FEDERAL REPUBLIC OF NIGERIA

URANIUM EXPLORATION IN NIGERIA

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DIRECTOR GENERAL
NIGERIAN GEOLOGICAL SURVEY AGENCY (NGSA)

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OUTLINE

- Introduction
- Historical Perspective
- Geology of Nigeria
- Exploration for Uranium
- Current Exploration Status
- Challenges
- Conclusion
Introduction -- Country Profile

- Area: Total: 923,768 m²
- Land: 910,768 m²
- Water: 13,000 m²
- Coastline: 853 km
- Capital: Abuja
- Official Language: English
- Major Languages: Igbo, Hausa, Yoruba.
- Others include Fulani, Ijaw, Tiv, Ibibio, Kanuri, Idoma
- About 250 linguistic groups
- Currency: Naira
- 1 USD = 156 NGN
- GDP: Approx. 510 billion USD (2013)
- Per – Capita Income: Approx. 2,800 USD (2013)
- 6.18% growth rate
- Oil revenue main stay of economy
Historical Perspective

- CELEBRATED 100 YEARS AS A COUNTRY IN 2014

- MINERAL EXPLORATION IMPORTANT COMPONENT OF THE 100 YEAR ODYSSEY

- CONDUCTED THROUGH INSTRUMENTALITY OF THE GEOLOGICAL SURVEY OF NIGERIA

- TECHNICALLY SET-UP IN 1919 BY THE BRITISH TO CONDUCT RECONNAISSANCE OF MINERAL RESOURCES RATHER THAN TIME CONSUMING GEOLOGICAL MAPP

- TECHNICALLY STEERED BY THE IMPERIAL INSTITUTE IN LONDON
# Early Activities of NGSA

<table>
<thead>
<tr>
<th>Early Activities</th>
<th>Locations</th>
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<tbody>
<tr>
<td>Tar Sand at Agbabu</td>
<td>Lignites of Asaba,</td>
</tr>
<tr>
<td>Tin &amp; Columbite</td>
<td>Lead/Zinc in Abakalik, Arufui</td>
</tr>
<tr>
<td>Coal in Enugu, Udi,</td>
<td>Kaolin</td>
</tr>
<tr>
<td>Limestones (incl. Marble)</td>
<td></td>
</tr>
<tr>
<td>Iron ore in Lokoja</td>
<td>Gold in Birnin Gwari</td>
</tr>
<tr>
<td>Talc in Lapai</td>
<td>Salt – Awe, Kukawa</td>
</tr>
</tbody>
</table>
Lignites of Asaba, Tin & Columbite in Jos, Uwet Tar Sand at Agbabu Lead/Zinc in Abakaliki, Arufui Coal in Enugu, Udi, Kaolin Limestones (incl. Marble) in different parts of the country

Iron ore in Lokoja

Gold in Birnin Gwari

Talc in Lapai

Salt – Awe, Kukawa
Industrial Minerals known in Nigeria (Bold Letters) as at 1957; other minerals are those required for complete industrialization

