

# **A Review of Geology and Coal Mining In South Eastern Nigeria: Implication for Sustainable National Development**

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**Abstract:** *Coal is a combustible carbonaceous material which occurs within the Campanian – Maactrictian Mamu formation of the Anambra Basin, Nigeria. The estimated total reserve is about 2.7 billion tones with over 0.6 billion tones proven (Dixon and Leighton L. H. 1969) coal mining has been successfully carried out using conventional underground mining methods as well as long or all mining methods. Although, coal mining activity ceased in the Enugu for some times now, the current policy of the government to commercialize the coal mining industry is expected to bring a boom in the sector. This will no doubt increase Nigeria foreign direct investment (FDI). Apart from its industrial uses, coal is a good alternative to fuel wood as it can be processed into coal briquettes which can be adapted in the rural and urban areas for use in coking. This effort will not only diversify Nigerian monolithic economy but will lead to reduction in the unemployment rate and by implication reduction in youth restiveness.*

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## **I. Introduction**

Coal is often described as a broad name given to stratified accumulations of carbonaceous material derived from vegetation (Dixon and Leighton 1969). It is a brownish black complex combustible rock that has its origin from biochemical process and physiochemical alteration of vegetation.

Coal generally occurs in layers and is called “coal seams”. In Enugu, SE Nigeria, the proved coal seams are five so far. It originates as partly decomposed and macerated vegetation matter mainly as vascular land plants. The process of coal formation could be

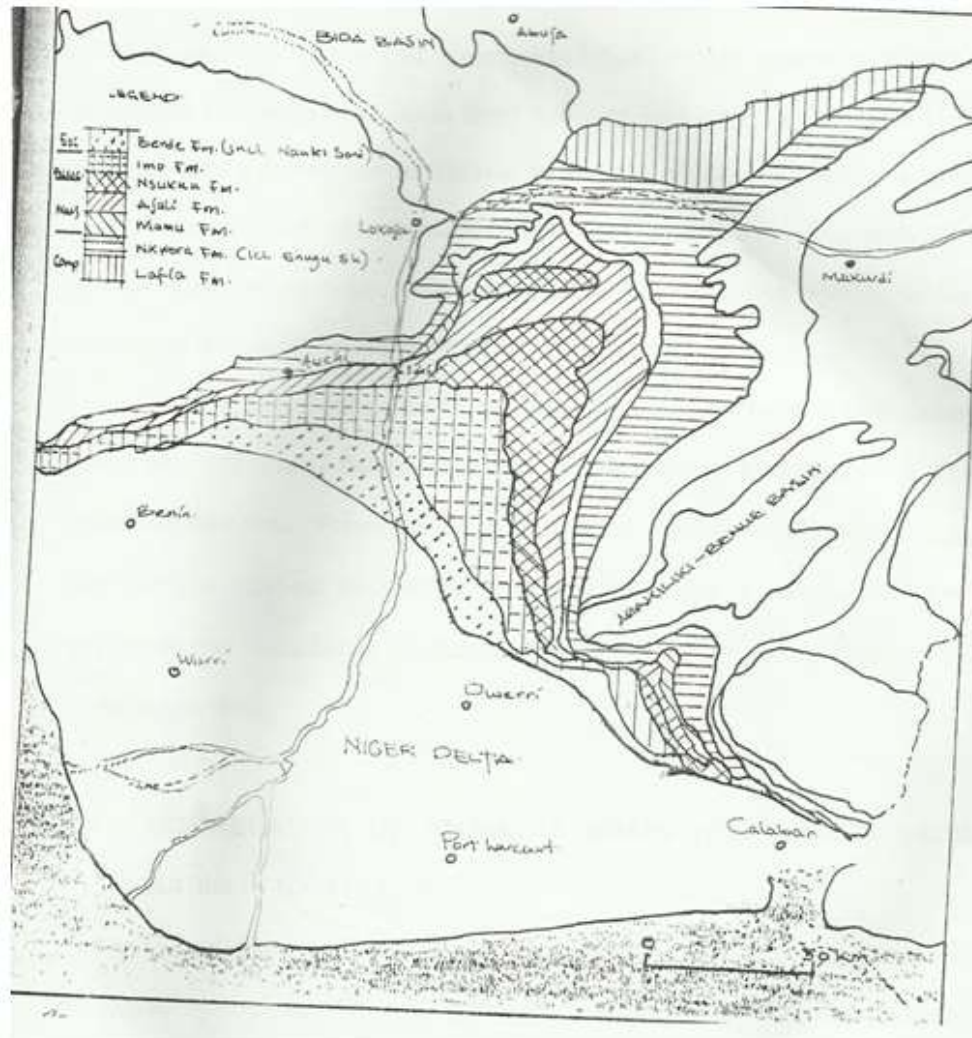
regarded as a metamorphic process brought about by the increasing weight of the overlying sediment, by tectonic movements by an increase in temperature resulting from depth of burial or from close approach to or contact with igneous intrusions or extrusions. The effect of close approach with igneous intrusions or extrusions may result in the formation of natural coke. Natural coke is found in some coal fields but there are relatively rare. (Adams, 1960).

