

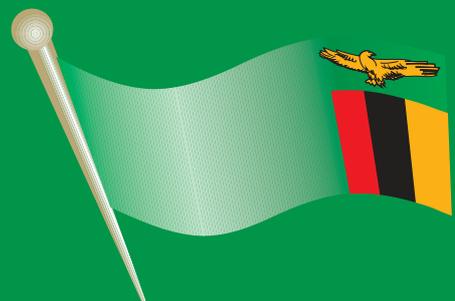
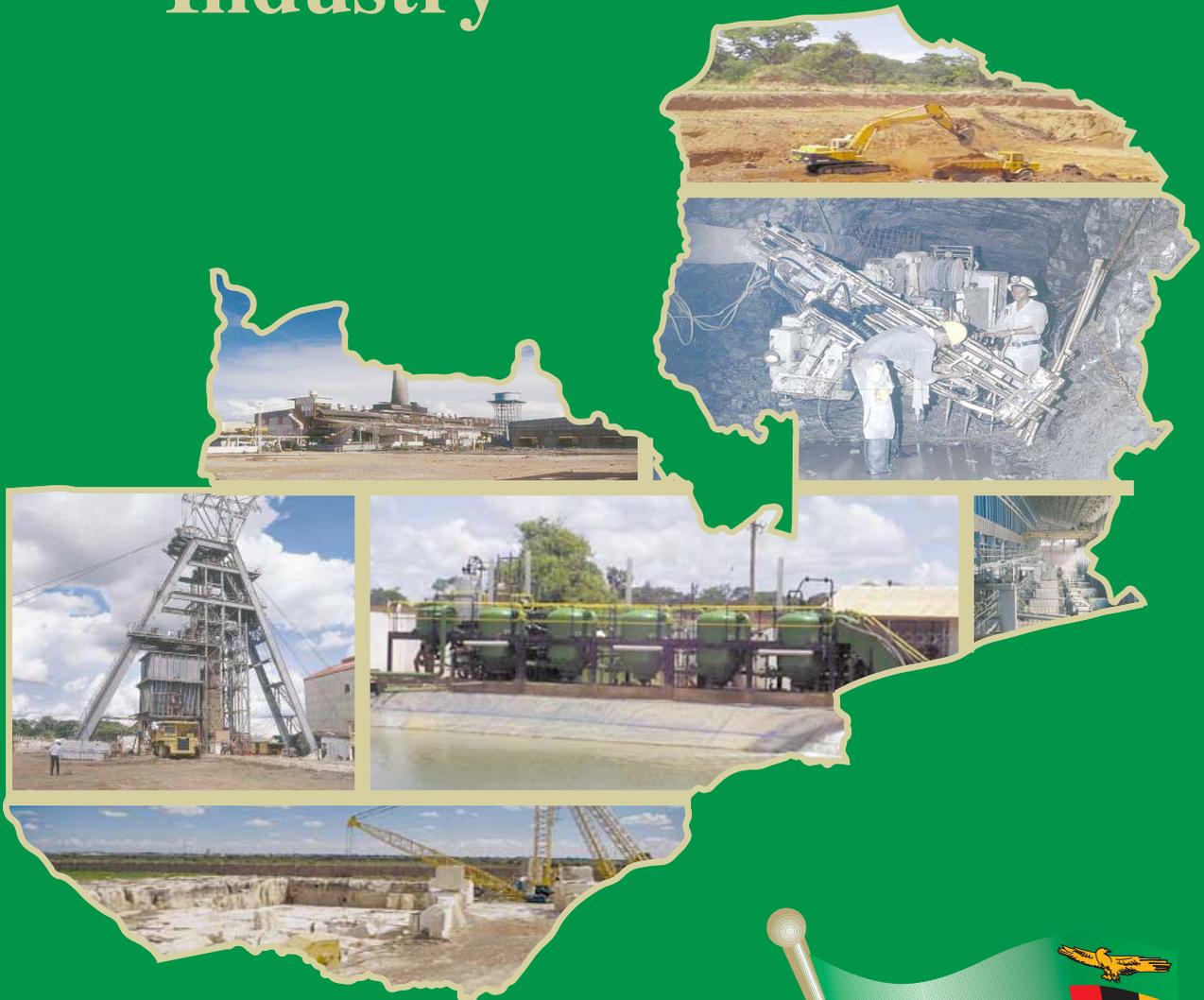
ZAMBIA

Investment Opportunities in the Mining Industry



Republic of Zambia

Ministry of Mines and Mineral Development



FOREWORD

Zambia is endowed with substantial mineral resources. However, the major metal, which has been exploited for nearly a century, is copper. Since the establishment of Zambia as a nation, copper has been, and still is, the single largest contributor to the Zambian economy. Depressed copper prices on the international market, plus the under-capitalization of our copper mines, have resulted in severe constraints on our economy.

To address this problem and in order to ensure that the mining industry continues to play a crucial role in national development, my government took very bold steps. A new Mining Act was put in place in 1995. The main features of the Act are: the divestiture of government from the business of mining through privatization of the mines; the liberalization of the fiscal policy; and the provision of several tax concessions to mining companies.

This brochure and the supporting "Technical Reference" illustrate the great mineral potential that exists in Zambia. The documents are produced to provide the investor with detailed information on Zambia as a mining investment destination. Furthermore, the significance of these documents is that they demonstrate the wide range of opportunities in mining in our country, in addition to copper mining.

In welcoming you, the users of this brochure, especially the investors, I wish to encourage you to make full use of the wide range of services available in the Ministry of Mines and Minerals Development. Please do not hesitate to call me personally should you desire.



Syamukayumbu K. Syamujaye (Dr.), MP
MINISTER OF MINES AND MINERALS DEVELOPMENT
Republic of Zambia

ZAMBIA

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Introduction

Zambia is a stable and vibrant country straddling central Africa and forming a natural hub for the sub-continent's diverse activities, having common borders with Angola, Democratic Republic of Congo (D. R. Congo), Tanzania, Malawi, Mozambique, Zimbabwe, Botswana and Namibia. Geologically the country is favoured with an abundance of mineral resources and, in the late Proterozoic Lufilian terrain of north-western Zambia, boasts one of the world's most important and complex metallotects hosting enormous reserves of copper-cobalt ore, together with gold, uranium, nickel, lead-zinc, iron and manganese. The Government of Zambia has taken significant steps to stabilize the economy and has created a positive investment climate which is particularly favourable to the exploration and exploitation of these and the numerous other mineral and energy resources identified and still to be discovered throughout the country.



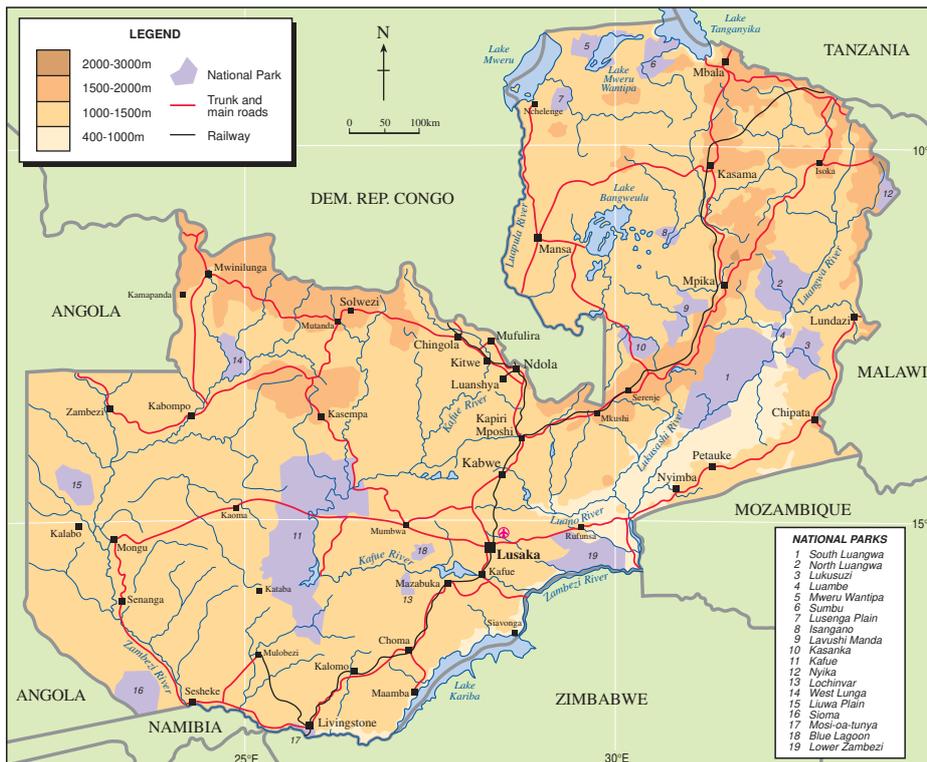
Regional location of Zambia and transport network in central and southern Africa

Zambia: The Country

Located well within the tropics and with an average elevation of between 1000m and 1500m, Zambia enjoys a sunny climate with three distinct seasons: a cool dry season in May-August with average daytime temperatures of 15-27°C; a hot dry season in September-November with temperatures of 27-32°C; and a warm wet season in December-April with temperatures of 20-27°C accompanied by the rains

that are so important to the country's expanding agricultural industry. The total area of the country is 752,614km² and, with a population of only 11 million people, vast tracts of the country are virtually uninhabited. The capital city is Lusaka, with a population of 1.5 million and other major centres include the towns of the Copperbelt (Kitwe, Ndola, Mufulira, Chingola, Kalulushi and Luanshya), Kabwe and Kapiri Mposhi in central Zambia, and Livingstone in the southern part of the country. Administratively the country is divided into nine provinces.

Key geographical features of Zambia





The Zambezi River

Four major river systems dominate Zambia's landscape: the Zambezi River in western Zambia and forming much of the southern border of the country including Lake Kariba; the Kafue River which drains the Copperbelt and then loops south-westwards and ultimately eastwards to join the Zambezi; the Luangwa system which dominates eastern Zambia; and the Luapula River which drains northwards into Lake Mweru, forming a common border with D. R. Congo along much of its length. Some nineteen areas of the country, large and small, have been designated National Parks to ensure a heritage for future generations.

Physical Infrastructure

Zambia possesses a well-established transport and communications network and is mostly self-sufficient in terms of electricity requirements.

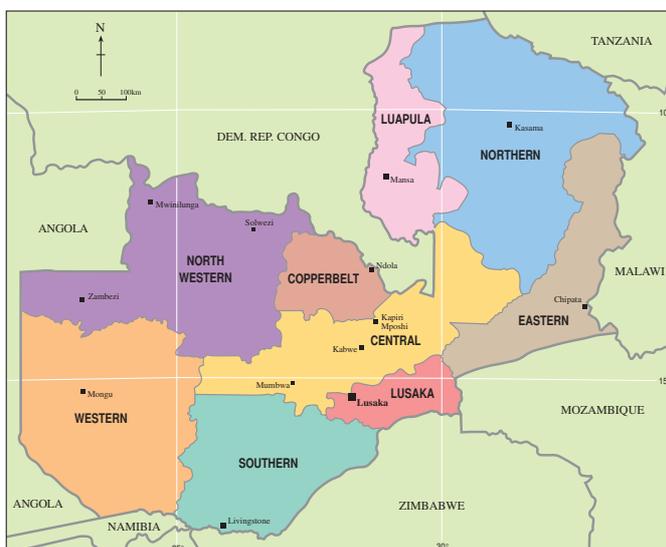
Transport Network

Zambia is the most important route centre in central Africa and an important gateway between the region and the countries of southern Africa.

Zambia's road network comprises 21,000km of main, trunk and district roads, 16,000km of urban and feeder roads, and 30,000km of ungazetted roads. Roads between the important centres are mostly paved and in good condition.

The key rail lines are from Livingstone on the Zimbabwe border through Lusaka and the Copperbelt into D. R. Congo and Angola, and the Tanzania-Zambia railway (Tazara) that starts from Kapiri Mposhi and extends eastwards to the Tanzanian port of Dar-es-Salaam. Currently, the line through Angola to the Atlantic coast requires rehabilitation but the Livingstone route through Zimbabwe links to the major south coast ports of Durban and Cape Town.

The country's major international airport is Lusaka and this is serviced regularly by a number of international airlines on routes throughout Africa and direct to Europe, India and the Far East. A local airline services regional routes in central and southern Africa, and domestic charter companies support air travel within Zambia.

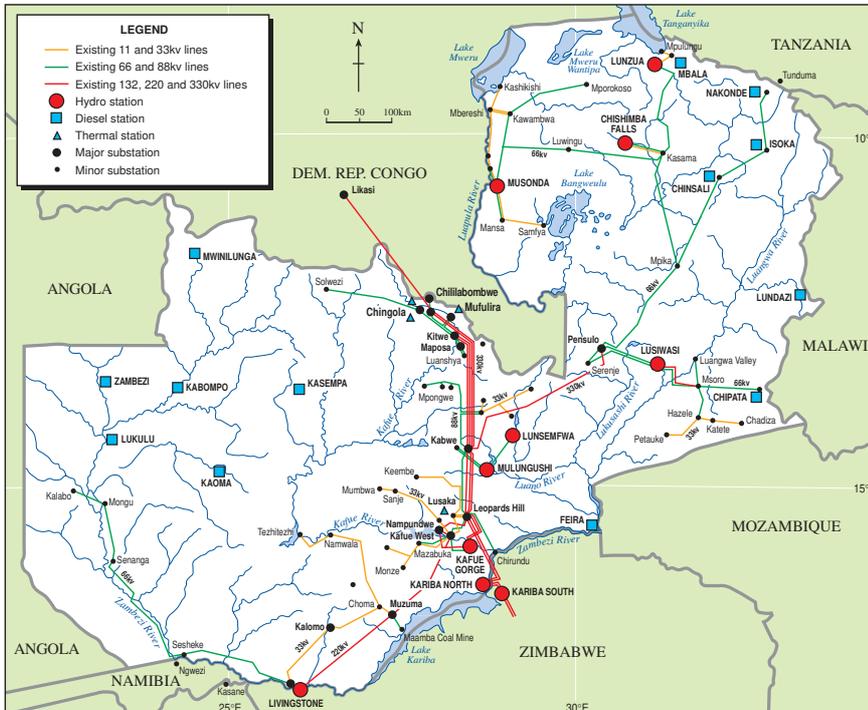


Provinces of Zambia

Telecommunications

Zambia has a well-established infrastructure of domestic and international telecommunications which is controlled by the Zambia Telecommunications Corporation (Zamtel). Cellular phone services are also now available via Zamtel and a number of other privately-owned companies.