<table>
<thead>
<tr>
<th>Category</th>
<th>Minerals/Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Mineral Fuels</td>
<td>Coal and Lignite Oil : Gas : Uranium : Thorium.</td>
</tr>
<tr>
<td>Iron and Ferro-alloy Metals</td>
<td>Iron (Manganese) : (Nickel) : (Chromium) : (Molybdenum) : Tungsten : (Vanadium) : (Cobalt) : Niobium : Titanium.</td>
</tr>
<tr>
<td>The Non-ferrous Metals</td>
<td>(Copper) : Lead : Zinc : Tin : (Aluminium) : Titanium.</td>
</tr>
<tr>
<td>Minor Metals and Related Non-metals</td>
<td>(Antimony) : (Arsenic) : Beryllium : (Bismuth) : (Cadmium) : (Magnesium) : (Mercury) : (Radium) : (Selenium) : (Tellurium) : Tantalum : Zirconium.</td>
</tr>
<tr>
<td>Precious Metals</td>
<td>Gold : Silver : (Platinum Metals).</td>
</tr>
<tr>
<td>Structural and Building Materials</td>
<td>Limestone and Cement : Building, (Roofing) and Crushed Stone : (Gypsum) : Clay : (Magnesite) : (Mineral Pigments) : Bitumen : Sand and Gravel (Asbestos) : (Vermiculite).</td>
</tr>
<tr>
<td>Ceramic Materials</td>
<td>Clay : Felspar.</td>
</tr>
<tr>
<td>Chemical Minerals</td>
<td>Salt : (Borax and Borates) : (Bromine Compounds and Iodine) : Sodium Carbonate and Sulphate : (Potash) : (Calcium and Magnesium Chloride) : Sulphur : (Strontium Minerals) : (Pyrites) and Marcasite : (Anhydrite) : (Nitrate) : (Lithium Minerals).</td>
</tr>
<tr>
<td>Fertilizer Minerals</td>
<td>(Potash) : (Nitrate) : Phosphates : (Gypsum) : Limestone and Lime : Sulphur.</td>
</tr>
<tr>
<td>Abrasives</td>
<td>(Diamond) : (Corundum) : Garnet : Quartz Sand : (Pumice) : Diatomite.</td>
</tr>
<tr>
<td>Gemstones</td>
<td>(Diamond) : (Emerald) : (Ruby) : (Sapphire) : etc.</td>
</tr>
<tr>
<td>Groundwater Supplies</td>
<td></td>
</tr>
</tbody>
</table>
HISTORICAL PERSPECTIVE CONT.

- World largest producer of Columbite
- 8th World producer of tin
- Produced coal for railway locomotives, Cement Manufacture and for export
- Contributed substantially to GDP
- Downtrend with the discovery of oil and almost total neglect of the industry
Geological Mapping

- Systematic geological mapping of selected sheets on
  - 1:100,000 and 1:125,000
- Delineation of areas of exposure of Basement Complex & the sedimentary cover, i.e. the earliest version of the geological map of Nigeria
- The intense focus on mineral search would account for the fact that the publication of the first (even then provisional) geological map of Nigeria waited till 1943, some 23 years after the establishment of the Geological Survey of Nigeria in 1919
Geological and Mineral Map of Nigeria as at 1957
Metallogenic (Mineral Bearing) Provinces

GEOLOGICAL MAP OF NIGERIA

Sn, Nb, Ta, U

Au, Ta, U

Pb, Zn, Ba, C
### Basement Complex

- **The migmatite-gnesis complex.**
- **The schist belts composed of metasedimentary and metavolcanic rocks.**
- **The pan-African Granitoids comprising the Older Granites and associated charnockitic rocks**

#### Younger Granites

- Found within the basement complex
- Ring complexes emplaced during the Jurassic

#### Volcanic rocks

- Tertiary-Recent Volcanic rocks.
Geology of Nigeria

- **Sedimentary Series in 7 basins**
  - Sokoto and Chad basins are part of larger basins outside Nigeria.
**Schists**
- From North-West to South-West
- Associated with Au, Nb-Ta wolframite and Gemstone mineralisation

**Granitic Rocks**
- North-west, North-Central, South-West, zones and South-Eastern to North-Eastern axis
- Sn, Ta, W
- Gemstone

**Old Sedimentary rocks**
- Benue Valley South Eastern, North Central and North-Eastern Flank
- Associated with Pb, Zn, Ag, Co, Ba, Cu
Radiometric Anomalies (1974-76 Data)

- 1974-1976 airborne survey at 2km spacing
- These areas covered by the survey include:
  - The lower Benue and the adjoining regions.
  - Ugep – Cross River State
  - Niger/Benue Confluence (Kogi State)
  - Sokoto and Dange areas
Govt. Initiative on Uranium exploration

- **NORTHWEST**- Ririwai Younger Granite ring Complex Major known prospect appears to lie in the Ririwai Younger Granites hosting reportedly the largest deposit of uraniferous pyrochlore, an ore of niobium with small amounts of U & Th
  1. Peralumunous Granite
  2. Peralkaline (Pyrochlore)

- **NORTHEAST**-
  1. Mika (Uraniferous rhyolites emplaced in Pan Africa Granites
  2. Gumchi (Sheared porphyric Granite
  3. Mayo Lope (Bima sandstone)