The classification of coal is referred to as ranks. It all depends on its appearance and properties. The rank can be regarded to be the actual percentage of carbon in dry mineral coal. Individual organic constituents of coals are known as 'macerals'. These macerals usually determines the quality and usefulness of the coal type. Three main groups of macerals are recognized namely the vitrinite, exinite and inertinite. The rank of a particular coal depends on the degree of alteration, which it has undergone (Schoof, 1956).

From studies, it is known that coals of various sorts occur throughout the stratigraphic column from Devonian upward with a remarkable maximum in the carboniferous. Bituminous and Anthracite coals occur mainly in the carboniferous era while lignite's and brown coals in the Mesozoic and tertiary era.

## **II. Geologic Setting**

In terms of Geology, Enugu occupies much of the highlands of Awgu, Udi and Nsukka. The hills are flanked by the rolling lowlands of Oji River, Anambra basin to the West and Ebonyi (Abome) River basin to the East. Fig 1 below is the map showing the various formations within the Anambra Basin.



**Fig 1:** Table Showing The Various Formations Within The Anambra Basin

The area contains about nine (9) geologic formations. From the East to the West in terms of age and sequence to exposure. (Afonja, 1975).

The formations are Asu river group of the Albian (Lower cretaceous) age which is made up of shales, sandstones and siltstones. Enugu shale to the North and Awgu shale to the South of the same axis. There were laid in the companian sub stage. Lower coal measures (Mamu formation) to the Maastrichtian age. This is the coal bearing formation. False bedded sandstones are also of the Maastrichtian age. This sandstones are thick, friable and poorly sorted. Upper coal measures formation (Nsukka formation) of the Devonian age. The formation consist of coarse sandstones and fragments which are mainly ironstone, ferruginised shale and sandstone. It abounds extensively on the Nsukka Plateau where difference in the eroded layers has left the resistant portions standing out as rounded conical demy as elongated flattened hills some in hundreds of metres above the general sea level.

The upper cretaceous sediments are probably uplifted during the tertiary formation giving rise to the Enugu Okigwe escarpment Imo shale clay formation of the Pleistocene age. This is about 1000 metres thick and overlies the upper coal measures conformably. The stratigraphic sequence of the Anambra basin is shown in the table below:

**Table 1** Stratigraphic Sequence Of The Anambra Basin

Age	Out cropping unit
Donian	Nsukka formation
Maastrichtian	Ajali formation mamu formation
Campanian	Nkporo group
Santonian	Awgu formation

**Source:** *www.google.com*(After Motso, Mode and Peters)

### **III. Minning Methods**

The history of coal industry in Nigeria began in 1909, when coal was first discovered at the streams along Udi escarpment, (Buchanan, 1955).

Initially, the coal industry was a section of the marine department and coal produced was supplied to the British Navy for steamboats and to the Nigerian railways for the steam locomotive engines.

During the early days, coals were extracted by digging with pick axe and head pans and baskets were used to carry it to the surface of the mine. As production increased and mining activities continued, other better mining methods were introduced and mechanized in other to meet the high demand.

Coal mining in Enugu is mainly by surface mining and underground mining systems. (Duffryn 1977). In the surface mining system, mining layers of rocks or soil overlying a coal seam are first removed after which the coal is extracted from the exposed seams. The types of surface mining include the open cast method (strip mining), drift mining, slope mining, contour mining and the anger mining.

In the underground mining methods, it is used if the one body has been probed and outlined and the depths is such that the removal of the over burden makes surface mining methods to be unprofitable. In such a situation a number of methods are employed to gain access to the coal seams. This is when underground mining methods are very effective.

