

DATABASE OF MINERAL RESOURCES OF ZAMBIA

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– Theory and Practice

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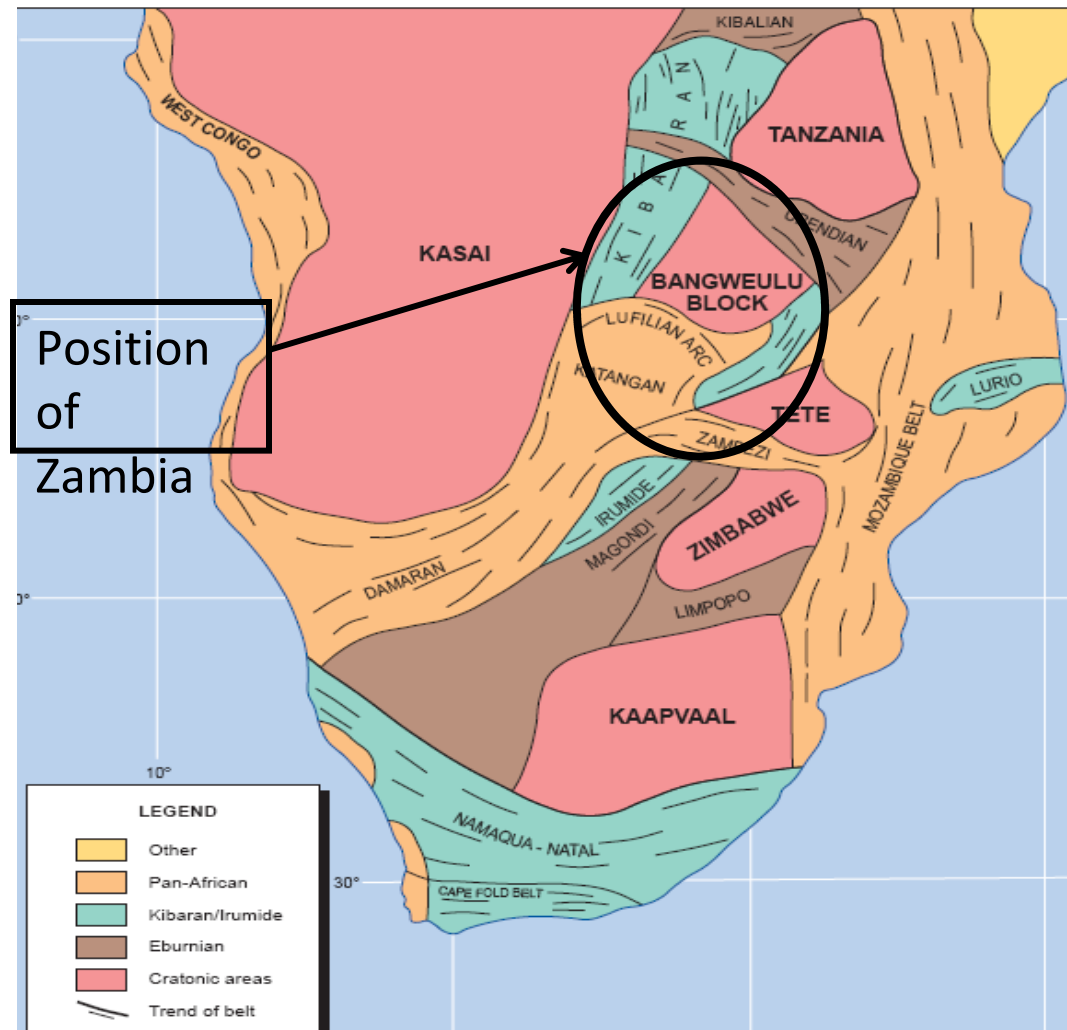
Introduction

- Zambia is a landlocked country in Southern Africa with a total area of 752,614km² and with a population of 12 million people. Located well in the tropics and enjoys a sunny climate with three distinct seasons. The country is endowed with mineral resources and since 1930s the mining industry has been the economic backbone of Zambia.



Regional Geological Setting

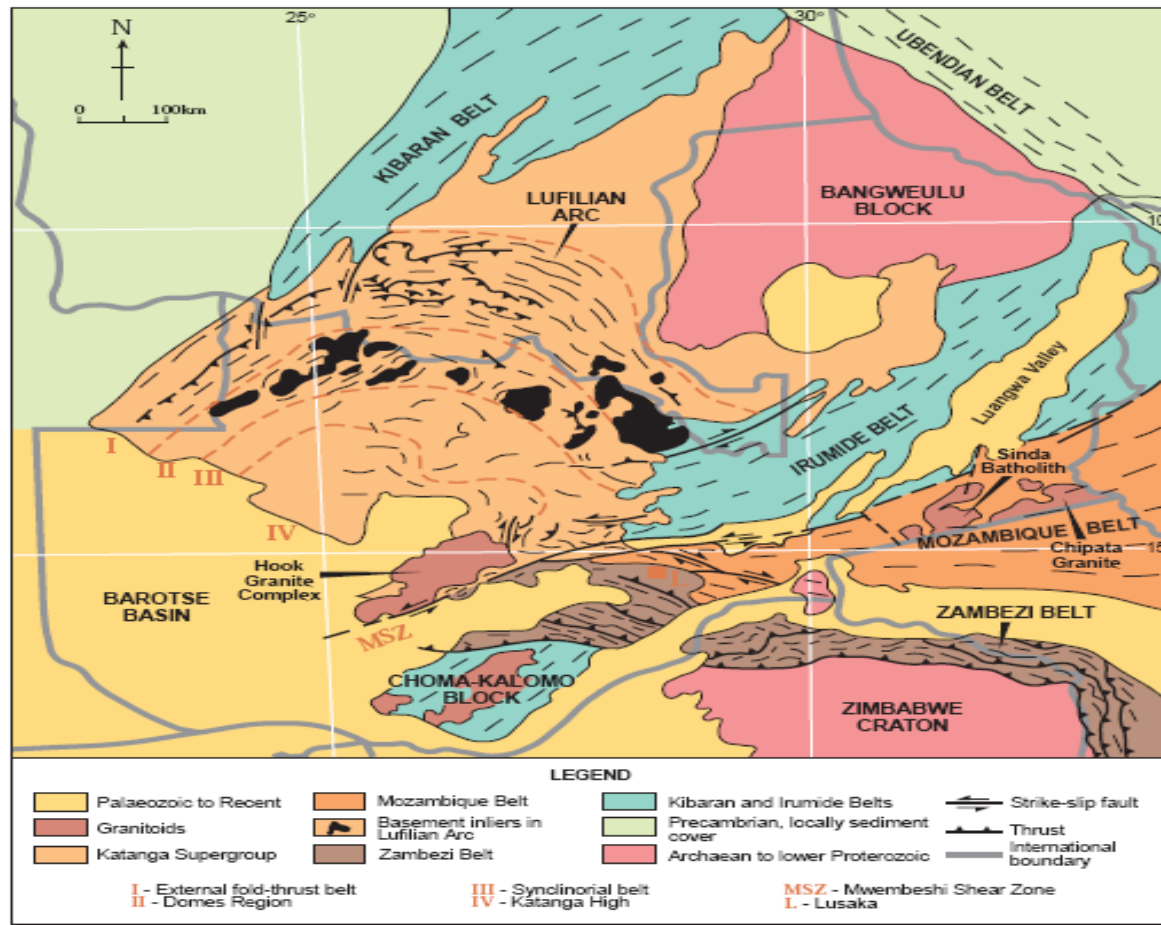
- Zambia is a vivacious country forming a natural hub for the regions diverse activities. Its diverse mineral endowment is entirely a function of the variety of geological terrains and the multiplicity of thermal tectonic events that have overprinted and shaped these terrains.



Regional Geological Setting

Zambia's geological terrains

- The multiplicity of tectono-thermal events reflect somewhat a complex geology. These differential movements have played an important role in the geological evolution and the genesis of the country's mineral and energy resource.

