

Availability of Data

Data shall be made available upon request.

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Mr. Vincent Oseikhuemen Binitie is the lead investigator, responsible for developing the concept, review, drafting and proofreading the manuscript. Mr. Ogaga Esharive was also involved in the review, drafting and proofreading of the manuscript.