The underground mining method includes a system of audits, and drifts (inclined roadways to seams). The method of working in a horizontal or moderately inclined seam may be classified into this basic three, namely: Room and pillar mining, Long wall mining, Conventional mining and Continuous mining.

Usually, the adopted method in any given situation would depend upon the geologic factors, seams thickness or thickness of bed, production targets and economic advancement of the country involved (Greg, 1990).

#### **IV. Results And Discussion**

Generally coal bearing rocks belong to the companion – Maastrichtian age. This is about 75 million years old. The prospects for the Enugu coal are quite numerous. They can be used as an alternative source of fuel for domestic and industrial purposes, in cement factories, thermal electric power stations, in railway steam engines, overseas export, steel and foundry mills as well as whole new industrial base for the manufacture of chemicals such as activated carbon, synthetic gas etc. Enugu coal have been proven to be very rich that is why if properly harnessed can be used to generate a lot of both internal and external incomes that will help in the country's National growth and development.

Below is a table showing coal reserves in the country.

**Table 2:**

<b>Site</b>	<b>Location</b>	<b>Indicated 14-situ reserves (Tonnes)</b>	<b>Inferred reserve million (Tonned)</b>	<b>Overall reserves million (Tonnes)</b>
Anambra	Ezimo	56	60	116
	Inyi	20	Unknown	20
Benue	Otukpa	57	75	132
	Okaba	73	250	323
	Ogboyoda	107	320	427
Delta	Asaba (Lignite)	250	Unkown	250
Enugu	Enugu (Sub bituminpus)	54	200	254
Nasarawa	Lafia – Obi (Coking Coal)	22	Unknown	22
Other states	Other location		1160	1160

**Source:** *Nigerian Coal Cooperation Annual Reports(2001).*

From the table above, Enugu State has one of the highest coal reserves. Its quality is enhanced by its carbonisation. This will help to remove the lignite content. Also when carbonalised other products like coke, tar, pitch, aromatics naphthalene and resins can be gotten which can be used for explosives.

Enugu state from research and studies has the second largest coal reserve in Nigeria and it is in the Anambra Basin. Generally the method of mining today depends on the geology and depth of the area. An interesting thing about Enugu washed fine coal is that it can be used directly as a coking coal component. Also, it has high tar yielding variety and from the tar oil, road construction tar can be obtained.

### **Problems of Coal Mining / Production In Enugu State, Nigeria**

Coal production requires broad based highly specialized technical operation involving sophisticated machinery and highly specialized personnel. However, the direct problems that may be encountered are; absence of appropriate capital base and inadequate investment policy, poor and irregular power supply and unpredictable transportation system, foreign sourcing of mining equipment, lack of experienced man power and outdated infrastructural facilities

### **Possible Solutions To The Problems Of Coal Mining In Enugu State**

- a. Coal prospecting and mining operations are capital intensive and for an adequate capital base necessary for mechanization and reactivation of the coal mines, genuine foreign and local investors that have vast experience are required and it is imperative in joint venture programme.
- b. There should be immediate reorganization of the Nigerian coal corporation to function as a profit making holding company with subsidizing companies in line with the privatization and commercialization program of the present and administration.
- c. Before any mining venture is embarked upon on any location, adequate feasibility studies should be carried out in order to obtain accurate data on the geophysical, topographic, engineering, geological, hydrogeological, geochemical and water resources nature of the mine area should be ascertained.
- d. A well coordinated comprehensive natural energy policy is very important and compulsory so as to assign roles to each of the two major energy resources of the nation with a view of protecting and optimizing the operations of each resource.

- e. Such an energy policy will ensure fair and realistic pricing of the fossil fuel productions and by-products and provide for the efficient interdependence of the energy providers (Ezra, 1978).

## **v. Conclusion**

Coal occurs in commercial quantity in Enugu state. The extraction and the use of coal in Nigeria started in 1916. Most of the coal in Enugu State is bituminous. Enugu coal is found on thin the spheres of Anambra basin. Coal generally in Enugu is mined through the open cast methods and the underground mining methods. Principally, the Nigerian mining cooperation which was established in 1949 is charged mainly with the responsibility of exploration, development and mining of the country's coal resources.

Enugu coal reserve is about 116million tones. The prospects of Enugu coal are quite enormous in the following area: As alternative source of fuel for industrial and domestic purposes in cement factories, thermal electric power stations, railway steam engines, steel and foundry mills, etc. For Enugu coal to be maximized to the fullest, it should be privatized to private interested foreign investors.

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