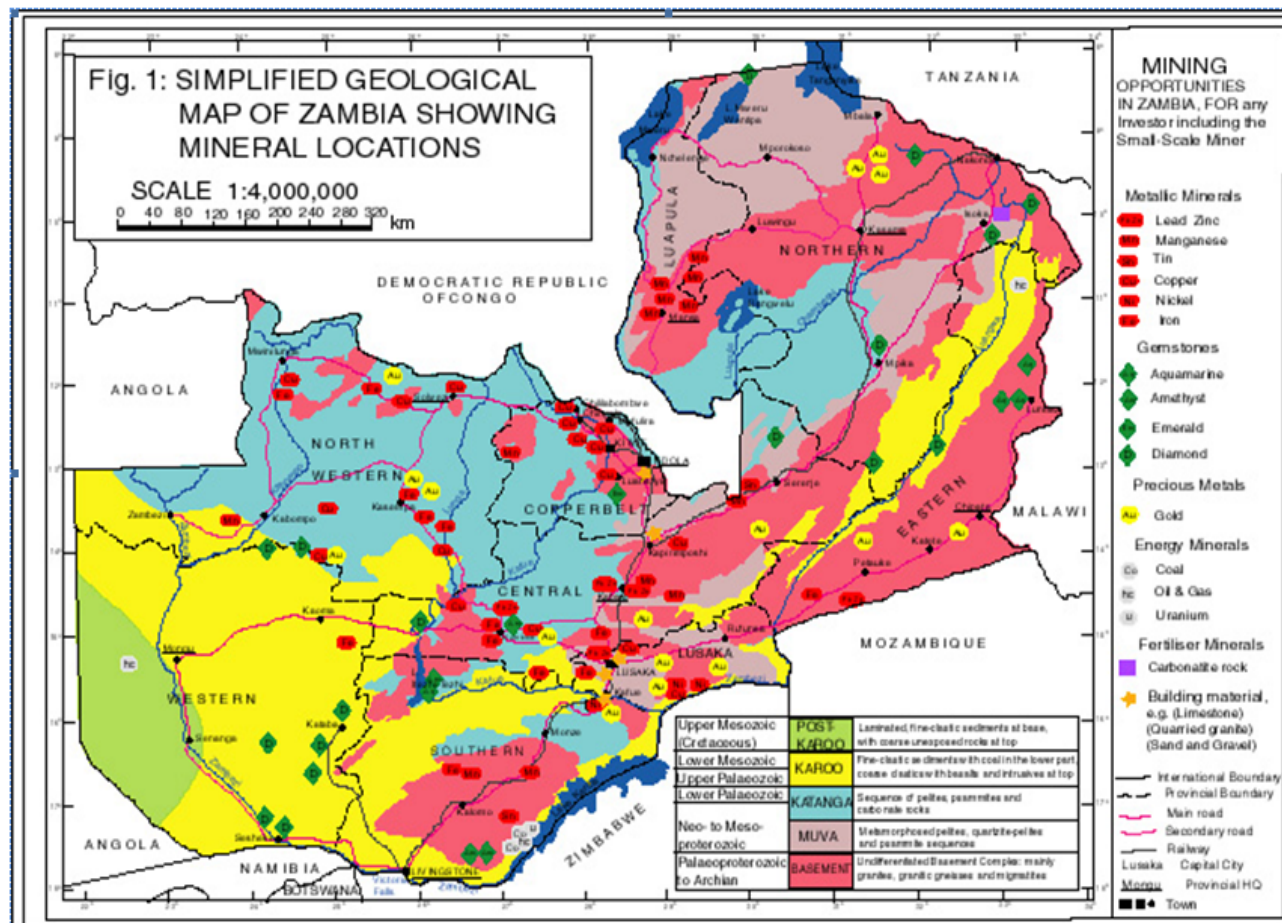


Stratigraphy (Modified after Mendelsohn -1961)

SUPERGROUP	GROUP	FORMATION	OROGENY
Kalahari			
Karoo	Upper Karoo	Batoka Basalt Red Sandstone Interbedded Sst & Mudstone Escarpment Grit	Rifting
	Lower Karoo	Madumabisa Gwembe Coal Siakandobo Sst	
Nguba	Kataba		NeoProterozoic (Pan African)
Katanga	Kundelungu	Kundelungu (Dolomites, Shales, Tillites)	
	Roan	Upper Roan (Dolomites)	
		Lower Roan (Rudites, Arenites, Siltstones & Mudstones)	
Muva	Manshya	Kasama (Meta quartzites) (Meta Pelites)	MesoProterozoic (Irumide)
	Mpanshya		
	Mporokoso		
Basement	Kapemba	(Granites) (Gneisses & Schist)	PaleoProterozoic (Ubedian)
	Mulungwizi		

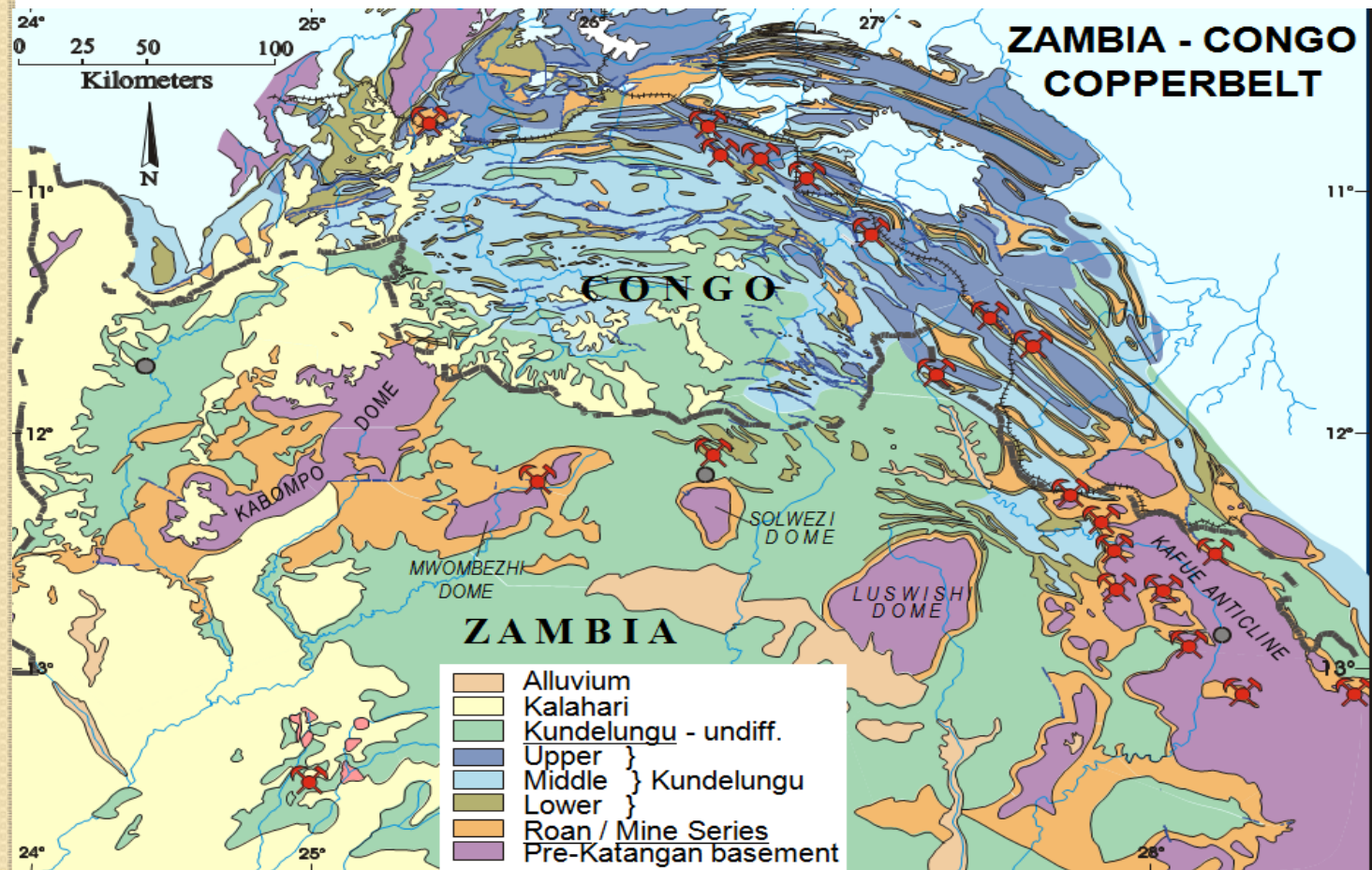
Geology and Mineral Resources

- Zambia's vast potential for mineral resources is due to its unique geographic location. Though a wide range of minerals occur in the country, the mining industry has been dominated by copper mining which has overshadowed the exploitation of other potential mineral resources.