Electricity generation and transmission in Zambia



Chishimba Falls

Energy

The country's most important source of energy is electricity and this is generated by three major hydro-electric power stations - Kariba North Bank (600MW), Victoria Falls (150MW) and Kafue Gorge (900MW). A number of smaller hydro-electric and diesel-powered stations contribute to the National Grid and also supply outlying areas. Zambia is also an exporter of electricity.

Zambia's Economy

The monetary and fiscal policies put in place by the present Government since 1991 have led to very considerable strengthening of the economy:

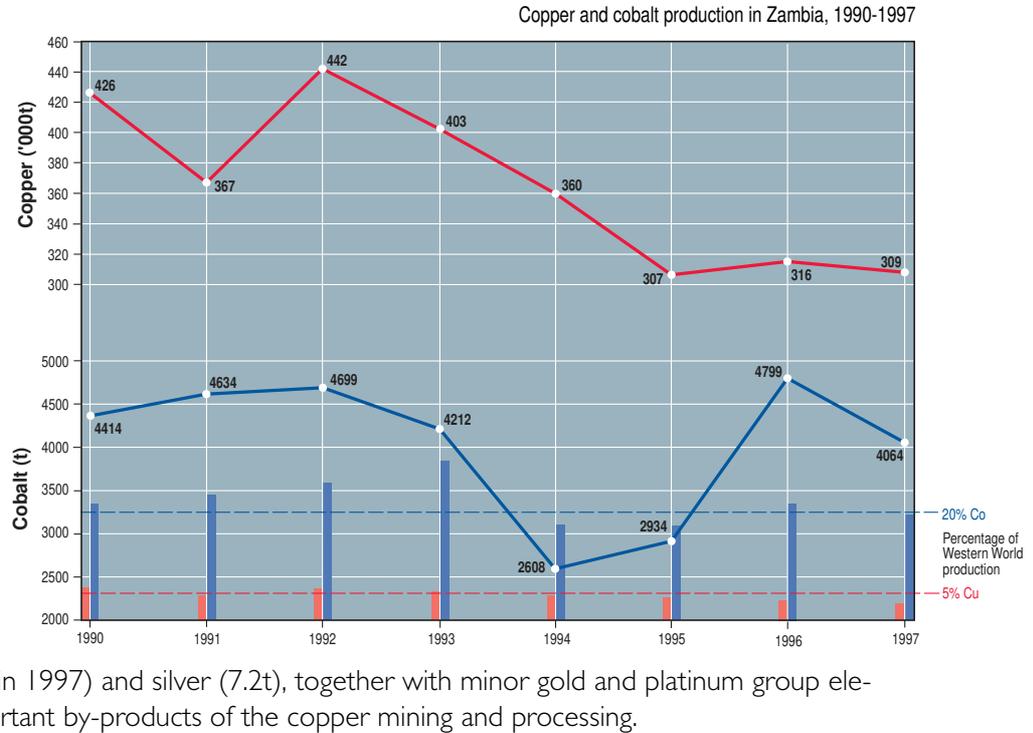
- ◇ Inflation has fallen from nearly 200% in 1990 to 18.6% at the end of 1997.
- ◇ Average bank lending rates have fallen from 116% in 1993 to 37% at the end of 1997.
- ◇ The trade balance showed a surplus for 1997 of US\$76.6 million compared with a deficit of US\$222 million in 1996.
- ◇ Non-traditional exports (i.e. excluding copper and cobalt) generated 26.4% of export revenue during 1997 and have shown an average growth of 24% since 1990.
- ◇ Foreign direct investment increased from US\$40 million in 1994 to US\$271 million in 1997, and rocketed to US\$949 million (including investment pledges) in the first half of 1998.

The privatization of the mines and companies of the Copperbelt and of other companies in Zambia has led to a flood of enquiries and substantial investment. The burgeoning Lusaka Stock Exchange saw a 117% growth in value during 1997 and a number of large companies are moving to equity placings during 1998. Negotiation of bilateral trade agreements with South Africa, Tanzania, Democratic Republic of Congo, Malawi and Zimbabwe bode well for positive and sustainable growth by Zambia's economy.

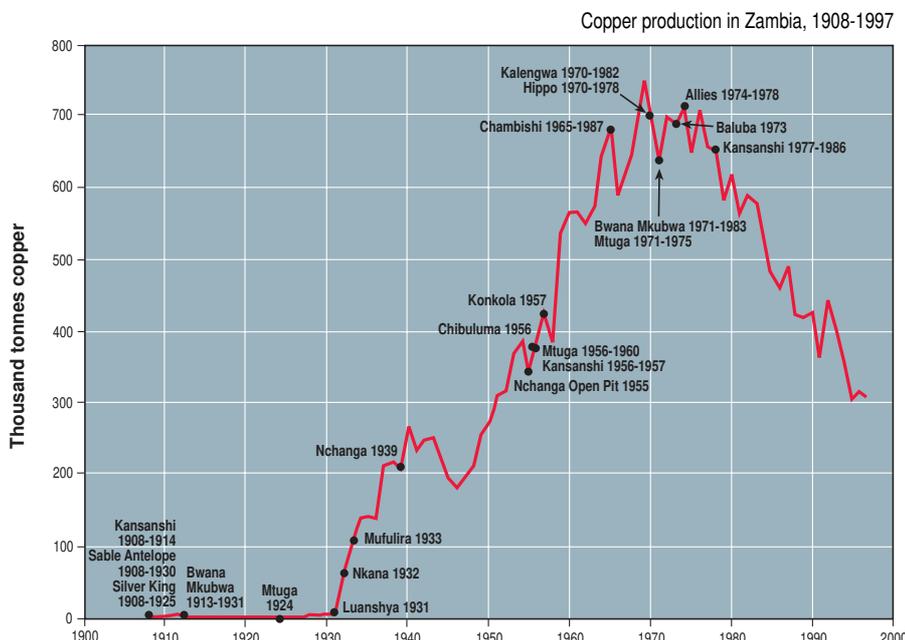
The mining industry has been the economic and social backbone of Zambia since the first major phase of exploitation of the Copperbelt's Cu-Co deposits commenced in the early 1930's. Since that time a wide spectrum of other metalliferous and non-metalliferous resources have been discovered in Zambia and, although exploitation of these has been limited, they clearly demonstrate the considerable opportunities for further exploration and mining.

Mineral Endowment

Zambia is internationally recognized as a major producer of copper and cobalt; in 1997 it ranked as the world's seventh largest producer of copper, generating 3.3% of the western world's production, and the world's second highest producer of cobalt (19.7%) behind the leading producer, D. R. Congo which sources its Cu-Co ore from the strike-extension of Zambia's Copperbelt mineralization. Significant quantities of selenium (16.7t in 1997) and silver (7.2t), together with minor gold and platinum group elements, are produced as important by-products of the copper mining and processing.

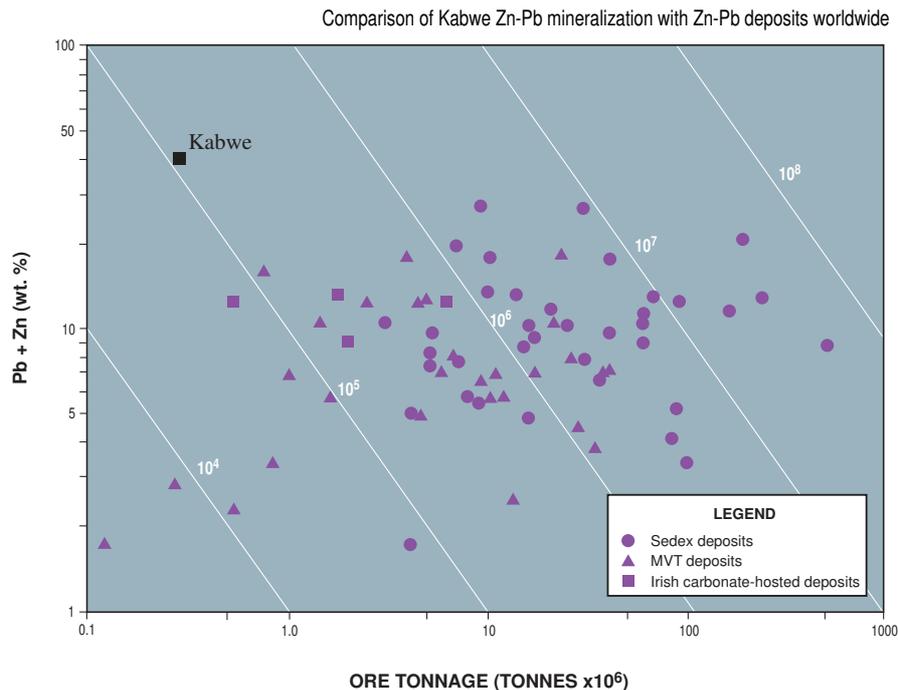


Copper mineralization was first discovered at the turn of the century but large scale production only commenced in the 1930's with the start-up of Roan Antelope (Luanshya - 1931), followed rapidly by Nkana (1932), Mufulira (1933) and then Nchanga in 1939. Copper production exceeded 400,000t.p.a. in the late 1950's and reached a peak of 700,000t.p.a. in 1969-1976 before beginning a progressive decline and sinking to a 1995 low of 307,000t.p.a. However, the privatization of Zambia Consolidated Copper Mines (ZCCM) will activate the remaining industry and halt this decline. With a total mineral resource of at least two billion tonnes on the Copperbelt alone, there is no doubt that copper and cobalt production will soon begin a significant upward trend.



Zambia has a history of gold mining on a relatively small scale, with the twenty larger deposits having produced a total of slightly more than 2t of gold since modern mining began in 1902. The largest past producers are Dunrobin (990kg gold), Jessie (390kg), Sasare (390kg), and Matala (225kg); Dunrobin has recently been re-opened by Reunion Mining and is scheduled to produce 500-600kg gold per annum. More than 300 gold occurrences have been reported throughout the country

and some of these are currently being re-evaluated. The other important metal production has been zinc and lead from the carbonate-hosted deposits of Kabwe which, with a total of 11 Mt of ore containing 40% combined zinc and lead, ranks as one of the highest grade Zn-Pb deposits in the world. Similar styles of mineralization have been recognized over a wide area to the north of Kabwe.



Substantial resources of iron are known in central and western Zambia, occurring as ironstones and lesser skarn deposits, but have yet to be exploited. Amongst other metalliferous occurrences reported are sedimentary and fracture-hosted manganese and orthomagmatic and shale-hosted nickel, together with tin and tungsten.

Alluvial diamonds have been recovered throughout Zambia, accompanied in places by indicator minerals but, despite the discovery of a number of kimberlite and lamproite intrusions, the sources of the diamonds have yet to be found. Zambia's high-quality deep green emeralds are in demand world-wide and, since 1970, have been mined continuously on the southern margin of the Copperbelt where they are hosted by pegmatite bodies. Pegmatites are also common in eastern Zambia where they have been exploited for aquamarine and tourmaline.

A wide range of known industrial minerals in Zambia include feldspar, silica sand, talc, barite, phosphate (in carbonatite and syenite), limestone, clays (mostly ball clay and brick clay), graphite, and many varieties of possible dimension stone.

Potential energy resources include uranium, important occurrences of which are detrital and vein-hosted uranium minerals in lower Karoo sediments and uranium minerals associated with copper mineralization in the copper deposits of the Copperbelt and north-western Zambia.

Since 1967, coal has been produced continuously by Maamba Collieries from the fault-controlled Karoo basins of southern Zambia. Production in 1997 was 164,000t but the open-pit mining operation has the potential to return to past production levels of 500,000t.p.a.

Limited exploration for hydrocarbons to date has been unsuccessful but evaluation of existing data and re-interpretation of the sequence stratigraphy indicates significant potential in the lower and mid-Karoo sequences of the Luangwa and Mid-Zambezi graben.

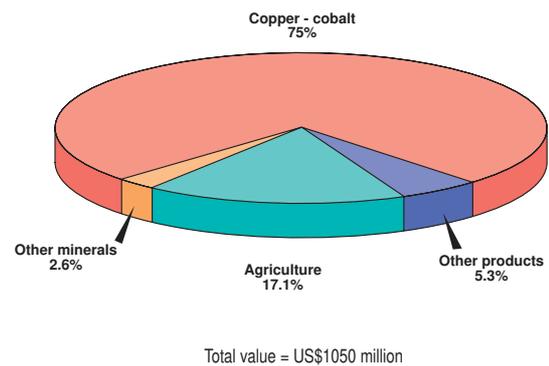
Metal and mineral production and sales in Zambia, 1997

Commodity	Production	Sales	Value (US \$ million)
Copper	308,888t	311,288t	711.65
Cobalt	4064t	4646t	186.31
Gold	226kg	159kg	1.73
Silver	7219kg	8576kg	1.34
Selenium	16,749kg	6588kg	0.03
Coal	164,443t	164,443t	0.22
Amethyst	699,343kg	1,149,040kg	2.14
Aquamarine	0	575kg	0.47
Emerald	509kg	1047kg	9.20
Tourmaline	0	5764kg	0.61

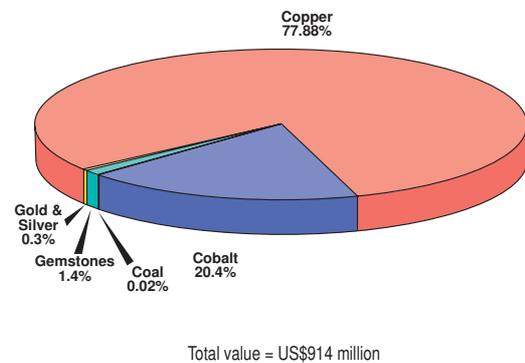
Mining and the Economy

For the past sixty years Zambia's economy has been heavily reliant on the mining of copper and cobalt, and, despite the positive steps taken to diversify the industrial and manufacturing base, this reliance remains. The mining sector contributed US\$822 million to the total export earnings of US\$1050 million in 1997 and, of this, US\$798 million was realized from sales of copper and cobalt. The balance of mining-sector earnings comes from sales of gold, silver, and selenium, mostly by-products of copper mining, and from emerald sales.

