AN INVENTORY OF MINERAL RESOURCES IN DELTA STATE, SOUTH SOUTHERN NIGERIA.

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ABSTRACT

Delta State is endowed with varieties of solid mineral deposits in addition to the abundant oil and gas resources that have been driving the state's economy since the mid 70's. Due to the vastness of these resources, there is the need to establish a database that would enhance and optimize their exploration with the aim of deriving maximum benefits from such venture. Inspite of the mineral endowments of Delta State, mining activities have been restricted to only oil and gas and silica sand. This paper therefore documents information on location, quantity, quality and uses of some of the minerals discussed here and it is hoped that it will serve as an accurate guiding tool to researchers. Investors should avail themselves of these great opportunities and invest in Delta State.

(**Keywords**: Minerals, benefits, potential, quantity, uses.)

INTRODUCTION

Sequel to a reconnaissance survey of Delta State, it has been discovered that some mineral resources occur in this largely unexplored area of the country for reasons of inaccessibility. The solid mineral sector has been acknowledged as an important aspect of sustainable development (Akpeke, 2006; Aniforowo, et al, 2007). The industry also has the potential for providing raw materials to industries, additional revenue and foreign exchange for socio-economic development as well as creation of job opportunities and technological advancement (**RMRDC MTE** report, 2003).

Many potential investors have always hinted that information and data on mineral potentials of Delta State are not readily available (**DSMCIC** report, 2001). Information on this sector in both government agencies and private firms have been scanty. Some organizations restrict information found to their private use, since they funded such research. This situation has robbed the state of investment opportunities in this sector of the economy. The objective of this paper is to stimulate research into exploration and marketing of solid mineral resources in Delta State.

THE STUDY AREA

Delta State lies in the tropics between latitudes 5°00' and 6°30' North of the Equator and Longitudes 4°45' and 6°40' East of the Greenwich Meridian.

The state is boarded by Edo state in the north-east/River Niger in the east, Bayelsa state in the south and the Atlantic ocean in the south-west. The climate of Delta State is tropical, characterized with heavy rainfall of over 2,000mm in the coastal areas to about 1,500 mm in the northern hinterland. The rainfall regime stretches from April to October with a brief dry period known as August break (double maxima), while dry season lasts from November to March. The hydrology of the state is dominated by the River Niger and its tributaries. Other major rivers are: Escravos, Forcados, Benin, Ethiope, Warri, Jameison, Oroghodo, Okpare, Okumeshi, Atakpo Rivers and other smaller ones also drain parts of the state.

Geomorphologically, the state can classified into

four units namely: Coastal barrier sands, Saline mangrove swamps, freshwater swamps forest and Inland rain forests. Unlike most part of Northern Nigeria that are characterized by rocks of the Basement Complex, Delta State is typically underlain by sedimentary rocks (Fig. 1). The result of abundant sediments in the state has manifested in the prevalence of sediment hosted mineral