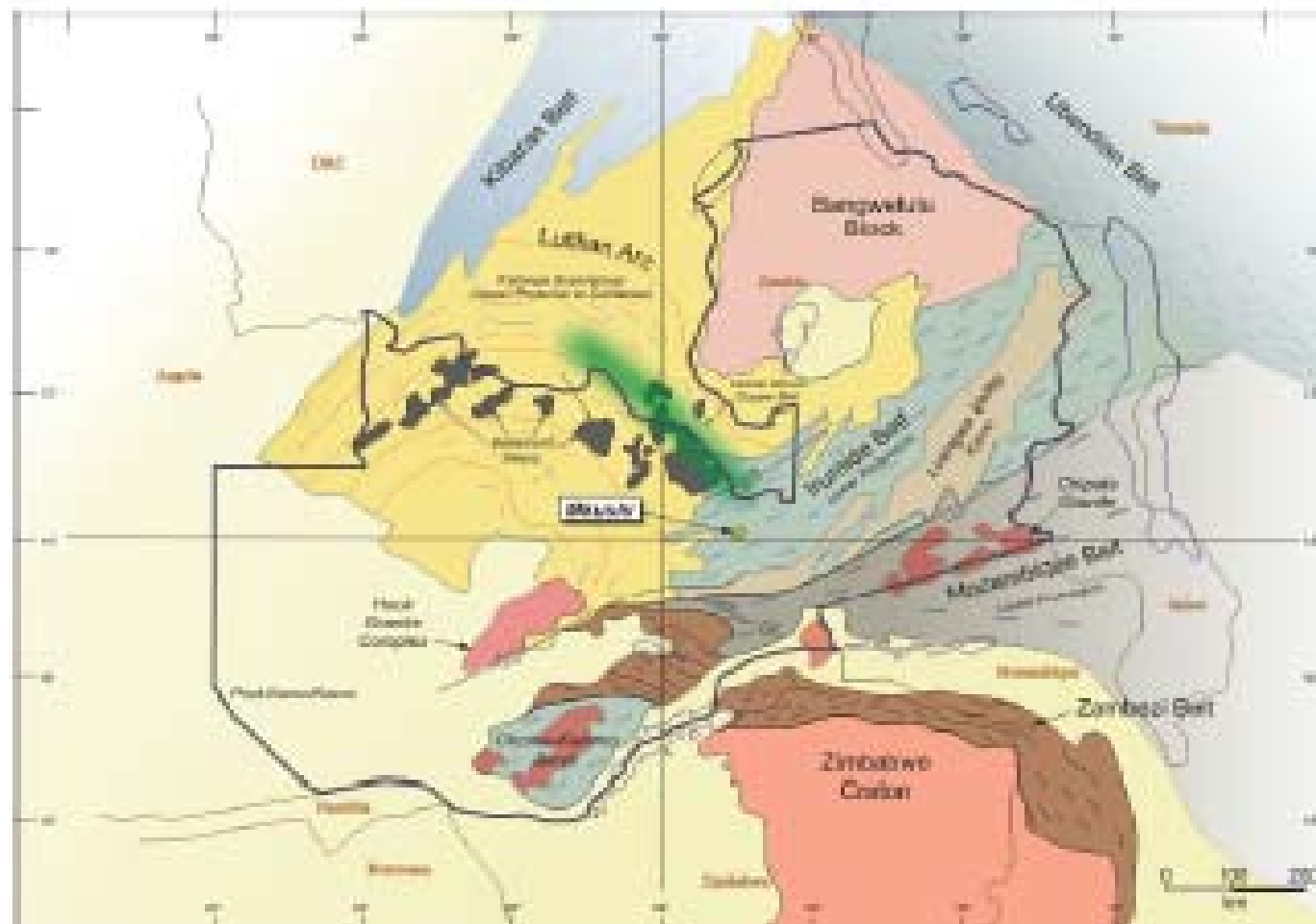
Geology and Mineral Resources

- **Copper-Cobalt:** The copper-cobalt mineralization is embedded in the NeoProterozoic rocks of the Katanga Supergroup. Copper resources have also been found in the thrust zones of North-Western Zambia which represents zones of detachment between the Basement and Katanga sequence.



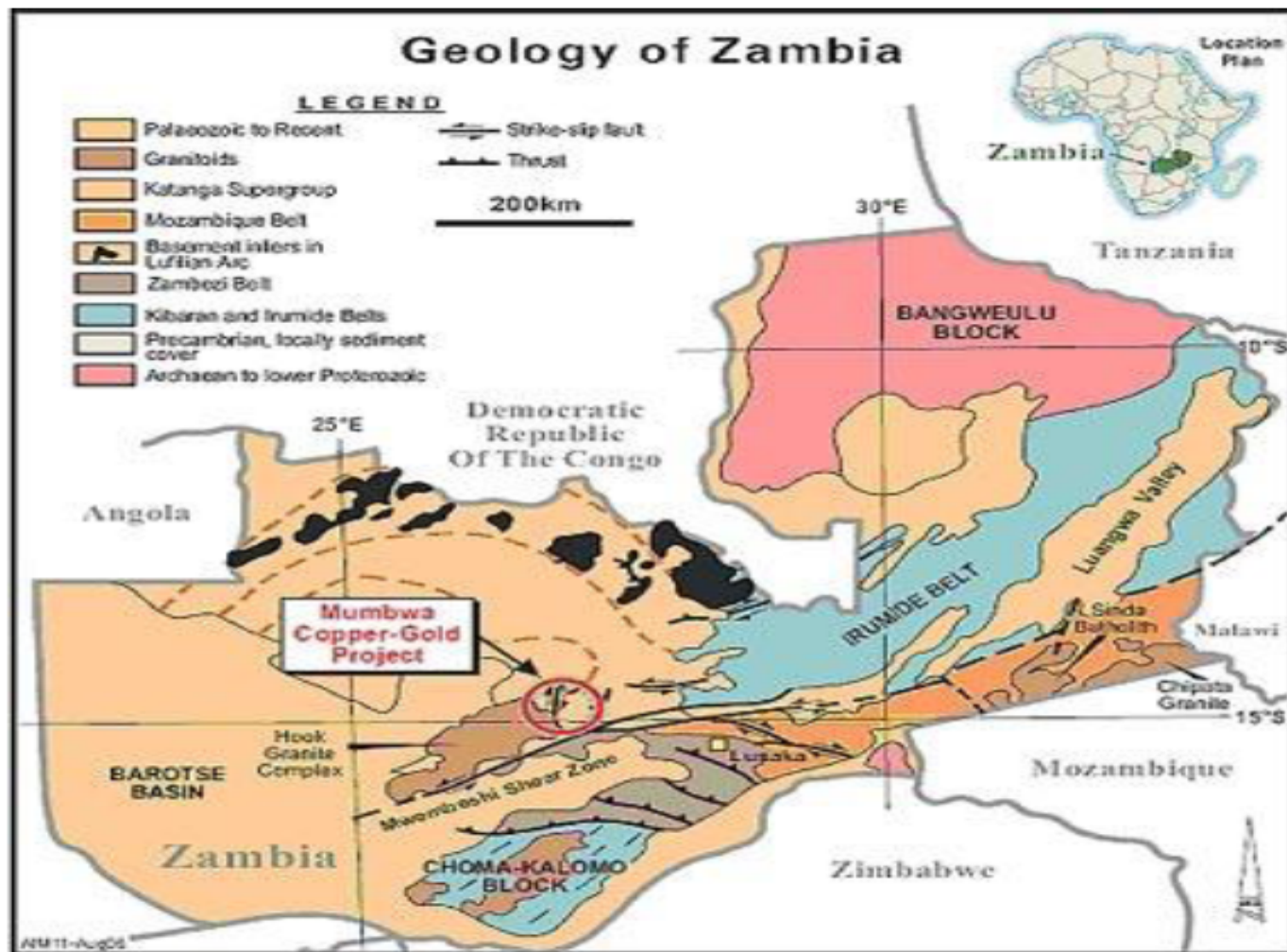
Geology and Mineral Resources

- Copper production outside the Copperbelt, mostly within the Katanga succession has come from Kansanshi, Lumwana and Mkushi. The area around Mkushi has some disseminated copper mineralization in the granites .