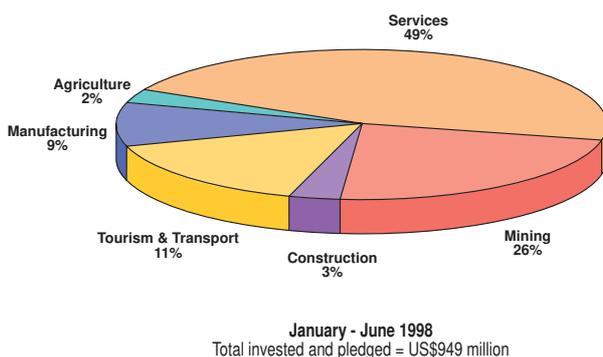
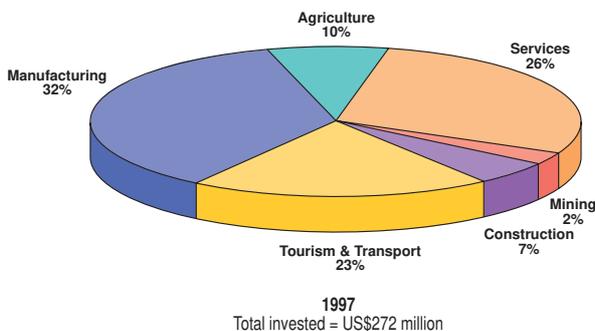
The vulnerability of Zambia's economy due to its reliance on copper mining has been exposed in the very recent past by the falling copper price and by falling production as a result of limited re-investment in the mining industry. However, the privatization process has already led to significant inflow of investment to the mining sector, and a reversal of fortunes is confidently predicted for the copper mining industry within the next 2-3 years. Reinforced by future production of additional metals and minerals, there is no doubt that the mining industry will continue to provide both a sound base and a stimulus for growth in the other sectors of the economy, leading to long-term prosperity.



Contributions of industrial and manufacturing sectors to Zambia's export earnings in 1997



Value of mineral sales in Zambia during 1997



Investment in Zambia

The Industry as an Employer

The mining industry is the single largest private sector employer in Zambia, currently employing approximately 37,000 people, and as such has played a leading role in establishing a social and welfare charter for workers across the country. Repatriation of benefits is mandatory as is maternity leave, and employees are entitled to paid sick leave of up to 26 days per annum. The Pensions Act requires employers to contribute to a pension fund for the benefit of employees. All employees are free to join trade unions, with most unions being affiliated to the Zambia Congress of Trade Unions.



Hand-picking of emerald-bearing pegmatite material, Ndola Rural area.

Skills' Development

Zambia possesses a pool of skilled workers, both technical and professional, which underpins the mining industry, and has a well-established system of tertiary education that will ensure a flow of appropriately trained people to meet the anticipated expansion of exploration and mining activities.

Technical Training

Mining and linked engineering skills have mostly been gained in-house through training schemes provided by the larger copper mines and, although industry-wide formal qualifications do not yet exist, the pool of expertise is considerable. Formal training is available at the Copperbelt University, Kitwe, where three year diplomas are awarded in Mining Technology and Metallurgical Technology. The combination of theoretical and practical training ensures a rapid uptake of the graduating "Technologists" into the mining industry. Two year courses in all areas of engineering are available at the Northern Technical College (Nortec), Ndola, with students graduating as Engineering Technicians.

Professional Training

The School of Mines at the University of Zambia was established in 1973 and comprises three departments - Geology, Mining Engineering, and Metallurgy and Mineral Processing. The annual intake averages about fifty students, with all students reading Natural Sciences in Year I before specializing in one of the three disciplines for the final four years. Graduates are awarded the degree of B.Min.Sc. (Bachelor of Mineral Sciences).

The School has an outreach policy to the mining industry and can provide training through customized short courses and through the supervision of M.Phil. and Ph.D. programmes of research linked to immediate problem-solving requirements identified by the industry.

The Government has adopted a pragmatic mineral policy which is designed to enhance investment in the mining industry and to ensure the development of a self-sustaining minerals-based industry. The privatization of many state-owned companies and especially the copper mining industry, formerly managed under the parastatal umbrella of Zambia Consolidated Copper Mines Ltd (ZCCM), is a clear demonstration of this intent. Enactment of this policy is being promoted by the Ministry of Mines and Minerals Development through the technical support available from its three constituent departments - Geological Survey, Mines Development and Mines Safety.

Mining Policy

Key objectives of the Government's Mining Policy, published in 1995, are as follows:

- ◇ To make the private sector the principal producer and exporter of mineral products through putting in place a privatization programme and to promote private sector initiative in the development of new mines in order to increase and diversify mineral and mineral-based products and exports. This will maximize long-term economic benefits to the country.
- ◇ To promote the development of the small-scale mining industry which has the potential to significantly contribute to the economy.
- ◇ To promote the development of gemstone mining and facilitate liberalized marketing arrangements in order to realize the industry's potential to contribute to the development of the economy.
- ◇ To promote the exploration and exploitation of industrial minerals and energy minerals and to encourage the establishment of a ferrous industry.
- ◇ To reduce the danger of ecological damage arising from mining operations as well as damage to the health of workers and inhabitants of the neighbourhood through air, water and land.
- ◇ To promote the local processing of mineral raw materials into finished products for added value.

The policy is aimed in particular at encouraging private investment in exploration and in the development of new mines. In addition to returning the major copper mines to the private sector, thus encouraging cost-effective management and greater exploitation of the enormous

copper resources, the policy seeks to direct attention to the exploitation of the very diverse range of metalliferous deposits, industrial minerals, gemstones and energy resources that are present throughout Zambia.

Ministry of Mines and Minerals Development

Policy decisions within the ministry are made by the Minister, assisted by the Deputy Minister. The chief executive is the Permanent Secretary who directs four statutory departments - Geological Survey, Mines Development, Mines Safety and Headquarters, the latter being devoted to administrative matters.

Geological Survey Department

The primary roles of the Geological Survey are to provide geological, geophysical and geochemical data on a country-wide basis, to act as a national depository for all information relating to the geology of Zambia, and to provide support and advisory services to the public. Contributing to these activities are a number of important sections which provide a range of investigative services:

Chemistry Laboratory: chemical analysis of samples by classical methods, atomic absorption spectrophotometry and ultra-violet spectrophotometry.

Geophysics Section: capabilities in gravity, magnetic and resistivity surveys, and also borehole logging (and resistivity and self-potential).

Mineral Dressing and Metallurgical Laboratory: determination of gold by fire assay; beneficiation testwork; equipped with crushing and pulverizing facilities, James table, magnetic and heavy media separators and flotation cells.

Gemmological Unit: identification, authentication and valuation of all types of gemstones.

Mineralogy and Petrology Laboratory: preparation of thin sections of rocks, minerals and ores for petrographic study; mineral identification by x-ray diffractometry; x-ray fluorescence analysis.

Two additional sections are of particular importance - the **Cartographic Unit** and the **Information Section**. Geological mapping was suspended in the mid-1980's but, with the support of international agencies, the Geological Survey has almost completed the compilation and publication of a large backlog of geological maps and accompanying reports. In 1997 new programmes of geological mapping were initiated in

north-western and north-eastern Zambia.

In its role as the national depository for geological information the Geological Survey has accumulated a wealth of maps, publications, reports and data generated by the Survey staff and also derived from external sources including exploration reports and international journals. These are archived and maintained by the Technical Records Office, Archive and Library which comprise the Information Section. Key data sources include the following:

Memoirs and Bulletins of the Geological Survey: descriptions and evaluations of specific geological terrains.

Geological Reports: texts to accompany 1:100,000 geological maps.

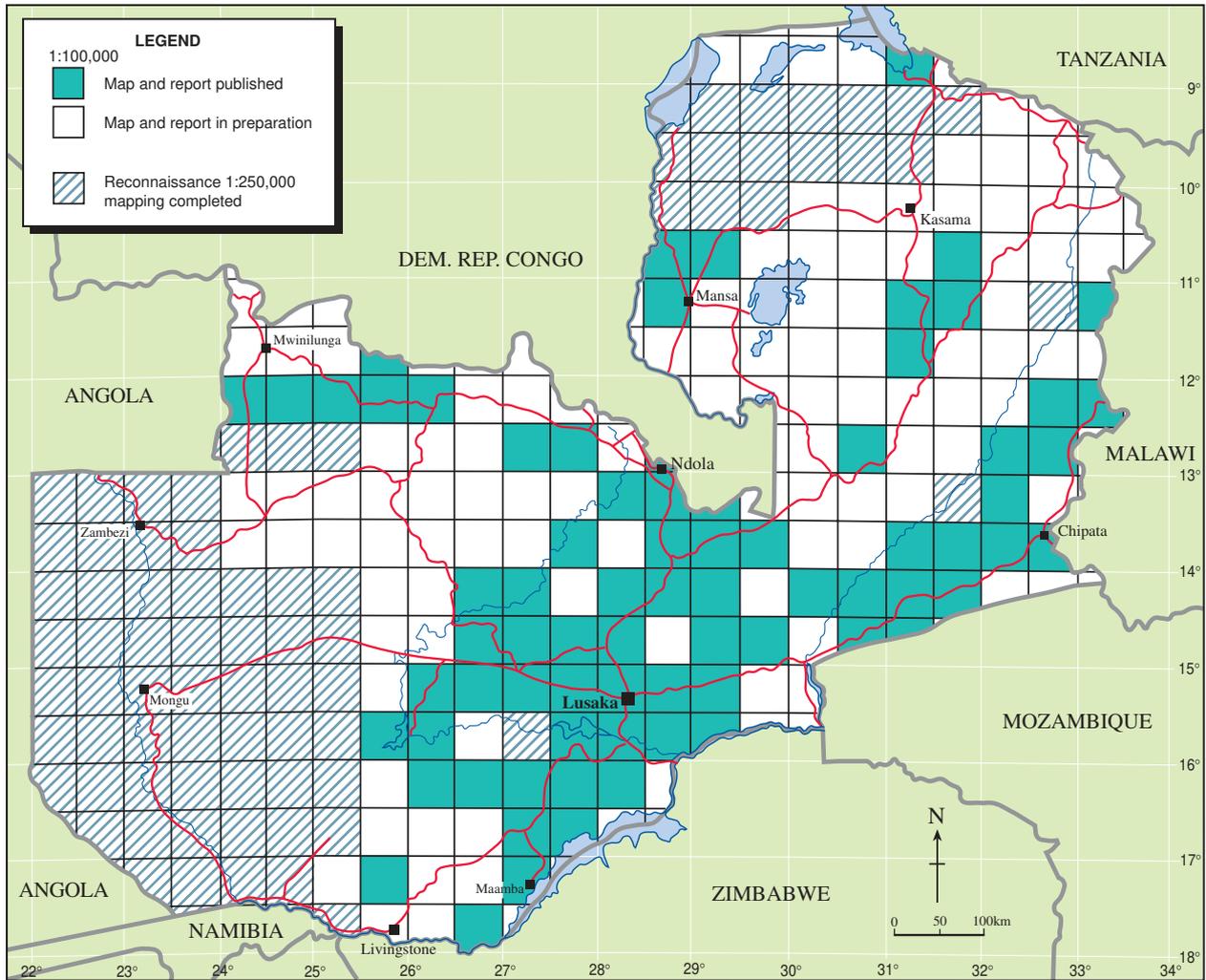
Economic Reports: descriptions of specific mineral deposits or occurrences of potential economic interest.

Technical Reports: similar to Economic Reports but often containing an element of technical evaluation.

Occasional Papers: publications in national and international journals relating to the geology and mineral resources of Zambia.

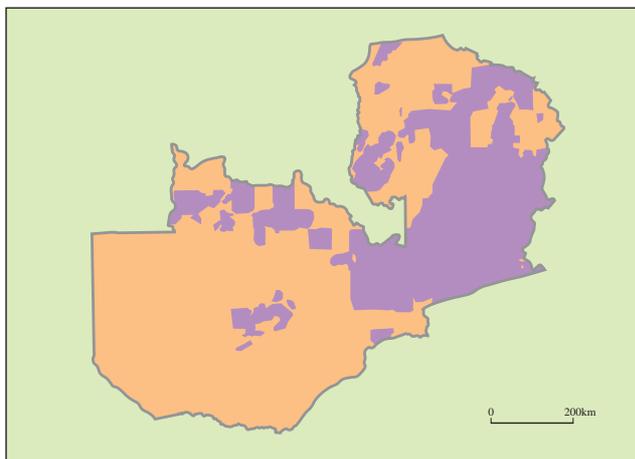
Mineral Exploration (Minex) Reports: produced by the exploration arm of Zambia Industrial and Mining Corporation Ltd. (Zimco), a former parastatal mining and exploration group, and describing mineral occurrences and exploration activities.

Geochemical Data: stream-sediment, soil and rock samples analysed for selective suites of trace elements and resulting from three major initiatives - the Regional Geochemical Mapping Project, the Metallogenic Province Mapping Project and the Granitoid Geochemistry Project, which have generated data for approximately 30% of Zambia. These data have been digitized, together with some data incorporated from company exploration reports, and are available on disk.