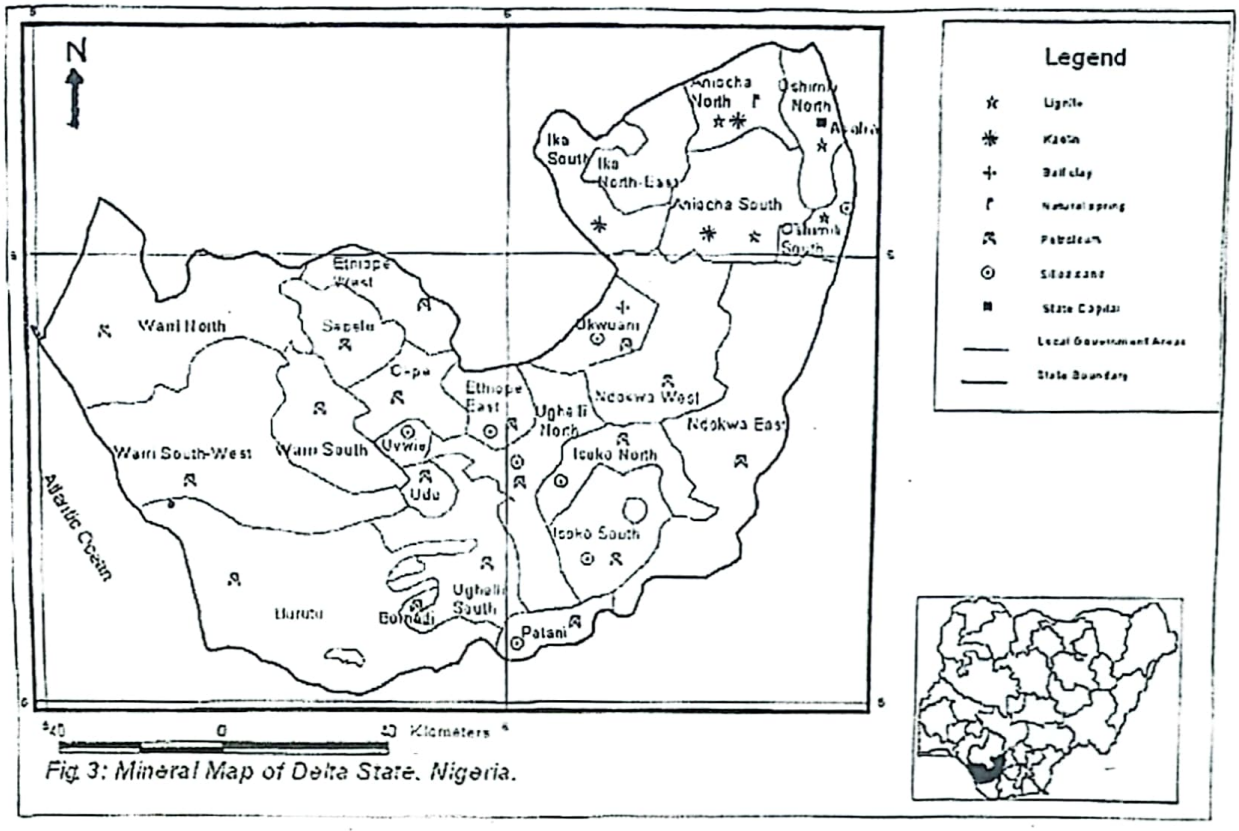

Fig 3: Mineral Map of Delta State, Nigeria.

Fig. 1: Generalized Geological Map of Nigeria

THE GEOLOGY OF DELTA STATE

A greater part of Delta State is underlain by the Benin Formation and the Delta Plain sands. The Benin Formation overlies the Agbada and the Akata Formations that are characteristic of the petroleum rich Niger Delta (Fig. 2). The Lignite series (also called the Ogwashi-Asaba Formation) is well developed in the Northern and Eastern parts of the state (Reyment, 1965; Kogbe, 1976; Okezie and Onuogu, 1985). The Ogwashi-Asaba Formation outcrops in several places in the state, but the Agbada and Akata Formations do not. Information regarding these two Formations are based on data from deep wells drilled for purposes of potable water supply and oil/gas exploration. The Two Formations have been described by Short and Stauble, (1967). The Ogwashi-Asaba and Benin Formations and younger lithologic units are described in details as background to describing the mineral deposits hosted by these units. The rock units are described thus:

BENIN FORMATION

The Benin Formation comprises unconsolidated white to yellowish sands that becomes pebbly in some horizons. Clays and clay-rich bands occasionally occur. The Formation is partly marine, estuarine, lagoonal, deltaic and fluvio-lacustrine in origin (Reyment, 1965). In most places where the Formation outcrops, the thickness reaches up to 200m (Kogbe, 1976).

The Benin Formation outcrops in Agbor, Amia, Patani and Ughotor. The Formation consists of friable white sands that are discoloured to yellowship or reddish brown in some places. Except in Agbor area, the sand is overlain by fairly thick (up to 2m) alluvium, comprising grayish clay or sandy-clay, rich in partly decayed plant materials. In Agbor

and environs the sand is overlain by thick lateritic soil (> 5m) that is highly susceptible to erosion. Gullies of about 2-6m deep and shallow channels, 0.5-1m deep are common place in Agbor, Umunede, Ubulu-Uku and Issele-Uku areas. The age of this Formation ranges from Miocene to Recent (Weber, 1971).

OGWASHI-ASABA FORMATION

Reyment (1965), described the Ogwashi-Asaba Formation as that which comprises essentially alternation of clays and lignite. It is poorly fossiliferous. In some places, the formation is mostly continental cross-bedded sandstone and grits. Carbonaceous mudstone and shale also occur. The clays are mostly mottled, white, bluish or pink in colour and vary from sandy to plastic in nature. According to Weber (1971), the age ranges from Oligocene to Miocene. These rocks do not easily outcrop but good exposures have been found in river valleys, especially along the Mgbiligba stream in Asaba, Oboshi and Atakpo River Valleys in Ibusa and Okpanam respectively. Good exposures of clays associated with the Ogwashi-Asaba Formation are found in Isho valley as well as along Ago-Uku stream, both at Ubulu-Uku.

Lignite seams found within the Ogwashi-Asaba Formation are commonly brownish to black in colours. They are thinly laminated and fissile. Good exposures of the lignite seams are not readily easy to come by in the field. However, in some places like the Nnem-Agadi stream in Obomkpa, Omi-Oke spring, Ukwuzu and Edigbala River valley at Ozanogogo, fairly good outcrops of lignite occur. Lignite seams are also exposed at Atakpo-Ako River in Ibusa and at the Mgbiligba stream in Asaba.