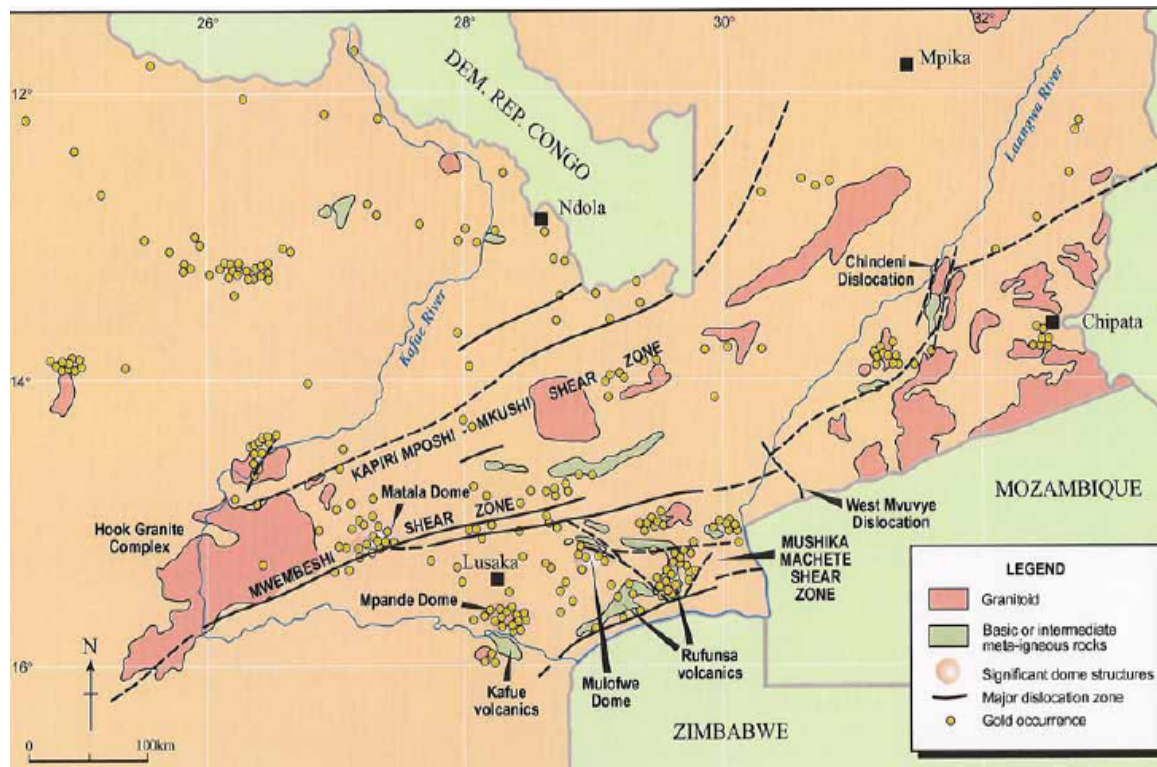
Geology and Mineral Resources

- **Mumbwa copper-gold** mineralization is associated with large scale and highly variable magmatic hydrothermal iron-oxide breccia complex. Katanga sequence underlies the area with a peripheral granite intruded the Katanga sediments during tectonic activity.



Geology and Mineralisation

- **Gold:** The majority of the deposits are lode-type associated with the Mwembeshi shear Zone. Gold mineralization occurs variously with copper and uranium in major thrust zones near the base of the Katanga Succession.
- More than 300 gold occurrences have been recorded, but mostly are only prospects. Historical producers are Dunrobin in Central Zambia and Jessie in Eastern Zambia.

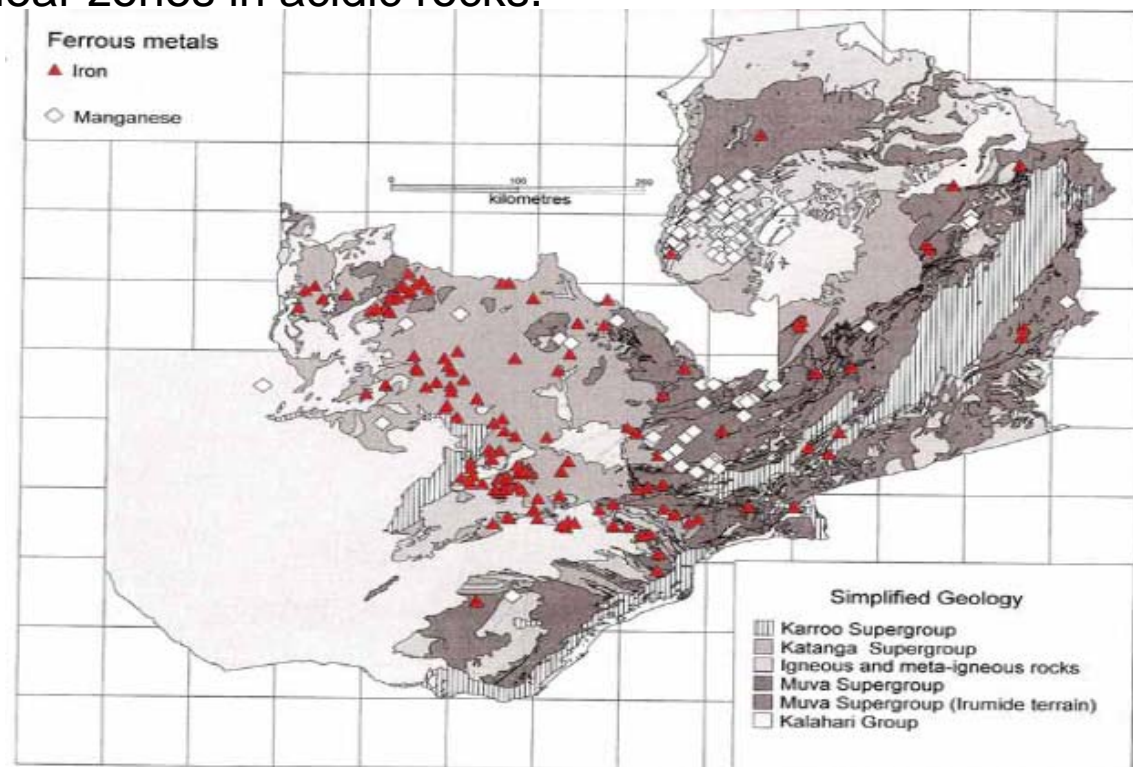


Geology and Mineral Resources

- **Nickel and Platinum Group Elements:** Orthomagmatic nickel occurrences are known in the Basement sequence and east and south of the capital city-Lusaka. Sediment-hosted nickel deposits in Mwashia and Roan Group of North-western Zambia are associated with the gabbroic intrusion and often show signs of hydrothermal enrichment. Minor platinum group elements are produced as a by-product of copper-refining on the major Copperbelt mines.
- **Zinc and Lead:** Carbonate-hosted Zn-Pb ore has been mined from Kabwe deposit in Central Zambia.