Availability of 1:100,000 and 1:250,000 scale geological mapping of Zambia

Geophysical Data: a reconnaissance-scale Bouguer anomaly map of the whole of Zambia published at a scale of 1:1,500,000 with contour intervals of 5 milligals; complete airborne magnetic coverage of Zambia and 70% radiometric coverage at line spacings of between 800m and 2000m and mean terrain clearance of 150m. The magnetic and radiometric surveys were undertaken in the 1970's and early 1980's and so are mostly not up to present-day standards, but the data are valuable for undertaking preliminary geological assessments of areas. The data are stored as contoured transparency maps.



Areas of Zambia for which geochemical data are available

Mineral Inventory Database: the Geological Survey has an ongoing commitment to the preparation of a computerized database comprising the c.350 mineral deposits and occurrences listed in a major compilation prepared by Watts, Griffis and McOuat (1991) on behalf of ZCCM. A search service is available to the public or the database can be purchased on disk. Copies of the substantial compilation by Watts, Griffis and McOuat can also be purchased from the ZCCM Operations Centre at Kalulushi. Additionally, ZCCM's Technical Services Department can provide access to their extensive archive of company reports and also permit examination and limited sampling of their enormous drill-core repository.

Mines Development Department

Key responsibilities for the Mines Development Department are the issuance of all prospecting, retention and mining licences, together with the monitoring of mining operations to ensure that development is in line with approved programmes of operations and in accordance with the Mines and Minerals Act. The Department also issues Gemstones Sales Certificates and undertakes reconnaissance surveys, demarcation of plots, placement of beacons and mine pit surveys.

Mines Safety Department

The Department's mission statement is:

“To formulate, monitor and maintain legislation regarding the safe and sustainable exploration and exploitation of mineral resources and the safe manufacture, transportation, use, storage, destruction, exportation and importation of civil explosives for the maximum benefit for the people of Zambia.”

The Department is divided into four technical sections - Mining, Explosives, Machinery and Environment - which variously enforce the relevant legislative and statutory instruments, formulate new legislation and regulations, evaluate all aspects of safety in mining operations, offer technical advice and training, and offer exemptions from the relevant regulations where appropriate.

Copper refinery, Nkana



In line with its stated Mining Policy, the Government of Zambia has enacted new legislation - the Mines and Minerals Act (1995) - which greatly simplifies licensing procedures, places minimum reasonable constraints on prospecting and mining activities, and creates a very favourable investment environment, whilst allowing for international arbitration to be written into development agreements, should this be deemed necessary. A framework for responsible development has also been created through publication of the Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997.

Licensing System

Three types of licence are available to the large-scale operator:

- ◇ **Prospecting Licence:** this confers the right to prospect for any mineral over any size of area for a period of two years renewable.
- ◇ **Retention Licence:** this confers the right to retain an area, subject to the Minister's agreement, over which feasibility studies have been completed but market conditions are unfavourable for development of a deposit at that time. Size of the area may be that covered by a Prospecting Licence or smaller area as redefined by the Licence holder. Duration would be for three years renewable for another single period of three years.
- ◇ **Large Scale Mining Licence:** this confers exclusive rights to carry out mining operations and other acts reasonably incidental thereto in the area for a maximum of 25 years. The area to be held should not exceed the area reasonably required to carry out the proposed mining operations. Applications need to be accompanied by environmental protection plans and by proposals for the employment and training of citizens of Zambia.

Similar rights are available to smaller operators, but on a reduced scale:

- ◇ **Prospecting Permits:** relate to areas of 10km² and have a duration of 2 years non-renewable.
- ◇ **Small Scale Mining Licences:** relate to areas not exceeding 400 hectares and have a duration of 10 years renewable.
- ◇ **Artisans Mining Rights:** give the right to local people to mine on an artisanal basis an area, not exceeding 5 hectares, for a period of 2 years non-renewable.
- ◇ **Gemstone Licences:** holders may carry out mining operations over an area, not exceeding 400 hectares, for a period of not more than 10 years.

Environment Framework

Key steps in establishing a project as laid down by the 1997 regulations are:

- ◇ Preparation of a project brief to the Director of Mines Safety describing the site, proposed activities, and all aspects of potential environmental impact.
- ◇ The Director may request more information or can forward the project brief to the Environmental Council of Zambia recommending one of : rejection; acceptance after submission of a full Environmental Impact Statement; the project be accepted and allowed to proceed immediately.
- ◇ Preparation of an Environmental Impact Statement and submission to the Director of Mines Safety.
- ◇ The Director of Mines Safety submits his recommendations to the Environmental Council which makes the final decision.
- ◇ Environmental Impact Statements, if called for, to be updated annually or within fifteen months of the first statement.
- ◇ Environmental audits of projects to be completed annually.
- ◇ If a developer finds the provisions of any regulation unduly onerous, he may apply to the Minister or Director of Mines Safety for an exemption from that regulation. The exemption may be granted under prescribed conditions.
- ◇ Developers of large scale mining projects to contribute to the Environmental Management Fund for rehabilitation purposes.

Export Procedures

In all cases a Customs and Excise Declaration form has to be completed, usually accompanied by a letter of authorization from the Mines Development Department. Additional procedures have to be followed for different commodities:

- ◇ **Gemstones:** Valuation Certificate required from Government Recognised Valuer.
- ◇ **Precious metals:** provision of a sample for analysis.
- ◇ **Base metals:** a one year letter of authority is issued by the Mines Development Department, rather than for individual shipments.
- ◇ **Rock and soil samples of no commercial value:** the samples to be physically checked before export

Tax Regime and Incentives

Surcharges on mineral production compare very favourably with most countries in terms of royalties and taxes, and a number of financial incentives have been created specifically to encourage investment in the mining industry.

Royalties

A royalty is payable calculated at 2% of the market value of minerals f.o.b. less the cost of smelting, refining and insurance, handling and transport from the mining area to the point of export or delivery within Zambia. Royalty payments may be deferred if the cash operating margin of a holder of a Large Scale Mining Licence falls below zero.

Corporate Tax

Exporters of copper and cobalt are levied 35% of taxable income whereas other mineral and “non-traditional” commodities (i.e. excluding copper and cobalt) attract a levy of 15%. Companies listed on the Lusaka Stock Exchange are levied at 30% of taxable income.

Relief from Income Tax

Any investment in mining, including prospecting, attracts deductions from income tax on the following expenditures:

- ◇ capital expenditure: allowances of 25% on plant, machinery and commercial vehicles; 20% on non-commercial vehicles; 5% on industrial buildings.
- ◇ prospecting expenditure under special circumstances.
- ◇ mining expenditure under special circumstances.
- ◇ mining expenditure on a non-producing mine.
- ◇ mining expenses incurred by a mine of irregular production close to the end of its life.

Relief from Other Surcharges

A holder of a mining right is exempt from customs, excise and VAT duties in respect of all machinery and equipment (including specialized motor vehicles) required for exploration or mining activities.

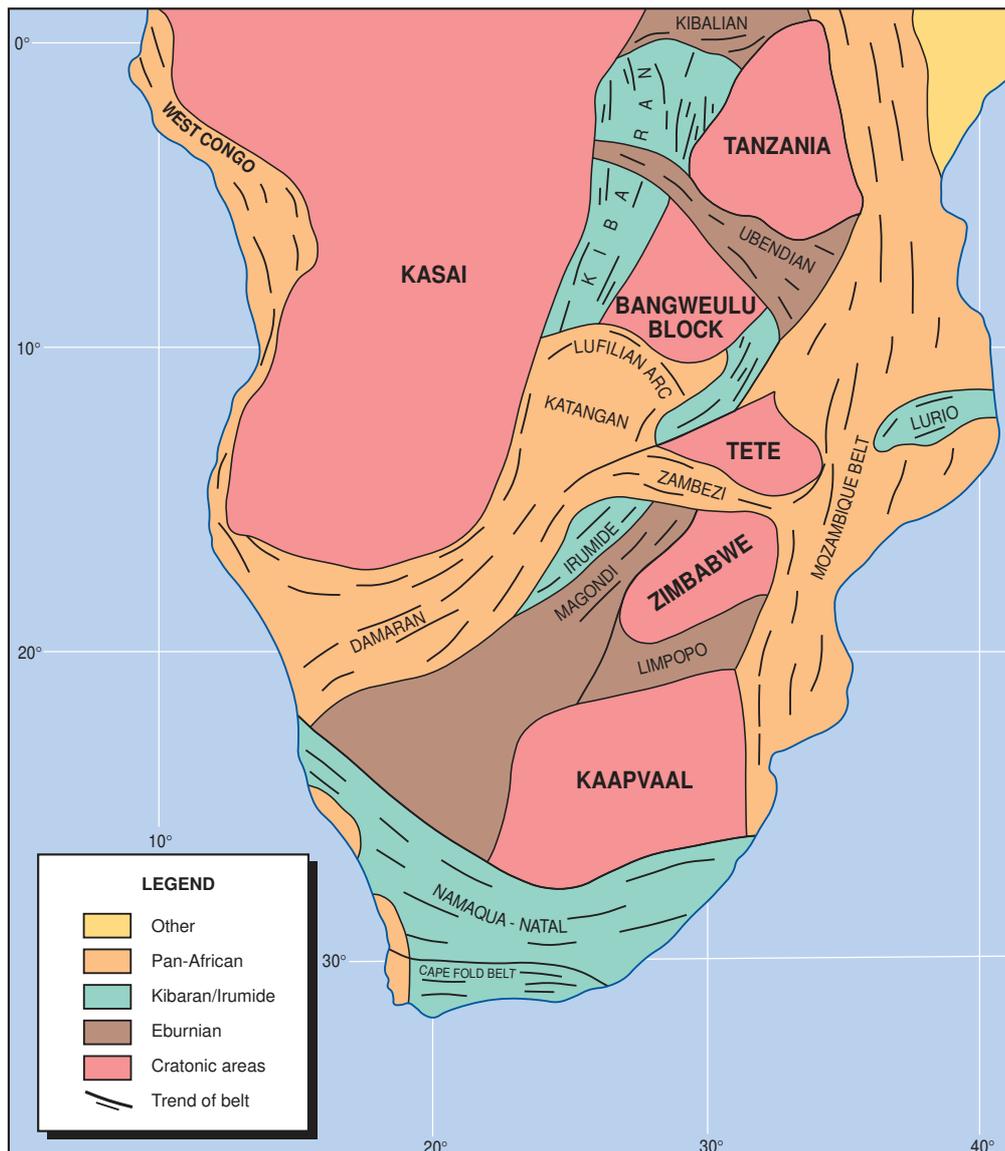
Remission

There are no restrictions in respect of the amount of profits, dividends, or royalties that may be externalized, although a withholding tax of 15% is levied.

Downtown Lusaka - the financial centre of Zambia



Zambia's diverse mineral endowment is entirely a function of the variety of geological terrains and the multiplicity of thermal and tectonic events that have overprinted and shaped these terrains. The resulting geological domains each have specific metallogenic characteristics in terms of known mineral occurrences that can be successfully utilized to direct further exploration. Equally importantly, the understanding of the processes that formed these domains has reached a level at which lateral thinking and conceptual modelling can be used to generate important new exploration targets.



Major cratons and fold belts of central and southern Africa

Geology of Zambia

The complex geology and multiplicity of tectono-thermal events reflect Zambia's somewhat unique position effectively sandwiched between the Kasai, Zimbabwe – Kaapvaal and Tanzania cratons. Differential movements between these stable blocks, together with their buttressing effects, have played an important role in the geological evolution of the country and hence in the genesis of the country's mineral and energy resources.

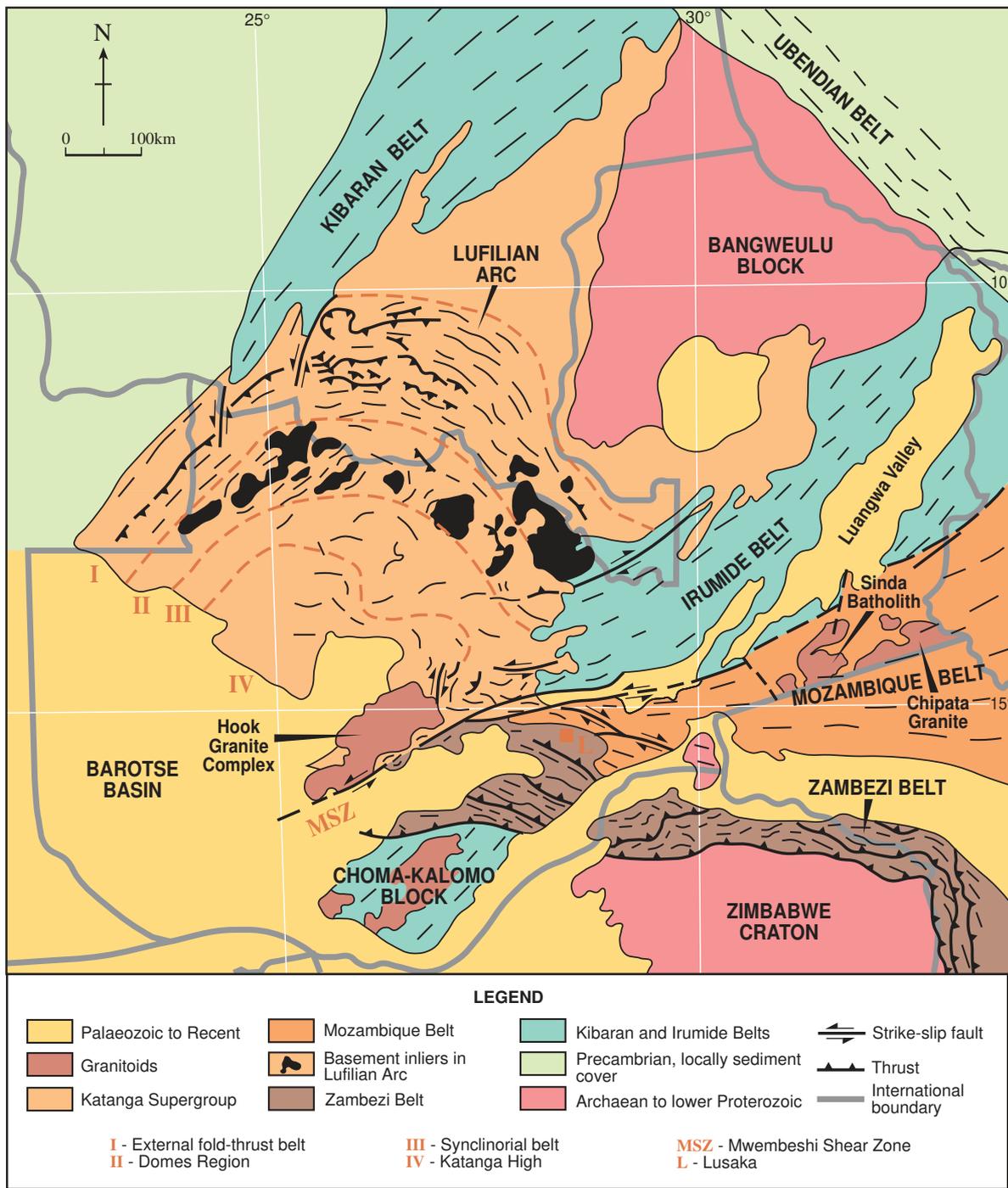
Stratigraphy

The oldest succession of rocks in the country, the **Basement Supergroup**, consists mostly of granitic gneisses and migmatites which are evident throughout eastern, central and southern Zambia, in places in-folded with meta-carbonate, meta-quartzite, and meta-pelite units. The Supergroup rocks are mostly younger than 2050Ma but the Lutembwe River granulite near Chipata has been dated at c.3000Ma. Granite, granitic gneiss, migmatites and amphibolites, believed to belong

mostly to the Basement Supergroup, also outcrop in the structurally elevated Kafue Anticline and "Domes" of the Copperbelt and north-western Zambia.