At Obomkpa, the lignite are overlain, in some cases by a thick, up to 3m, mottled sandy clay. Moreover, the lignite and the overlying clay beds are covered in most parts by 5-8 m reddish brow Latertic soil. Where the base of the lignite seams is seen, at Nnem-Agadi stream, the lignite is also underlain by grayish clay with numerous organic particles. The lower clay unit has also been interpreted by Onuogu and Okezie (1985). The Benin and Ogwashi-Asaba Formations are the host-rocks of major mineral deposits in Delta State.

MINERAL RESOURCES IN DELTA STATE

Although different mineral resources have been identified to occur in Delta State, reliable information on their location, quantity, quality and uses has been before now, rarely available to prospective investors (DSMCIC report, 2001). In view of this scenario, visits to selected sites were embarked upon. The survey was field oriented, with a view to carrying out a comprehensive assessment and survey of industrial mineral resources in Delta State. This includes visits to selected sites of mineral deposits to identify and document some of their geologic attributes. An inventory of these deposits are indicated in table 1.

Table 1: Identified Minerals and their Locations in Delta State.

S/N	MINERAL	L G A	LOCATION	REMARKS
1	Lignite	Aniocha-North	Obomkpa	Outcrops occur at Nnem-Agadi River which has six exposed outcrops of about 6 m thickness for each seam. Other outcrops are situated at Iyiodo and Nkpunkpu spring.
		Oshimili-South Oshimili-North Aniocha –South	Asaba Okpanam area Ibusa Azagba- Ogwashi/ Issele-Azagba area	The Ogwashi-Asaba Lignite is the most important Lignite seam in the Issele-Azagba-Ibusa-Okpanam area. It outcrops in the four head water tributaries of the Atakpo River. Four seams in the Mgbiligba, three in Iyiokwa and Iyiukwu and one in Iyiosha. The average thickness of these seams is about 7m. The Atakpo River, about 2.5 km north of Ibusa road, has an average thickness of about 1.5 m. The Ibusa Lignite has five seams of lignite outcrops on the Oboshi River and its tributary, the Ukpai. Another six seams also outcrops in Asinta, another tributary of Oboshi River, has a thickness of about 1.8 m.
2	Kaolin	Ika-South	Ozanogogo area: Uvbe, Edigbagba Evbo-Ebi and Eduneha	Outcrops of kaolin on the ground are very rare because the clay is overlain by a very thick (up to 15 m in Uvbe) brownish soil material that becomes coarse, sandy to pebbly at the bottom of the layer. The kaolin bed at Uvbe extends for about 2 km bandwidth across the community.
		Aniocha-North	Ukwunzu (along a road cut about 500m N-W of Obi's palace, Iko-Onicha area and at valley of Omi-Oke springs)	The lateral extent of kaolin is about 1.5 km while the transverse extent is estimated to about 600m across the community. In most places, the Kaolin is overlain by soil or earthy overburden of about 0.5-3.5 m thickness. The overburden is mainly brownish to reddish brown sandy soil.

		Aniocha-South	Isho in Anioma area, SW of Ubulu-Uku town.	Deposit at Isho is capped by a thick, up to 0.2m iron stone that is overlain by thin (0.5.-1 m) brownish top soil. Iron stone band also occur within the Kaol in unit and generally dips 16-20^0 SW. The Kaolin deposit is over 4 m thick and extends up to 5 km on the N.S.axis along Ago-Uku stream to Isho and up 0.5 km on the E-W axis across the river valley.
		Osimili-North	Ibusa deposits Occur At Atakpor-Ako River between Ibusa and Okpanam	Good outcrops are found near the Atakpo-Ako River bridge on Ibusa- Okpanam earth road but occurrence is traceable for more than Udu-Nduli area, to the South of Ibusa. Deposit is overlain in most parts by a thick 3 -6 m reddish brown lateritic soil. The soil characteristically grades from reddish brown, purple to greyish as one approaches the Kaolin deposit. This colour variation is a good indicator for lo cating occurrence of Kaolin in Ibusa and other area investigated. Outcrop thickness is up to 15 m.
3	Silica sand	Ughelli-North Isoko-North Isoko-North Patani Ukwuani Ughelli-North Ethiope-East Uvwie Uvwie Oshimili South	Ugheli Idherie-Iyede Ozoro-Owhe Patani Obiaruku Agbarho Kokori Ovwian Ogbolokposo Asaba	Ughelli, Idherie- Iyede; Olomoro-Oleh and Ozoro-Owhe deposits have high silica content and production is linked mainly for glass production
4	Ball-clay	Ukwuani Ughelli-North Ughelli-South	Amai (deposits occur in the Ogbueshi and Ukpata areas to the South of Amai town) Uwherun Ewu	Deposits are being exploited by natives
5	Crude oil (petroleum)	With the exception of Aniocha-North, Anioch South, Ika-North, Oshimili-North, Oshimil-South (where detailed investigation is on going)deposits are being exploited by running companies across the state.	Occur extensively across many towns and villages in 19 local governments of the state	Onshore and offshore mining is on going