- **SOUTHEAST**-
  1. Ugep-Idomi in Cross River state
  2. Udi in Enugu state

- **NORTH WEST**- Sokoto Phosphate Exploration
To further the process of Uranium exploration the Fed. Govt. of Nigeria formed the
Nigerian Uranium Mining corporation in Technical Partnership with TOTAL COMPAGNIE MINIERE (TCM) of France
Primarily to explore, develop and mine uranium deposits in Nigeria
NUMCO Operations

- NUMCO’S Choice of location was based on:
  - i PanAfrican granitic and metamorphic basement
  - ii Young granites and volcanic complexes
  - iii Sedimentary cover with Niger type targets

Operated on an area 112,346 sq km
(Lat. 11° 30’N-8° N and Long. 10° 30’E to the Cameroun boarder)
NUMCO EXPLORATION INITIATIVE

**MIKA**
- 14,173 line km of Heliborne gamma-ray spec. survey
- Mineralization at granite shear zone
- 23 nos. 434.8 m of drill cores
- 52 t U at 0.63% at 130m cut off of 0.03%

**GUMCHI**
- VLF survey
- 65 nos. drill holes
- 6,348 metres
- 100 t U at grade of 0.9% up to 200 m at cut off of 0.03%
- 5,679 m logged

**MAYO LOPE**
- Stratiform occurrences at 200-350m depth
- Hydrogeochemical survey
- 3 nos. holes drilled (257.86m)
Uranium Exploration-N.E. Nigeria

- Promising areas include Kaltungo, Gubrunde, Ghumshu, Mika and Mayolope.
- Garkida (Mubi Area)
- Mika (South Benue Area)
- Kaltungo
- Gubrunde
<table>
<thead>
<tr>
<th>S/N</th>
<th>Project location</th>
<th>Geology</th>
<th>Quantity</th>
<th>Average grade ppm</th>
<th>UNFC-2009 Class</th>
<th>UNFC-2009 Subclass</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mika zone NE, Nigeria</td>
<td>Uranium mineralisation in Rhyolite</td>
<td>130tU</td>
<td>540ppm</td>
<td>Expl. project</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>More drilling needed</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Ririwai NW, Nigeria</td>
<td>Uranium bearing mineral is pyrochlore in Peralkaline Granite</td>
<td>215 ppm</td>
<td>215 ppm</td>
<td>Expl. project</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>More drilling needed</td>
<td></td>
</tr>
</tbody>
</table>
Red patches indicate high uranium anomaly whereas, green shading indicates medium uranium anomaly. You could observe from the map that uranium also occur within the sedimentary Basins - especially the Lower Benue Trough and larger part of the Bida Basin.

Areas with concentration greater than 5 ppm.
Uranium Concentration map of Bida basin

- Areas with pink colour in the central and southern parts are anomalous zone for Uranium mineralisation.
WHERE ARE WE TODAY?

Geological Maps (95 of 337 nos.)

100% Coverage on Airborne Geophysical Survey

Geochemical Mapping (8 of 44 GRN Cells)

30% Gravity coverage
Survey Outputs: Types of Geoscience Data used by Industry

Geological Maps

Geochemistry map (Gold – Koton Karfi Cel)

Geophysical Map (Nigeria)
Where are we today?

Airborne EM coverage (24,000Km)

Lineament Map
Moving Forward

- NGSA will continue more systematic exploration taking advantage of new air borne data
- Continuation of our National geochemical mapping programme
- More comprehensive analysis of the Coal and Phosphate resources
- Re-analyzing the cores from the NUMCO uranium exploration projects
- Studying the oil company cores/logs
- Ensuring easy access to geoscience data for interested investors
CHALLENGES TO UNCF IMPLEMENTATION

- Limited access to credible data from private companies operating in the solid minerals and the petroleum sector.
- Time frame required to educate all stakeholders on the need to adopt the UNFC-2009.
Portable Ground Information System Gamma-ray spectrometer (PGIS-S)
SURVEY TECHNIQUES
THANK YOU
www.ngsa-nig.org