The overlying meta-sedimentary **Muva Supergroup** generally exhibits a tectonized contact with the Basement sequences. In central and eastern Zambia the sequence of meta-pelites and meta-quartzites is commonly infolded and even

Geological terrains of Zambia



SUPERGROUP	MAJOR GROUP	OROGENY
	Kalahari	
	(Lueti Formation)	
Karoo	Upper Karoo	KAROO RIFTING
	Lower Karoo	
	Kataba	
Katanga	Kundelungu	LUFILIAN OROGENY (D2 & D3) c.690-450Ma
	Mwashia Fm.	LUFILIAN OROGENY (D1) c.850-750Ma
	Mine Series	Lusakan Folding Event c.850Ma Lomamian Orogeny (?) c.950Ma
Muva	Manshya River	IRUMIDE OROGENY c.1350-1100Ma
	Mpanshya	
	Mporokoso	
Basement	Kapemba	UBENDIAN OROGENY c.2000-1800Ma
	Mulungwizi	

Major lithostratigraphic subdivisions and tectono-thermal events in Zambia

imbricated with the Basement rocks, the two sequences being later folded to form the core of the Irumide Belt extending north-eastwards from Kabwe to Mpika, and also forming a major component of the Zambezi Belt south and east of Lusaka. Within the Bangweulu Block of northern Zambia the sedimentary sequence is very different, comprising a lower 5000m thick succession of continental sediments (rudites, arenites, quartzites and argillites) - the Mporokoso Group, overlain by quartzites, hematitic sandstones, mudstones and minor conglomerates of the Kasama Formation which ranges in thickness from c.100m over the Bangweulu Block to 3500m southwards into the Irumide Belt. Sedimentation commenced around 1800Ma and ended c.1250Ma.

The **Katanga Supergroup** overlies the Basement and Muva sequences with marked angular

unconformity and spans an approximate time interval of 1000Ma - 500Ma. The rocks are exposed throughout the Copperbelt and north-western Zambia, partially overlie the southern edge of the Bangweulu Block, and also occur within the Zambezi Belt south and east of Lusaka. The lower part of the almost exclusively sedimentary sequence is the economically important *Mine Series Group* which hosts the bulk of the copper-cobalt mineralization of the Copperbelt. This sequence was deposited in response to a NE-directed marine incursion across a deeply dissected continental landscape, the lowest unit - the Lower Roan Formation - comprising conglomerate and aeolian sandstones succeeded by siliciclastic sediments and finally by argillites, dolostones and arenites. The overlying Upper Roan is a predominantly dolomite-argillite sequence which is succeeded conformably by carbonaceous shales, argillite and minor carbonate rocks of the Mwashia Formation.

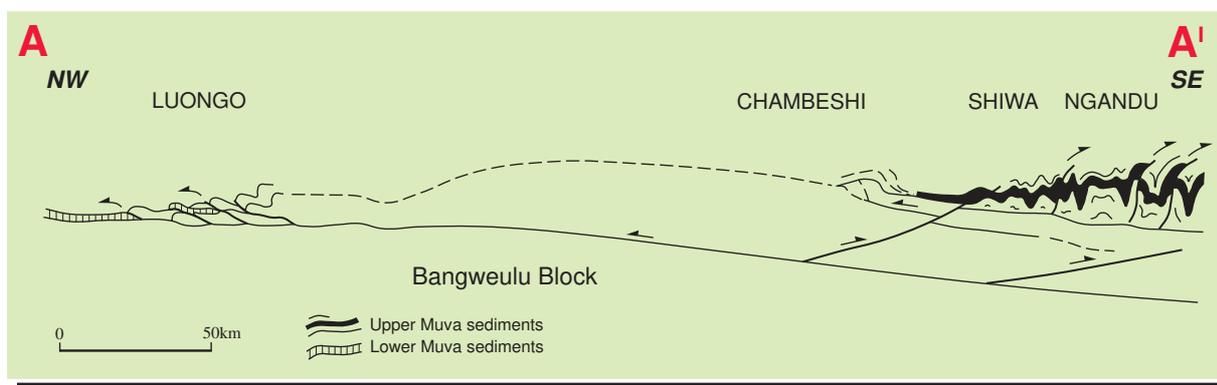
An hiatus of as much as 100 million years was succeeded by a period of glaciation and the deposition of a tillite unit, the "Grand Conglomérat", at the base of the *Kundelungu Group*. This was followed by a thick sequence dominated by dolomitic limestones, shale, a further tillite and a fine shale-dominated unit.

A poorly defined unit, the **Kataba Group** comprising unmetamorphosed marine sandstones and mudstones, has been intersected by drilling beneath basal Karoo rocks and has been broadly dated as Ordovician-Silurian. The extent of the unit is not known.

Rocks of the **Karoo Supergroup** (late Carboniferous to Jurassic) occupy the rift troughs of the

Mid-Zambezi, Luangwa, Luano-Lukusashi and Kafue valleys and also outcrop in western Zambia. The *Lower Karoo Group* comprises a basal conglomerate, tillite and sandstone overlain unconformably by conglomerate, coal, sandstone and carbonaceous siltstones and mudstones (the Gwembe Formation), and finally fine grained lacustrine sediments - the Madumabisa Formation. The unconformably overlying *Upper Karoo* essentially comprises a series of arenaceous continental sediments and overlying mudstones capped by basalts of the Batoka Formation.

In western Zambia and within the Zambezi Valley, the Batoka basalts are unconformably overlain by up to 100m of continental sandstones and mudstones of *Cretaceous* age, and much of western Zambia is covered by aeolian sands and minor epiclastic sediments of Quaternary to Present age comprising the *Kalahari Group*.



Cross-section A of the Irumide Belt in north-eastern Zambia
Daly (1986) in *Geol. Soc. London Spec. Pub.* 19

Tectono-thermal Events

A number of major tectono-thermal events have affected Zambia and have often contributed directly to the accumulation of metals, minerals and even energy resources.

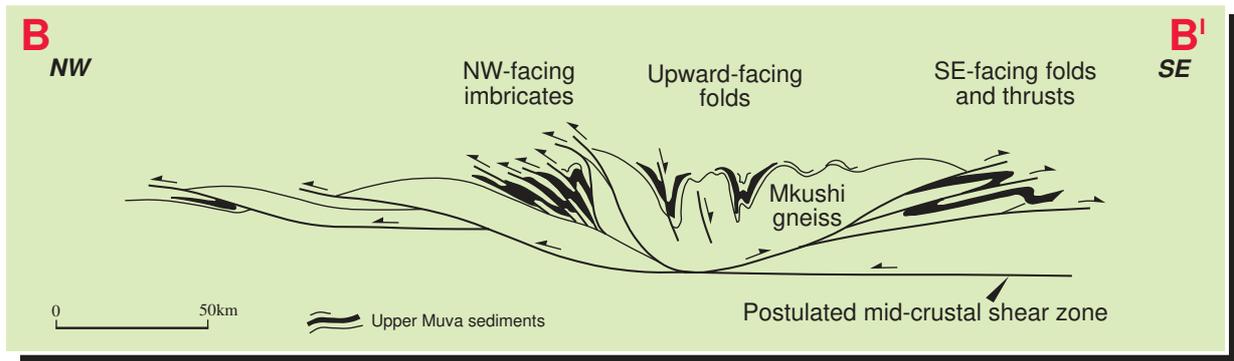
The earliest recognizable event in the region was the **Ubendian Orogeny**, c.2000-1800Ma, which generated the NW-SE-trending fold belt of high-grade metamorphic rocks that demarcates the north-eastern margin of the Bangweulu Block. Within Zambia, however, the only evidence of this fold event is a SE-trending fabric recorded in the Mafinga Hills, although granitic rocks flanking the southern and north-western margins of the Bangweulu Block represent a late Ubendian thermal event.

The next major orogenic event was the **Irumide Orogeny** which resulted in extensive folding and shearing of Basement and Muva rocks in central and eastern Zambia during the period 1350-1100Ma, broadly synchronous with the Kibaran Orogeny of D. R. Congo. The resulting Irumide Belt trends north-east to east-north-east through eastern Zambia and is also evident within the

Choma-Kalomo Block of southern Zambia. Intrusive granitic magmatism accompanied the orogeny in the Choma-Kalomo Block (1345-1200Ma), and charnockitic granites were emplaced in the Basement-Muva terrain east of the Luangwa Valley at about 1100Ma.

The Irumide Belt has been interpreted as a NW-facing, 350km wide foreland fold and thrust belt resulting from NW-SE-directed crustal shortening. In the northern sector of the belt, this contraction was accommodated by the Luongo Fold and Thrust Zone near the southern margin of the Bangweulu Block and by the Shiwa Ngandu Fold. Shortening in the south-western part of the belt was taken up within the Mkushi Gneiss Complex, which has been interpreted as a "pop-up" structure.

The subsequent **Lomamian and Lufilian Orogenies** the latter broadly equivalent to the continent-wide *Pan-African Orogeny*, were represented by a complex series of tectonic and thermal events in the approximate time interval 950 - 450Ma. Two somewhat different domains



Cross-section B of the Irumide Belt in central Zambia
Daly (1986) in Geol. Soc. London Spec. Pub. 19

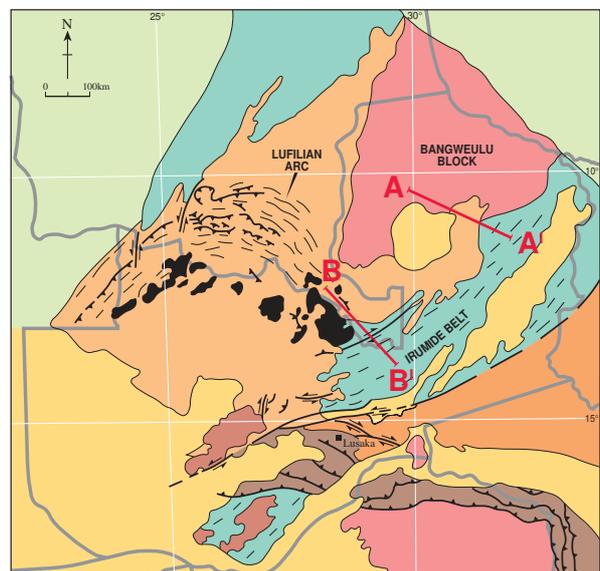
were generated - the Lufilian Arc and the Zambezi-Mozambique Belts, separated by the Mwembeshi Shear Zone. Key events have been recognized in the formation of these still poorly understood terrains:

- Early recumbent folding of the Lower Roan sequence during the c.950Ma Lomamian Orogeny (although there is some debate as to whether this represents a discrete major orogenic event).
- ENE-directed thrusting contributing to the development of the Kafue Anticline and other Domes as Basement culminations. Concomittant WSW-directed thrusting of the Zambezi Belt, the Zambezi and Lufilian Arc terrains being separated by the Mwembeshi Shear Zone, a transform shear forming part of a major inter-cratonic zone of dislocation.
- "Lusakan Folding" event at c.850Ma that accompanied deep burial of the Lower Roan.
- Main phase of NE-directed thrusting, probably c.850-750Ma, with nappe emplacement in the Shaba Province of D. R. Congo and possibly also in the Copperbelt. Syntectonic emplacement of batholithic granites into the Zambezi Belt c.820Ma.
- Strike-slip faulting and late folding c.690-540Ma.

- Emplacement of syn- to post-tectonic granites: Mtuga Granite and Mkushi aplites c.607Ma; Hook Granite Complex 570-530Ma; Sinda Batholith near Petauke at c.490Ma.