Table 2: Uses, some quantities and qualities of mineral occurrences in Delta State

S/N	MINERAL	LOCATION	USES	QUANTITY (TONNES)	QUANTITY	REMARKS
1	Lignite	Asaba	Suitable for the production of fuels and chemicals. Can also be used for generation of electricity	125×10^6	Highly calorific in value 10,825 BTU/1b	Occurs in extensive deposits in Ogwashi-Asaba area. In some cases, overburden ranges from 15-20 m
		Obomkpa		50×10^6	Similar to Asaba deposit, but has greater calorific value, 11233 BTU/1b	Overburden of about 15m can be witnessed. Deposits occur extensively.
2	Kaolin	Ozanogogo Ukwunzu	Moulding China ware, coating printing papers, fillers in rubber paints, used in white ware pottery, bricks and Portland cement, chalk, refractories.	80×10^6 14.4×10^6	Pure and workable, but has iron content, Fe_2O_3 (1.04-1.27 %) Good quality, very plastic and pure with very low iron content Fe_2O_3 (<0.43 %)	Overburden ranges from 3 -10m in some case. The overburden to reddish brown sandy soil. Overburden ranges from 2-5 m
		Ubulu-Uku Ibusa		10.1×10^6 5.0×10^6	Pure and workable, with fairly significant impurity, Fe_2O_3 (0.20-1.35 %) Pure, low silica and workable very low impurity, Fe_2O_3 (0.35-0-42 %)	Over burden of 0.5 -1 m hick can be encountered Ibusa Lignite has an over burden ranging 3-5 m thick
3	Ball clay	Amai Uwherun Ewu	For the production of floor and wall tiles as well as. sanitary wares	Widespread in occurrence. Not yet determined -do- -do-	Siliceous (SiO_2>60 %) and presence of silt reduces workability. Highly plastic and shows greater shrinkage cracking when fired.	Exist in tropical swampy forest. The clay deposits are overlain by a thin 0.1 m grey silt -stone which is usually scooped to win the clay.
4	Silica sand	Ughelli, Idherie-Iyede, Ozoro-Owhe, Olomoro-Oleh, Patani, Obiaruku, Agbarho, Kokori Ovwian, Ugbolo-Kposo Asaba	For glass production abrasive (sand paper) blast chemicals, foundary, water treatment, pottery and hydraulic fracturing	Occur in commercial quantity	The Ughelli, Idherie-Iyede Ozoro-Owhe, Olomoro-Ole Silica sand have 97 % silica content while others have less	With minimal processing, deposit have greater potential for glass production
5	Crude oil (Petroleum)	Occurs and offshore across the state	Refined for petrol, gas, kerosene, engine oil, grease, bitumen etc	Occur in commercial quantity	Has less of sulphur	Detailed studies is recommended

*(**Source:** Delta State Ministry of commerce, Industry and Co-operatives report, 2001)*

CONCLUSION AND RECOMMENDATION

Existing data demonstrates substantial mineral resources in Delta State which was discussed above. There is high level of confidence that substantial economically mineable mineral reserves, sufficient to support industrial growth and development can be proven. However, a lot more is yet unexplored due to inaccessible terrain and lack of detailed studies.

Detailed reconnaissance and preliminary investigation is highly recommended in exploring other minerals that are likely to occur in large quantities but have not been explored. This can be achieved by the state and federal Government in collaboration with private professionals/stake holders to produce a detailed mineralogical/geological map of Delta State. Foreign control mining industry should be called to assist Delta State in the exploration of terrains that have not been explored.

Delta State should take a cue from some countries like Botswana, Gabon, Ghana, Namibia, Guinea, Niger, Sierra Leone, Zimbabwe etc. where new mining development has been successful mainly due to the formation of joint ventures/public private partnership (PPP) between the private sector and government.

Lastly, there should be a stable and transparent regulation which clearly spells out the right and obligation of the investors and the government, a competitive and well structured fiscal regime which provides an adequate return to investors and a fair share to the government, assured access to foreign exchange at market rates for dividend reparation as well as operational needs and effective support and monitoring of private mining by well organized government institutions.

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