Geology and Mineral Resources

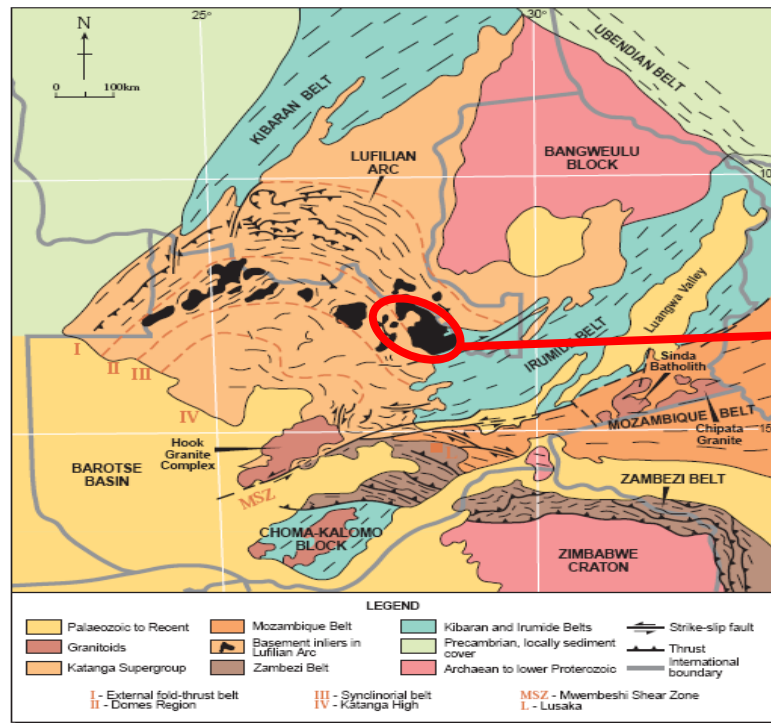
- **Iron:** Substantial resources of iron ores –in excess of 500Mt and these can be broadly classified as sedimentary type and a pyro-metasomatic type based on the chemical composition and geology. However, Zambia imports all its steel and there is no local production of iron.
- **Manganese:** Manganese was mined in Mansa in Luapula province of Zambia for use in the manufacture of battery cells. Numerous small deposits are known to occur throughout the country. Mineralisation appear to be confined to shear zones in acidic rocks.



Geology and Mineral Resources

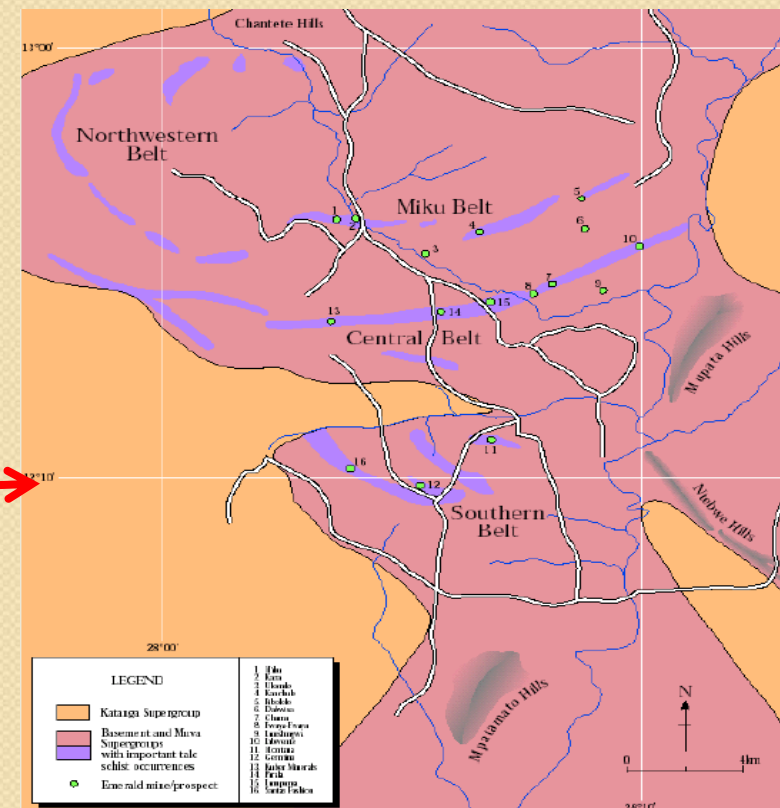
Gemstones

- Emeralds:** Zambia produces about 20% of the world's emeralds and they are sought after due to their deep green colour. They are recovered exclusively in Ndola Rural area hosted by Muva age talc schist intruded by tourmaline bearing pegmatite bodies.



Ndola Rural Area

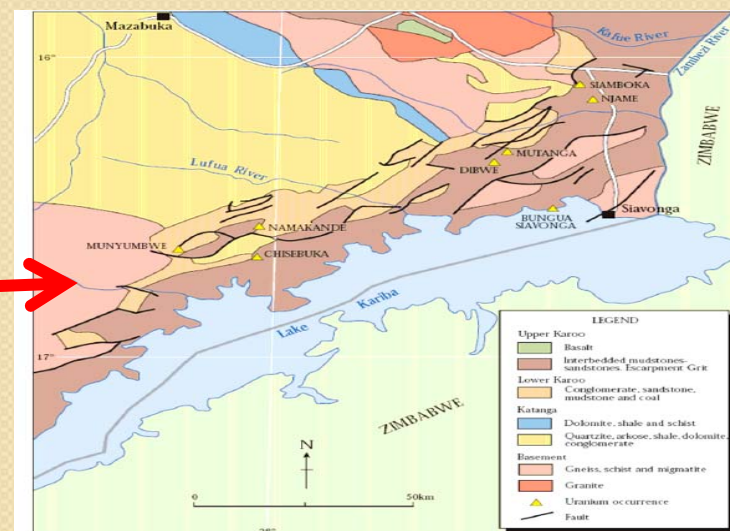
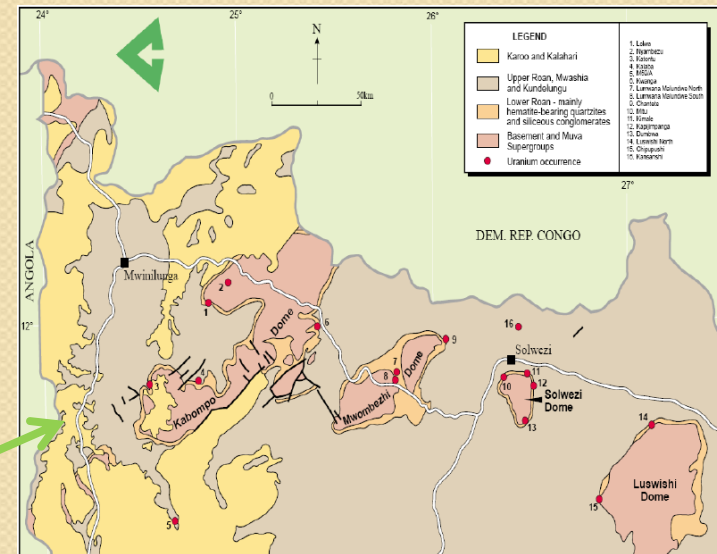
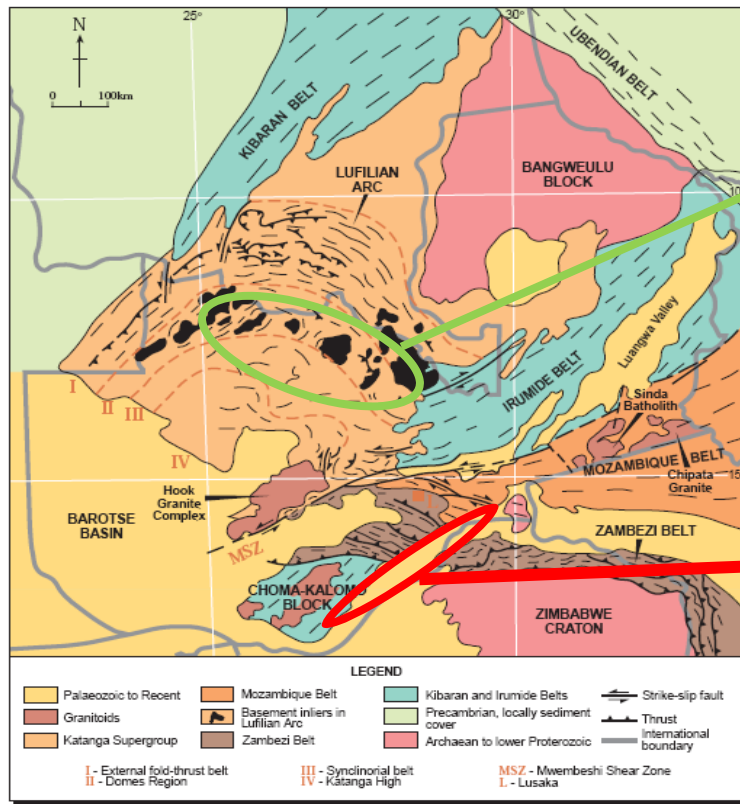
- Emeralds occurrences**