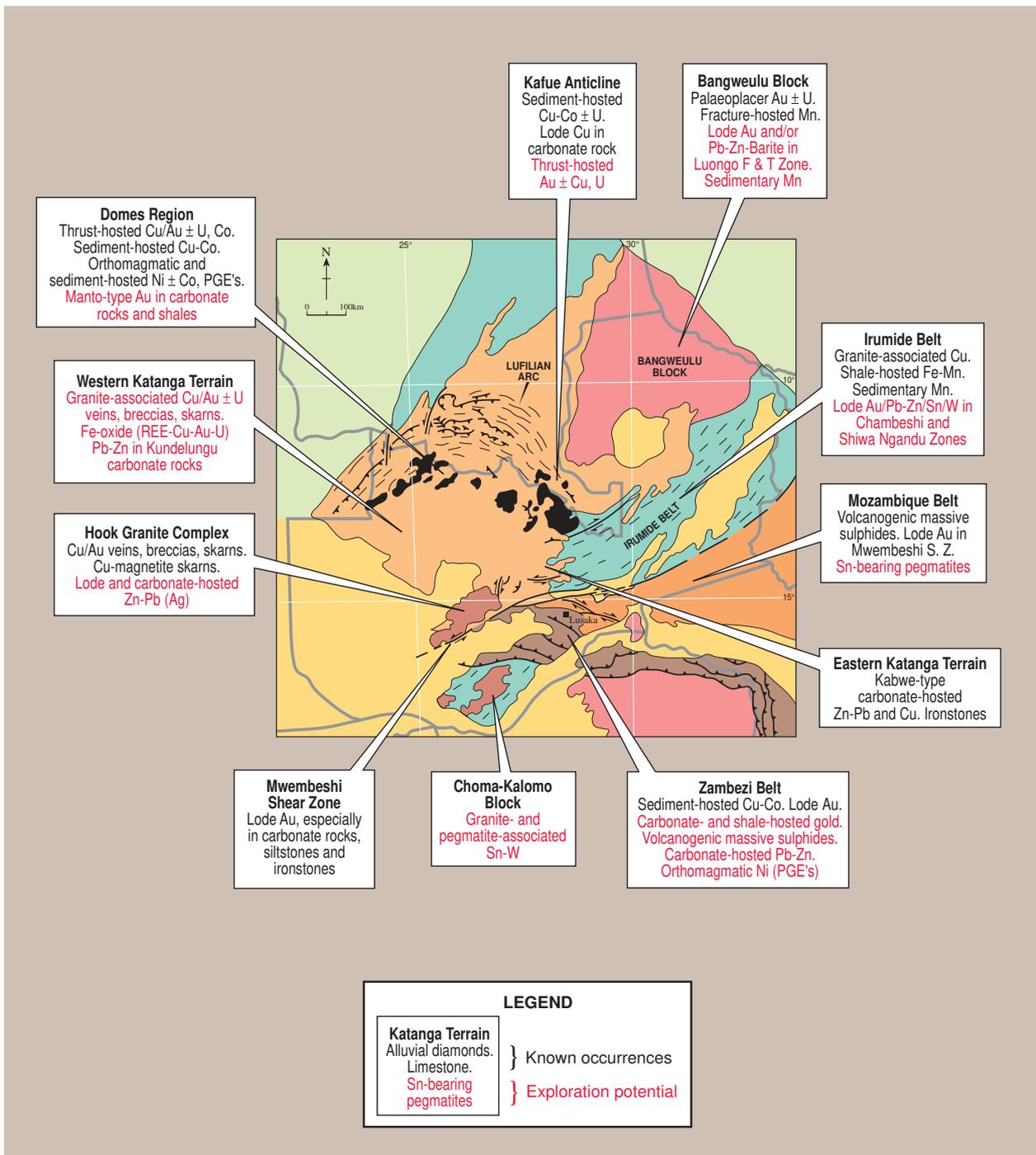
The final tectono-thermal event was the **Karoo Rifting** associated with the break-up of Gondwanaland during the Permian followed by opening of the proto-Indian Ocean in the Jurassic; and a final episode of rifting related to the development of the East African Rift system in late Cretaceous and early Tertiary times. The Permian rifting was accompanied by reactivation of the Mwembeshi Shear Zone. The complex history of rifting in the region accounts for the marked variations in sedimentation within Zambia's rift valleys, culminating in the eruption of the late-Karoo Batoka basalts.

Location of cross-sections A and B



Economic Geology

Zambia's amazingly wide spectrum of mineral resources spans a range of metals, particularly copper-cobalt and gold, gemstones, a variety of industrial minerals and potential energy resources - uranium, coal and hydrocarbons. Ranging in size from world-class operating mines to small prospects, the multiplicity and variety of resources demonstrate clearly the opportunities for further exploration and exploitation.



Metal occurrences and exploration potential in Zambia

Metals

Gold

More than 300 gold occurrences have been recorded but most are only prospects; largest historical producers are Dunrobin (990kg) and Matala (225kg) in the Mumbwa area, Jessie (390kg) in the Rufunsa area, and Sasare (390kg) in eastern Zambia. Dunrobin was re-opened by Reunion Mining in 1997 as an open-pit, heap-leach operation and is producing 50kg gold per month. The majority of the deposits are lode-type bodies associated with the Mwembeshi Shear Zone and related syntectonic intrusions. Significant gold mineralization also occurs, variously with copper and uranium, in major thrust zones near the base of the Katanga succession. Minor palaeo-placer gold has also been reported in the Mporokoso Group in the Bangweulu Block.

Copper and Cobalt

In excess of one billion tonnes of ore (c.2.7% Cu) has been mined from the mines of the Copperbelt and conservative estimates suggest that a further two billion tonnes await exploitation. The copper-cobalt mineralization is stratabound within arenites, shales and carbonate rocks of the lower-Katanga Mine Series Group. Copper resources have also been identified in the thrust zones of

north-western Zambia which represent zones of detachment between Basement and Katanga sequences, and in western and central Zambia where shearing and intrusion emplacement through the lower Katanga succession have generated a considerable number of lode, stockwork, breccia and skarn deposits. Other types of deposit include the disseminated copper mineralization in the granites and aplites of the Mkushi area and copper-bearing stratiform sulphides in the Lusaka area.

Zinc and Lead

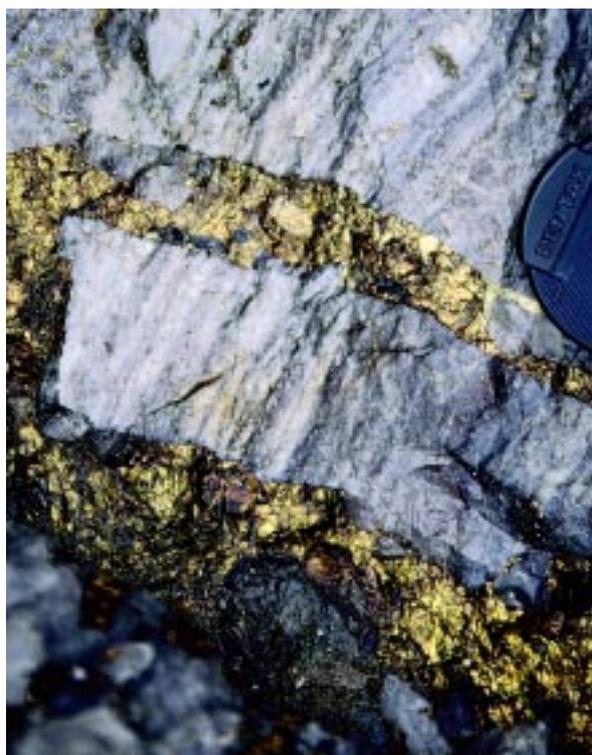
Carbonate-hosted Zn-Pb ore has been mined from the Kabwe deposit in central Zambia where 11Mt of ore averaged close to 25% Zn and 15% Pb. The stratabound mineralization comprises massive, breccia and replacement sulphides within carbonate rocks marking the transition from Lower Roan to Upper Roan. Similar styles of mineralization at the same stratigraphic position, some copper-rich, are evident throughout the Kabwe area and northwards to Kapiri Mposhi. Carbonate-hosted Pb-Zn has also been recorded in Lower Roan limestones in the Copperbelt and in lower Kundelungu rocks in western Zambia. Stratabound, probably exhalative, Cu-Zn-Pb deposits occur in Basement and Muva sequences of south-eastern Zambia.

Iron

Substantial resources of iron have been identified, occurring primarily as sedimentary ironstones in the lower-Katanga Mine Series successions of central and western Zambia. Total resources of more than 900Mt with an iron content $\geq 50\%$ have been provisionally estimated, with some individual deposits up to 200Mt in size. Small, high-grade skarn and replacement deposits are associated with Pan-African felsic and mafic intrusions that have penetrated the lower Katanga succession in western Zambia, particularly around the Hook Granite Complex, but such deposits have rarely been fully evaluated.

Manganese

Occurrences are numerous but mostly small, occurring as tabular, probably stratiform exhalative, deposits within Basement and Muva sequences, and as supergene enrichments, either capping low-grade sedimentary accumulations or concentrated within sub-vertical fractures of limited vertical extent.



Vein and disseminated chalcopyrite in quartzite, Kansanshi Mine

Nickel and Platinum Group Elements

Orthomagmatic nickel occurrences are known in the Basement sequences east and south of Lusaka and include one near Mpala Gorge which may be a faulted remnant of Zimbabwe's Great Dyke. Sediment-hosted nickel deposits in Mwashia and Mine Series rocks of north-western Zambia are associated with gabbroic intrusions and often show evidence of hydrothermal enrichment. Minor platinum group elements are produced as a by-product of copper-refining on the major Copperbelt mines.

Tin (-tantalum)

Small quantities of cassiterite have been recovered from complex quartz-muscovite-feldspar pegmatites of probable Irumide age in the Choma-Kalomo area in southern Zambia. Columbite-tantalite has also been extracted in very minor quantities.

Tungsten: Wolframite has been noted in pegmatite of the Choma Tin Belt, and lode-type scheelite-bismuth mineralization is associated with a two-mica granite of early Lufilian age at Unda Unda, 80km east of Lusaka.

Gemstones

Diamonds

Alluvial diamonds have been reported throughout much of northern, north-eastern and western Zambia and in many places are accompanied by indicator minerals. Kimberlite and lamproite intrusions occur within and near to the western flank of the Luangwa River and also in southern Zambia but no diamond-bearing diatremes have yet been discovered.

Emeralds

Zambia produces about 20% of the world's emeralds and they are much sought after due to their deep green colour. The gemstones are recovered exclusively from the Ndola Rural area of the southern Copperbelt where they are hosted by Muva-age talc schists intruded by tourmaline- and phlogopite-bearing pegmatite bodies.

Other Gemstones

Aquamarine and tourmaline are mined in the Lundazi and Nyimba areas of eastern Zambia where they occur in pegmatites that were broadly



Emerald mining in the Ndola Rural area

synchronous with the c.486Ma Sinda batholith. Amethyst is currently being mined in the Mwakambwiko Hills near Lake Kariba where it occurs in veins and stockworks generated during late-Karoo or post-Karoo tectonism.

Industrial Minerals

Zambia boasts a wide range of industrial minerals capable of underpinning the anticipated growth in the mining, manufacturing and agricultural sectors.

Feldspar

In recent years the demand for feldspar has been from local ceramic producers and also from Kapiri Glass Products Ltd., based at Kapiri Mposhi. Production has mostly come from two pegmatite deposits - a 4m thick body of alkali-feldspar-pegmatite containing minor muscovite and quartz near Siavonga and a 5m thick, partially kaolinized, pegmatite at Shipingu, near Kapiri Mposhi.

Silica Sand

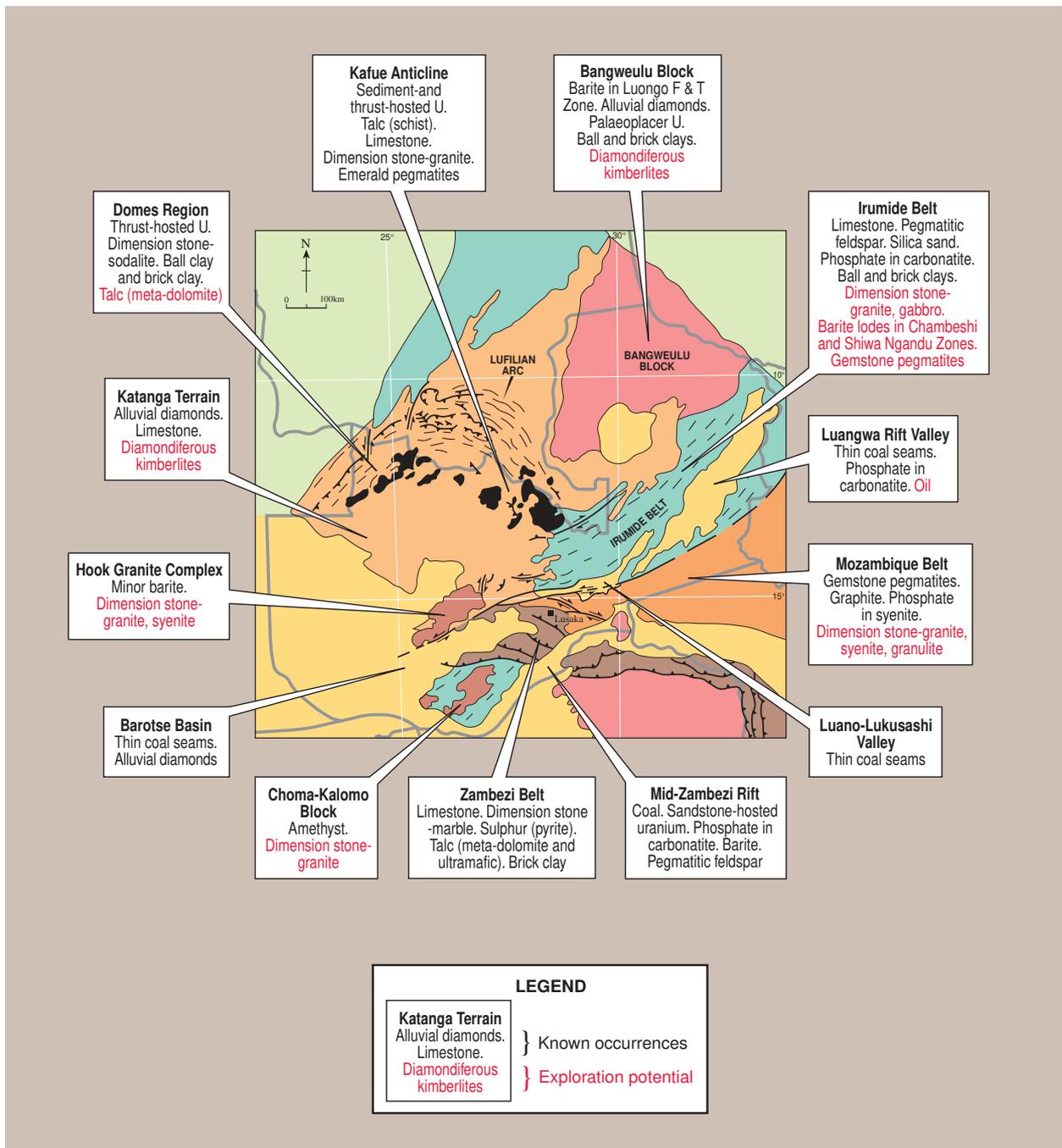
Sands of various specifications occur throughout Zambia but the only occurrence to have been exploited is the deposit of high-quality glass sand at Kapiri Mposhi which was the basis for glass manufacture by Kapiri Glass Products Ltd., until the recent closure of the company. The sand is an unconsolidated eluvial deposit derived by the weathering of quartzites of the Muva Supergroup.

Talc

The current small demand for talc within Zambia is met partly by local production but good quality white talc for the pharmaceutical industry is imported. Deposits in Zambia have not been extensively evaluated but range from talc derived during metamorphism of dolomites near Lusaka to a hydrothermally altered mafic to ultramafic intrusion, also in the Lusaka area, and talc schist occurring in the footwall of copper mineralization near Ndola.

Barite

A variety of deposit types are known, the most significant being the vein and replacement bodies hosted by red shales and marls of the Mporokoso Group within the Luongo Fold and Thrust Zone of the Bangweulu Block. Vein type mineralization also occurs within the Irumide Belt and rare occurrences have been reported associated with the Hook Granite Complex and also hosted by Karoo sediments within the Mid-Zambezi Rift.



Known and potential occurrences of industrial minerals, gemstones, and energy resources in Zambia

Phosphate

Apatite, the most important potential source of phosphate, occurs in significant concentrations in syenitic intrusions and carbonatite bodies. Significant syenite-hosted deposits include the apatite-quartz bodies of Chilembwe, near Petauke in eastern Zambia, and breccia and pegmatite bodies in syenite intrusions near the north-eastern margin of the Hook Granite Complex. Carbonatites in Zambia are mostly related to Karoo-age rifts and very substantial low-grade apatite deposits have been noted in two of these - Kaluwe in the Rufunsa-Feira area and Nkombwa Hill at the northern end of the Luangwa Rift.

Limestone

Carbonate rocks are a common component of the Katanga Supergroup and also occur within the Basement Supergroup. Limestone and dolomite are abundant in the area around Lusaka and these and other deposits in the Southern, North Western, Northern and Luapula Provinces have been identified as being suitable for agricultural use. High-purity, low-MgO limestones are currently being exploited from the lower Katanga succession near Ndola on the Copperbelt.

Dimension Stone

A very wide variety of potential dimension stones are present in Zambia but they have rarely been evaluated fully as to their suitability. They are mostly of igneous origin and include gabbroic and doleritic rocks of the Basement and Muva terrains in eastern and central Zambia, granites of the Mpika area in north-eastern Zambia, and the

Mining of marble as dimension stone near Lusaka



extensive granitic and charnockitic rocks of the Chipata area in eastern Zambia. A very attractive pink and green, sodalite-rich, syenite occurrence has been exploited near Solwezi, and grey and white marbles are currently being mined for export on the western outskirts of Lusaka.

Clays

A considerable number of deposits of ball clay and brick clay are known but they have rarely been subjected to bench tests and firing tests. Large deposits of ball clay occur at Solwezi and at Kasanka, 60km north of Serenje, and kaolinite-rich clays have been recorded at Masuku in southern Zambia and near Shiwa Ngandu. Brick clays are exploited at an artisanal level throughout Zambia.

Other Industrial Minerals

These include graphite, gypsum, kyanite and asbestos, with moderate resources of graphite having been identified at a number of occurrences in the high-grade metamorphic terrains of eastern Zambia. A major fluorite deposit has been defined at Sianyolo in the Mid-Zambezi Valley.

Energy Resources

Uranium

Three important types of uranium occurrence have been recorded in Zambia: in Karoo sandstones; associated with the copper mineralization of the Copperbelt; and structurally controlled mineralization in the Basement domes of north-western Zambia. The Karoo occurrences comprise presumed detrital concentrations, up to 1000ppm U, in the Escarpment Grit Formation, and fracture-controlled autunite-torbernite-pitchblende in the same arenitic units of the Mid-Zambezi Rift. Uranium occurrences associated with the Copperbelt mineralization variously consist of pitchblende, coffinite, and brannerite, or meta-torbernite and other secondary minerals concentrated near the base of the copper mineralization or within the footwall rocks immediately underlying the ore bodies. A total of 120,000kg of U_3O_8 was

produced from Nkana Mine in the period 1957-1959. Uranium mineralization in the Basement domes is variously accompanied by copper and gold and almost invariably occurs in kyanite-bearing schists which are now known to represent major thrust zones developed along the Basement-Katanga contact and propagated up-sequence northwards and eastwards. The Lumwana Malundwe deposit in the Mwombezhi Dome, as an example, contains some 4000t of U_3O_8 , in addition to at least 19.5Mt copper ore at 1.4% Cu and minor gold.

Coal

Zambia possesses substantial coal resources and has been producing coal continuously since 1967. The bulk of the coal has come from the Maamba coal mine, an open-cast operation in the southern part of the country near Lake Kariba. The Maamba deposit and other known coal occurrences are confined exclusively to the lower-Karoo Gwembe Formation, within the series of fault-controlled basins that comprise the Mid-Zambezi Rift Valley. The Maamba deposit occurs within the Kazinze Basin but coal seams have also been discovered in the adjacent basins. Thin coal seams and carbonaceous shales have also been identified in the lower Karoo (Gwembe Formation) of the Luangwa and Luano-Lukusashi Valleys and in the eastern part of the Barotse Basin in western Zambia.

Hydrocarbon

Two exploration programmes by Mobil and Placid Oil between 1986 and 1991 failed to discover oil but, of two boreholes within the Luangwa Rift Valley, one was terminated before intersecting the most favourable reservoir horizons. Considerable thicknesses of littoral and continental sediments underlain by carbonaceous rocks with oil-generating potential are present

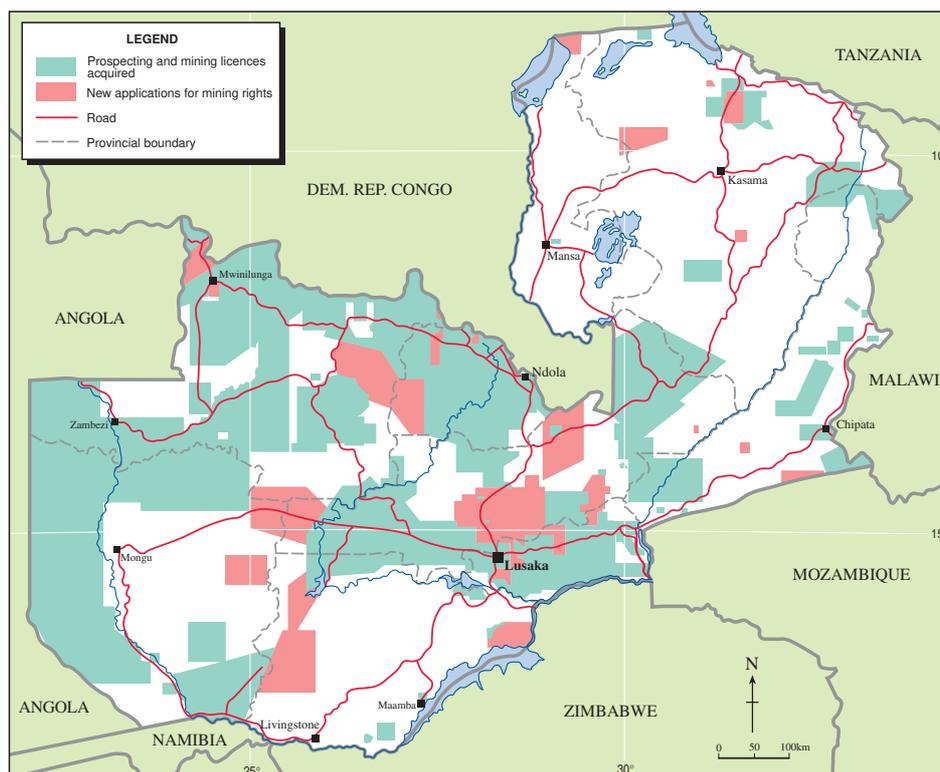
within the Karoo-age graben of both the Luangwa and Mid-Zambezi Valleys.

Recent Mineral Exploration and Development

Exploration

The mining legislation enacted in 1995 and the favourable investment environment have created a high level of interest both in existing mining operations and in the exploration potential. Currently approximately 50% of the country is covered by existing Prospecting Licences and by applications for licences. Exploration in many cases is focused on areas where minor past production or prospects indicate some potential, but a significant level of activity is also being devoted to greenfields exploration in areas with little or no history of discoveries. Companies active in the mid-1990's include Anglo American, Avmin, Billiton, Caledonia Mining, Cyprus Amax, Equinox Resources, Falconbridge, Phelps Dodge, RTZ Mining and Zamgold.

Ground tenure in Zambia in mid-1998



RECENT DISCOVERIES

Billiton: “At Kabwe, a programme of core and RC drilling has outlined disseminated zinc-lead mineralization over 1000m strike length, with open pit potential”. (*African Mining*, v. 3, Jan/ Feb. 1998)

Caledonia Mining Corp. and Cyprus Amax Zambia Corp. : sixteen RC holes on the Kadola licence area, 85km south of Luanshya “were drilled on significant mobile metal ion (MMI) geochemical anomalies generated by Cyprus Amax, and included assays of 0.90% Cu over 9m and 1.04% Cu over 14m”. (*Mining Journal*, 30 Jan. 1998)

“BHP has exercised its option on Caledonia Mining Western Ltd’s Mulonga Plains property... after a joint reconnaissance sampling programme... in 1997... for diamond indicator minerals...”. (*Mining Journal*, 13 March 1998)

“Equinox Resources NL reports that drilling on the Zambezi joint venture with Anglo American intersected low-grade copper and cobalt mineralization at Kabompo...”. (*Mining Journal*, 1 May 1998)

Additionally, in 1998 a resource of 100 million tonnes of ore averaging 1.9% Cu has been reported by Cyprus Amax for the Kansanshi deposit in north-western Zambia.

Development

Although still to be completed, privatization of ZCCM has led to a flurry of interest in the mining sector and an encouraging level of physical investment. Important developments include:

- ◇ purchase of the Luanshya/Baluba mining and metallurgical complex (now known as Roan Antelope Mining Corporation Group) by the Binani Group for US\$35 million, with a commitment to further capital expenditure of US\$69 million.
- ◇ sale of Chambishi Mine to the Non-Ferrous Metal Industry of China for US\$20 million.
- ◇ a feasibility study of Konkola Deep by Anglo American-controlled Zambian Copper Investments, a project which will ultimately require an investment of around US\$750 million.
- ◇ sale of Kansanshi to Cyprus Amax subject to the results of a phased exploration programme which would ultimately necessitate a total investment of US\$48 million by Cyprus Amax prior to securing project financing.
- ◇ commitment by Avmin (formerly Anglovaal) to US\$12.5 million of exploration expenditure, mostly directed to evaluation of Konkola North.
- ◇ construction of a US\$30 million-plant at Bwana Mkubwa by First Quantum Minerals for re-treatment of copper oxide tailings.
- ◇ sale of Chibuluma Mine to Metorex Pty. for US\$17.5 million and a commitment to US\$34 million for the development of Chibuluma South.
- ◇ purchase of ZCCM’s Power Division by the Copperbelt Consortium – two UK-based power companies, National Grid and Midlands Power, and a team of ZCCM managers.

Another exciting development has been the opening up of the old Dunrobin goldmine by Reunion Mining as an open pit heap leach operation which poured its first gold late in 1997. Production of 50kg of gold per month for at least three years is anticipated and the potential for proving further ore in the area is reported to be high.

The complex geological evolution of Zambia, together with the abundance and diversity of mineral deposits and other natural resource deposits, 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 conceptual models.

Gold

The great majority of gold deposits in Zambia are mesothermal lode deposits (veins and more dispersed occurrences in brittle and brittle-ductile shear zones). Most are localized within structures related to the Mwembeshi Shear Zone in central Zambia. This major inter-cratonic shear zone was undoubtedly trans-crustal in vertical extent and clearly acted as an important conduit for fluid flow and magma emplacement. It also exhibits a history of multiple reactivation throughout the Lomamian and Lufilian (Pan-African) Orogenies (c.950-450Ma) and was even reactivated during Karoo rifting. Consequently there was considerable potential for the genesis of substantial lode deposits, particularly where dilational zones (releasing bends, dilational jogs, etc.) facilitated maximum fluid flow, and where the shear zone traversed the carbonate rocks, carbonaceous siltstones and ironstones of the lower Katanga sequence which would have proved highly efficient chemical traps for hydrothermal gold. Significant skarn and breccia deposits were probably developed adjacent to syntectonic granitoid and even syenitic intrusions associated with the shear zone, although to date only relatively small occurrences have been identified in the Mumbwa area around the Hook Granite Complex and satellitic intrusions. A similar prospectivity can be assigned to the poorly-known Kapiri Mposhi - Kipushi Shear Zone and adjacent NNE-trending zones of deformation.