Geology and Mineral Resources

Uranium

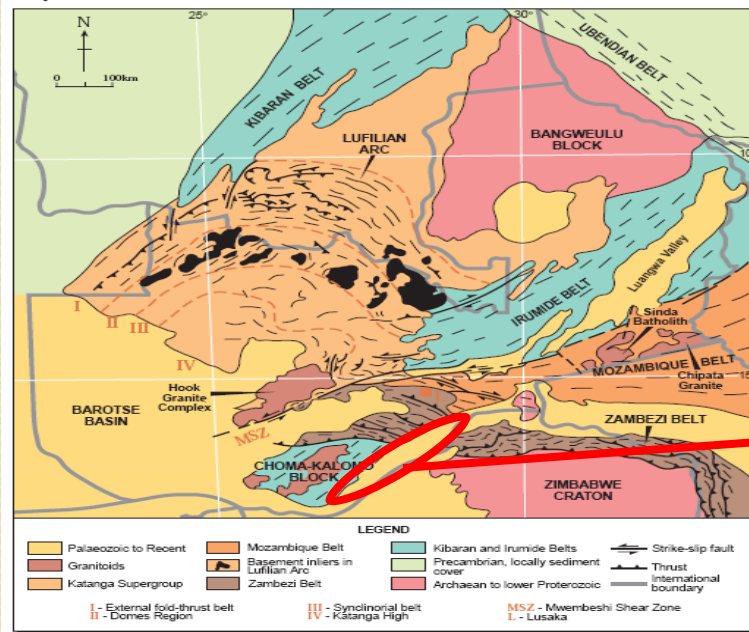
- Significant deposit occurrences have been recorded in Zambia associated with copper mineralisation in the Copperbelt, Basement domes of North-western Zambia and Karoo



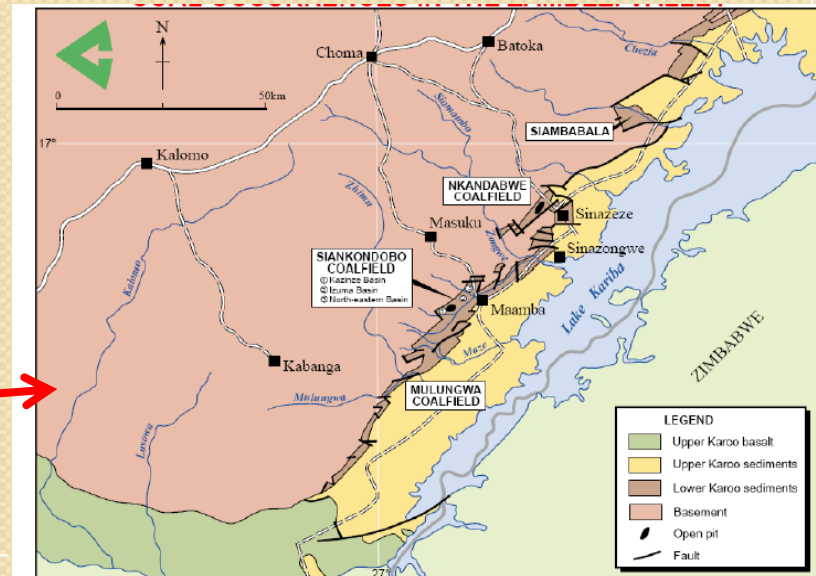
Geology and Mineral Resources

Coal

- Zambia possesses substantial coal resources and has been producing coal since 1967 from Maamba mine near Lake Kariba. The Maamba deposits and other occurrences are confined to the Lower-Karoo Gwembe Formation within fault controlled basin.



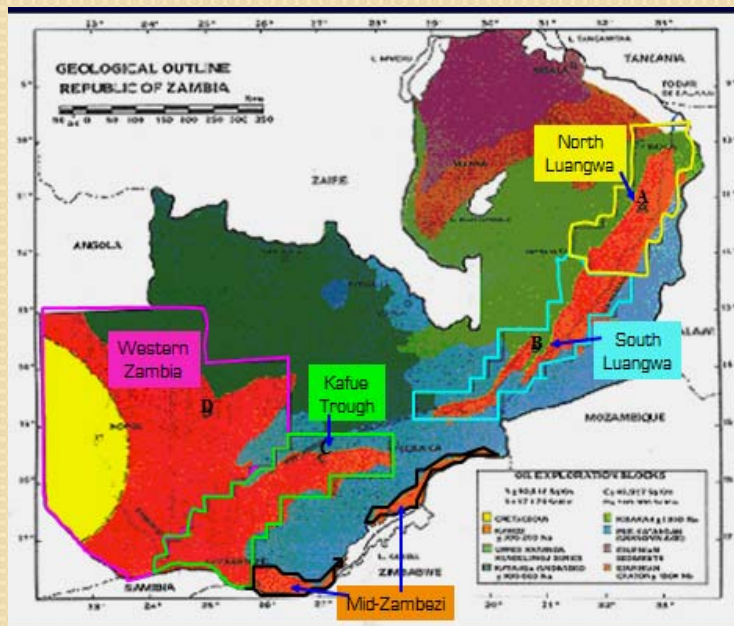
Coal deposits



Geology and Mineral Resources

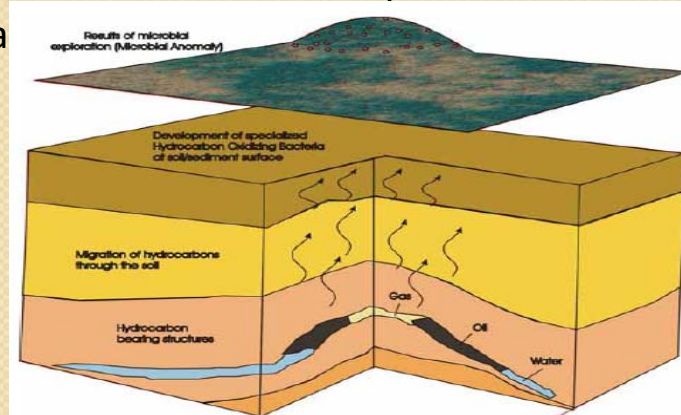
Hydrocarbons

- The petroleum potential of Zambia can be considered unexplored. The Western, mid-Zambezi and Eastern part of Zambia have favourable history of Lower Karoo hydrocarbons generations and Upper karoo development of structural traps during rifting.



Concept of the microbial prospecting of oil and gas

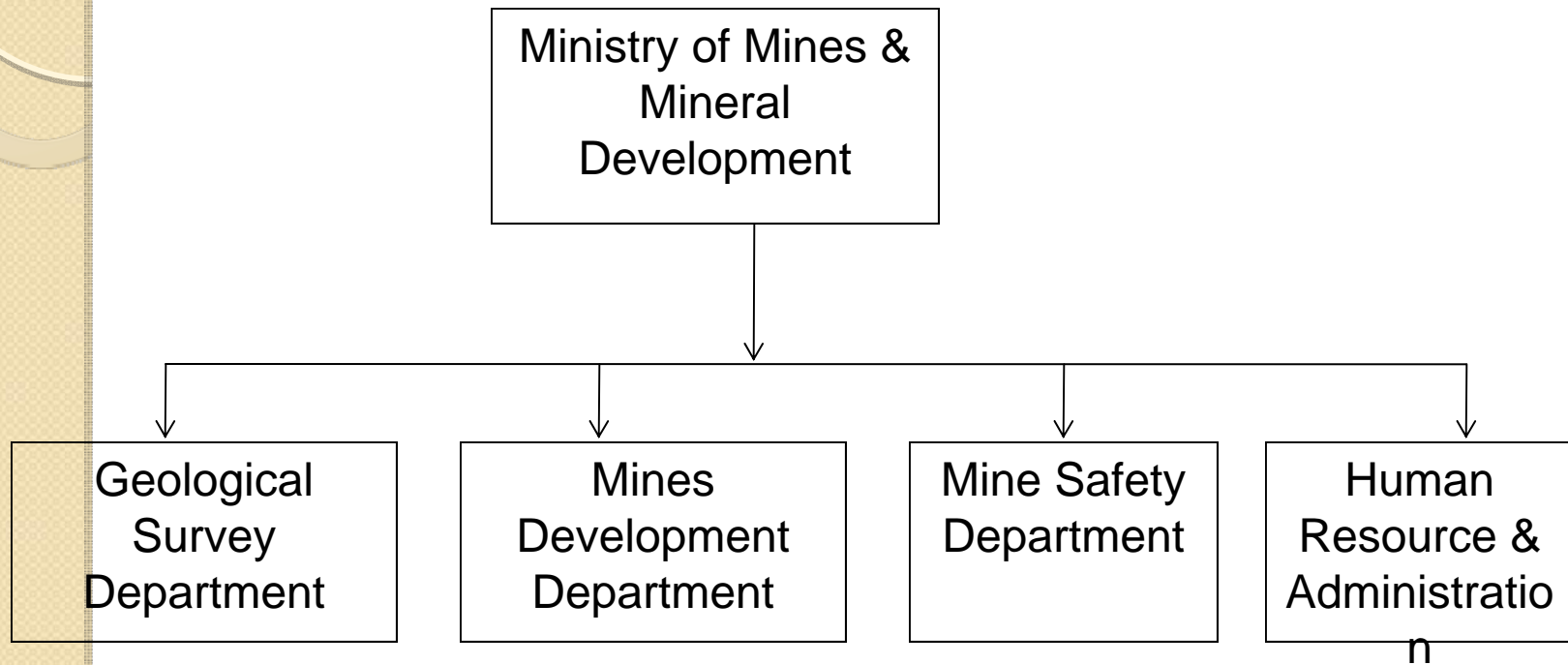
- Microbial prospecting for hydrocarbons is based on the seepage of light gaseous hydrocarbons from oil/gas reservoir to the surface and their utilisation by hydrocarbon-oxidizing bacteria. The detection of anomolous population of methene, ethane and propane oxidizing bacteria in the surface soil /sediments helps to prospect for hydrocarbons. Hydrocarbon prospecting in Western and Eastern Zambia using the Microbial Prospecting for oil and gas technique indicated that the Western and Eastern Zambia have potential for oil and ga



Geology and Mineral Resources

- **Industrial Minerals:** Zambia boast a wide range of industrial minerals capable of underpinning the anticipated growth in the mining, manufacturing and agricultural sectors.
- **Feldspars:** occur in pegmatite hosted within granitic gneisses and schist of the basement. Pegmatite's occur extensively within the basement of central Zambia.
- **Talc:** talc in Zambia is of two generic groups, formed by regional metamorphism of siliceous dolomites of Katangan age and by hydrothermal alterations of basic intrusions associated with dolomites. Talc occurrences have been recorded in Lusaka, central, Copperbelt, Eastern and north-western Zambia.
- **Phosphates:** Apatite, the most important potential source of phosphate occurs in significant concentrations in syenite intrusion and carbonitite bodies. In Zambia, phosphate has attracted a great deal of attention as the possible source of fertilizer raw material.
- Others include **Kaolin, gypsum, silica sand, fluorite, graphite** and **barite**.

Mining Administration Of Mineral Resources





Mining Administration Of Mineral Resources

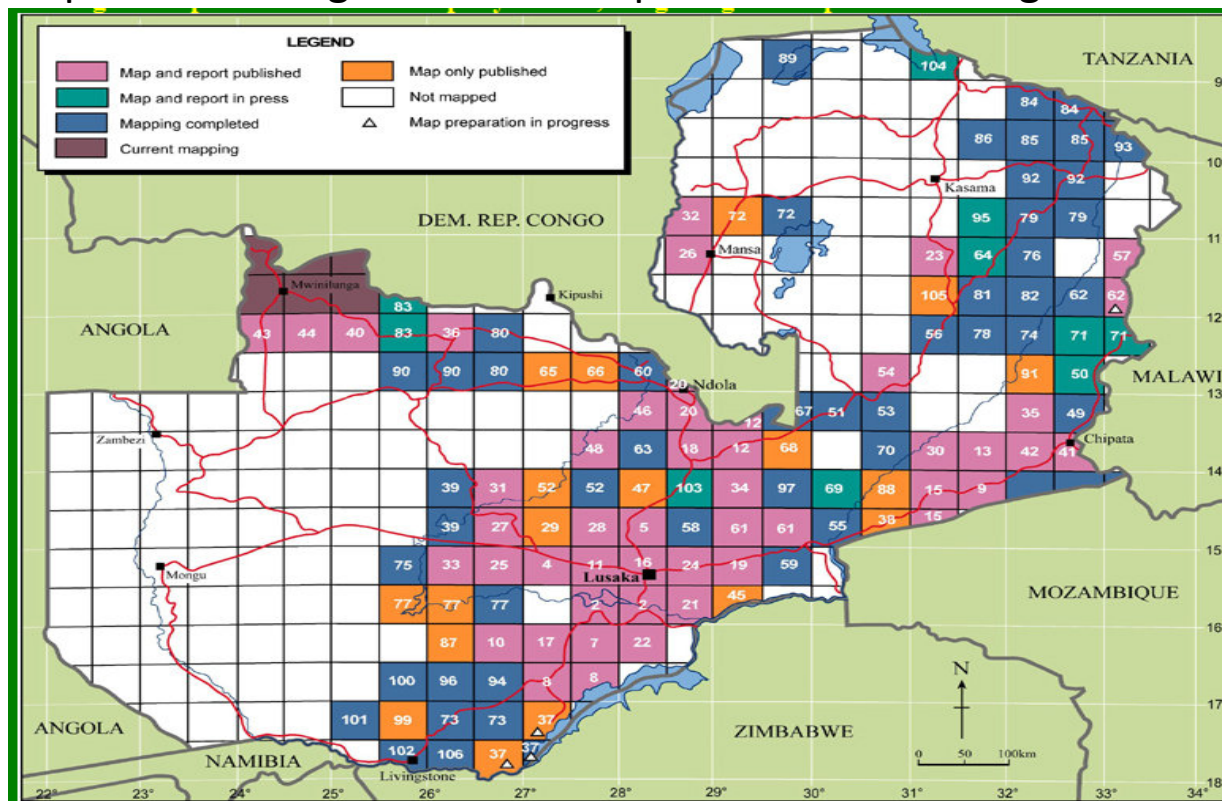
Geological Survey Department: The role of Geological Survey Department is to:

- Provide geological, geophysical and geochemical data on a countrywide basis.
- To prospect on behalf of the government.
- To act as a national depository of all information relating to the geology of Zambia.
- To provide support and advisory services to the public.
- To administer the prospecting licences, mineral processing licence, geological and mining consultancy and mineral laboratory permits.

Regional Geological Mapping

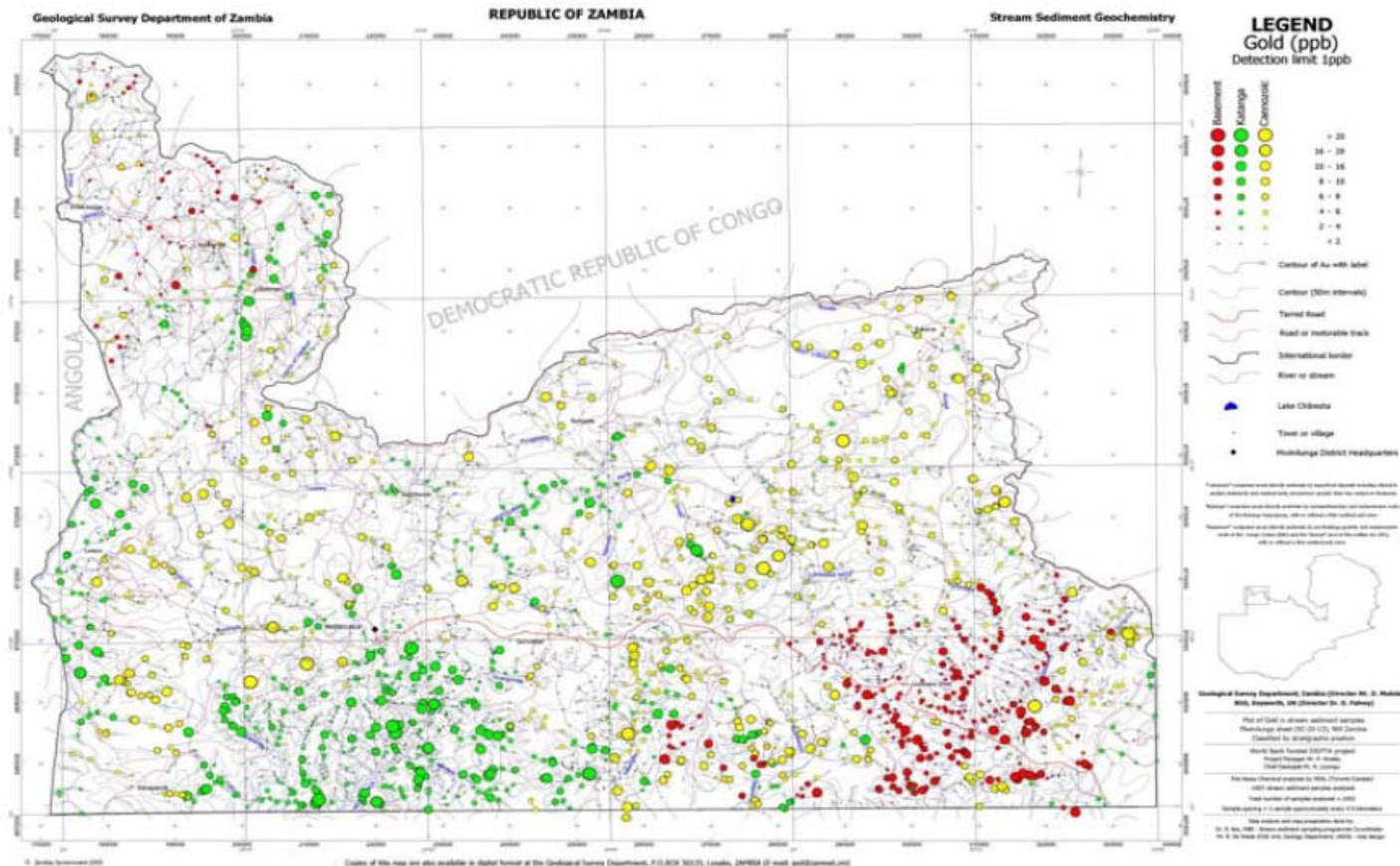
The **Geological Survey department** has made considerable achievements under its statutory obligations. Regional Geological mapping has made available maps and data.

- 58% of the country has been geologically mapped.
- 123 quarter degree sheet areas mapped at 1: 100,000 scale (15 digital maps).
- Regional mapping has also produced geological databases which are important for companies wishing to invest in exploration and mining in the country.



Geochemical Surveys

- The Geological Survey of Zambia, in conjunction with the British Geological Survey, carried out detailed soil and stream sediment geochemistry between 1998 and 2000. Based on the extensive data set, a series of statistical tools were used to model trace and major element distributions in Northwest Zambia, link this data in with the known geology and mineral potential and to establish a baseline environmental dataset for future.



Mineral Resource Exploration

- The government through the Geological Survey Department has issued mining licences to the private sector wishing to invest in a particular mineral resource deposit. The mining licences are issued according to the scale of operation (small-scale and large-scale).

Mineral Resource Exploitation

- Table1: Ownership of Copper Mines In Zambia. Note that the ownership is truly global

Zambian Company	Location	Controlling Company	Country
Konkola Copper Mines (KCM) PLC, Konkola Deep, Nchanga Tailings	Chililabombwe & Chingola	Vedanta/ZCCM (GRZ)	India/UK/Zambia
Mopani Copper Mine PLC, Nkana and Mufulira Mines	Kitwe & Mufulira	Glencore (Swiss, 73%), Xstrata/ First Quantum (13%) / ZCCM/GRZ	Switzerland/Canada/ Australia/Zambia
Bwana Mukubwa Limited (BMML) Bwana Mukubwa/Lonshi	Ndola	First Quantum Minerals Ltd (FQM) /ZCCM/GRZ	Canada-Australia /Zambia
Kansanshi Mine Limited	Solwezi	First Quantum Ltd /ZCCM/GRZ	Canada/Zambia
Chibuluma Mines Limited Chibuluma South & West	Kalulushi	Meteorex /ZCCM/GRZ	South Africa/Zambia
Non Ferrous Metals Africa Mining PLC (NFC). Chambishi Mine	Chambishi	NFC/ZCCM/GRZ	China/Zambia
Luanshya/Baluba Mine PLC Luanshya Mine	Luanshya		China/Zambia

Mineral Resource Exploitation

- MCM operates underground mines at Mufulira (once the largest underground mine in the world) and Nkana in Kitwe producing about 240,000MT pa. + some 2000MT cobalt pa.
- KCM (Nchanga & Konkola mine) is the single largest producer with 250,000Mt @ 4.33% copper.
- FQM produces about 40,000MT pa by leaching old tailings – some of this originates in 3000MT/day of 5.75% ore trucked across the border from Lonshi (DRC) – only 30km from Bwana Mkubwa, plus Kansanshi Mine expected to produce up to 100,000MT/pa + 150,000MT pa of copper concentrate and 25,000 oz gold.
- The Lumwana project acquired by Equinox Resources Ltd of Australia in 2000, contains two large copper-cobalt-gold-uranium deposits at Chimiwungo and Malundwe. Lumwana at resources of more than 1 billion metric tons that contain 0.67% copper at a 0.2% copper cutoff. It also contains resource of 7.2 Mt at a grade of 0.14% uranium oxide.

Mineral Resource Evaluation

- Evaluation of mineral resources is currently being undertaken by the prospecting companies. The method of reporting mineral resources is dependant on the individual company. E.g. SAMREC or JORC.

Mineral Potential

- Geologically, Zambia contains elements characteristic of ancient mobile belts. The igneous, sedimentary and metamorphic rocks are the foundation of Zambia both geologically and economically. The complex geological evolution of Zambia, together with the abundance and diversity of mineral deposit are pointers towards the considerable potential for the discovery of new occurrences through exploration based on empirical models driven by known deposits and exploration formulated on the conceptual models.



Conclusion

- Zambia has potential for more minerals inclusive of :
 - Base Metals
 - Gemstones
 - Energy Minerals
 - Hydrocarbons

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