In eastern Zambia, key targets related to the Mwembeshi Shear Zone include areas where it traverses the restricted occurrences of volcanosedimentary rocks (eg. Sasare area) and also the offset zones related to the West Mvuvye and Chindeni Dislocations, the former appearing to have been a focus for fluid flow (and wallrock

alteration) and the latter as it also traverses mafic volcanic rocks.

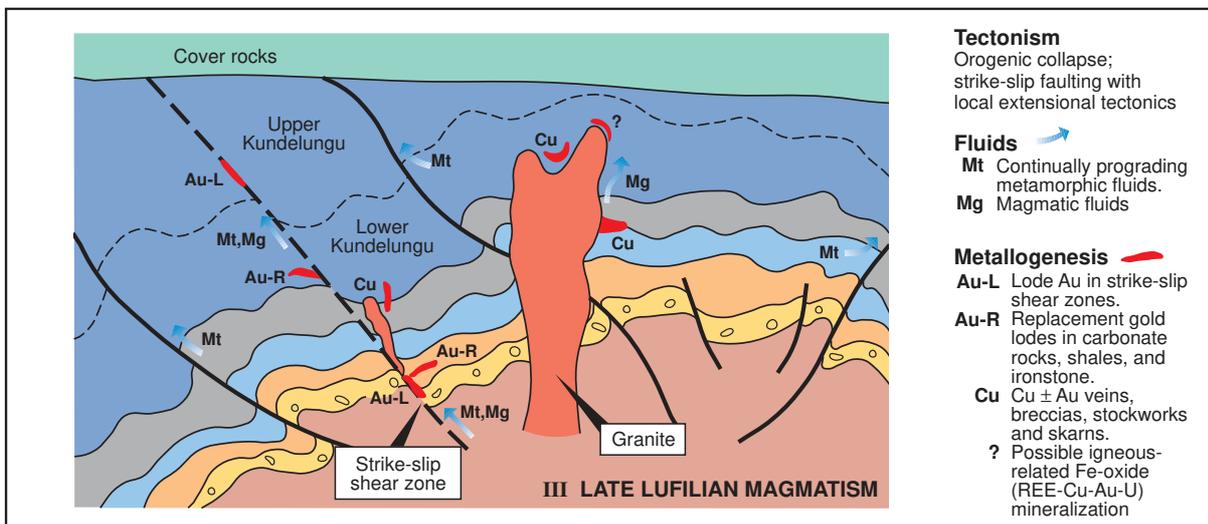
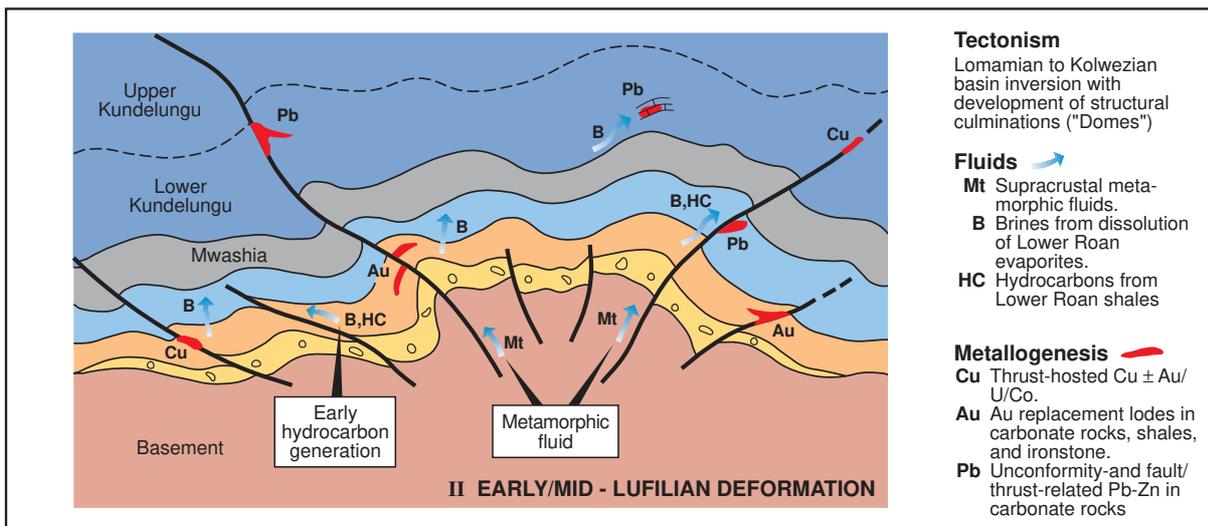
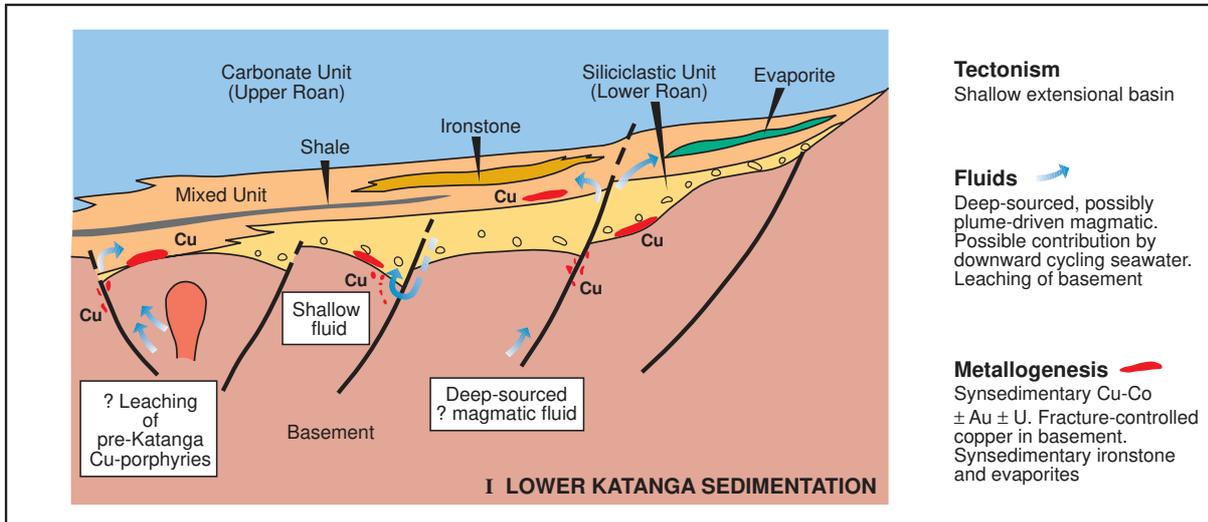
Within the Zambezi Belt south of the Mwembeshi Shear Zone, thrusting and faulting of the complex Basement-Muva-Katanga terrain was accompanied by widespread de-watering, resulting in the genesis of a considerable number of gold prospects, screening of which could pinpoint optimum potential in terms of host structure and country rocks. Similar and probably more substantial fluid flow occurred within the early Lufilian thrust zones of the Domes Region of north-western Zambia to generate complex copper ± gold ± uranium lodes within the lower Katanga sequences and these represent important exploration targets.

In north-eastern Zambia a similar lode-gold potential, not yet investigated, exists within the Luongo Fold and Thrust Zone, the Chambeshi Fold and Thrust Zone, and the Shiwa Ngandu Fold Zone, where leaching of Basement rocks and de-watering, quite possibly on a massive scale during the Irumide-age crustal shortening, could have created conditions favourable for gold metallogenesis. The minor occurrences of palaeoplacer gold within the lower Mporokoso Group littoral sediments of the Bangweulu Block have some similarities to Witwatersrand-type mineralization and merit a basin-wide evaluation.

Copper

Combined reserves and resources of copper-cobalt ore in operating mines of the Copperbelt exceed two billion tonnes and these have mostly been delineated for exploitation after privatization of the industry has been completed. Somewhat similar styles of copper mineralization, variously containing gold, uranium and cobalt, are evident in the Domes Region to the west of the Copperbelt and are attractive exploration targets. Recognition that a number of these deposits are hosted by thrust zones, however, offers greater opportunities for locating deposits at higher elevations within the Katanga sequence than normally anticipated. Precious metal enrichment is also more probable in such zones, and manto-type copper-gold deposits may be developed in adjacent carbonate and shale units. Recognition of thrust-hosted copper mineralization also encourages critical evaluation of the established synsedimentary or syndiagenetic model

for the Copperbelt mineralization in the search for new deposits. Widespread scapolitization of the Katanga sequence in the Domes Region attests to another phase of hydrothermal activity, involving NaCl-brines probably derived by dissolution of evaporites, and the occurrence of copper enrichment (0.8%) in scapolite-schists in the Mujimbeji prospects of the Kabompo Dome indicates yet another potential type of exploration target.



Metallogeneses during early Katanga sedimentation and ensuing Lufilian Orogeny

Vein, breccia and skarn deposits of copper are likely to be developed in any area where the copper-rich lower Katanga succession has been overprinted by faulting or intruded by felsic to mafic bodies, features particularly evident in central and western Zambia. The regional coincidence of evaporites (in the Lower Roan), granitic intrusions, widespread scapolitic alteration, and Cu (Fe)-Co-Au-U mineralization also offer the intriguing possibility for the occurrence of deposits belonging to the enigmatic Fe-oxide (REE-Cu-Au-U) spectrum of deposit-types which includes, amongst many others, Olympic Dam. The granitic association of copper in the Irumide Belt near Mkushi also merits a careful re-evaluation of the genesis and potential of this style of mineralization. Copper-bearing massive sulphide deposits of possible exhalative origin discovered in the Lusaka area and south-eastern Zambia point to additional targets for exploration.

Other Base Metals and Rare Metals

Zinc and lead deposits discovered to date are hosted entirely by carbonate rocks occurring stratigraphically at the Lower Roan - Upper Roan transition. Considerable potential remains in the Kabwe area, and the Katanga-age carbonate sequences northwest of Mumbwa offer a similar potential. The migration of NaCl-rich brines, indicated by the distribution of scapolite in north-western Zambia, could have led to extensive mobilization of Pb and Zn and the subsequent genesis of vein and replacement deposits in lower-Katanga carbonate rocks and even in overlying Kundelungu carbonate units. The common occurrence of vein and replacement deposits of barite within the early Proterozoic sequences of the Bangweulu Block, where caught up in the Luongo Fold and Thrust Zone, also suggest the activity of NaCl-enriched brines and thus imply that conditions here too may have been favourable for the transport and precipitation of Pb and Zn.

Substantial resources of **iron** have been identified, mostly in lower Katanga successions, and the requirement here is for thorough evaluation of known deposits within the context of potential demand from burgeoning Zambian industrial and manufacturing sectors and a wider demand throughout central Africa.

Manganese occurrences also are known but there is potential for the discovery of further supergene-enriched deposits throughout the Muva terrains of northern Zambia.

No major layered intrusions have been identified in Zambia but the most likely hosts for orthomagmatic **nickel** deposits are gabbroic intrusions south and east of Lusaka and the possible faulted extensions of the Great Dyke near Mpala Gorge in the southern part of the country. Some of the sediment-hosted occurrences of metal associated with gabbroic bodies in north-western Zambia also have modest potential.

The **tin (-tantalum)** potential lies in a thorough re-evaluation of the Choma Tin Belt in southern Zambia and in detailed prospecting of the pegmatitic areas of eastern Zambia. The Hook Granite Complex and granitic bodies intruding the Irumide Belt merit some attention for **tin** and/or **tungsten** mineralization and the unusual scheelite-bismuth mineralization of the Unda Unda area, 80km east of Lusaka, would be a priority for tungsten exploration. Syntectonic and post-tectonic granitic magmatism associated with the Irumide Orogeny in north-eastern Zambia may have led to tin and tungsten enrichment in the Chambeshi Fold and Thrust Zone and Shiwa Ngandu Fold Zone.

Gemstones

Diamonds

The occurrence of diamonds and indicator minerals in Zambia highlights the considerable exploration potential. The most favourable terrains are the stable cratonic Bangweulu Block and possibly the Kabompo area of western Zambia where alluvial diamonds are particularly abundant. The rift-related kimberlites and associated rocks of eastern Zambia have limited potential as they were probably derived from thermally eroded, and hence diamond-depleted, mantle.

Emeralds

Systematic exploration of the Ndola Rural area utilizing a combination of radiometric surveys and soil geochemistry, supported by detailed mapping, offers considerable potential for the discovery of additional deposits of the high-quality gemstones.



Amethyst crystals

Other Gemstones

Pegmatite bodies of Lufilian (Pan-African) age in eastern Zambia are numerous and further discoveries of aquamarine and tourmaline are likely. Amethyst is relatively common in southern Zambia near Lake Kariba and exploration should focus on late-Karoo and post-Karoo fault zones.

Industrial Minerals

Zambia is favoured with considerable resources of **feldspar** (Pan-African pegmatite bodies), **silica sand** (Muva-age quartzites), **limestone** (mostly lower Katanga), and a variety of rock types potentially suitable for **dimension stone**. Numerous occurrences of **ball clay** and **brick clay** are evident throughout the country but the quality of the clays has rarely been thoroughly investigated. Good quality **talc** has yet to be discovered but the focus of interest would be on hydrothermally altered ultramafic rocks and on metamorphosed dolomites in the Lusaka and Copperbelt areas. Major targets for **barite** exploration would be vein and replacement deposits in the Luongo Fold and Thrust Belt of the Bangweulu Block. Any search for **phosphate** (apatite) would necessitate re-evaluation of the carbonatite-hosted deposits associated with the Karoo-age rifts of southern, central and eastern Zambia. Medium- to high-grade **graphite** deposits are confined to the high-grade metamorphic terrains of eastern Zambia. The fluorite deposit at Sianyolo awaits exploitation and other occurrences associated with Karoo-age rifts have been reported.

Uranium

The greatest potential for uranium appears to be vein and disseminated mineralization hosted by Lower Roan and Upper Roan sequences and most commonly occurring within the footwall rocks immediately underlying some of the copper ore bodies of the Copperbelt and Domes Region. It also shows significant enrichment in the thrust-hosted copper (\pm gold) mineralization of the Domes Region. Calcrete deposits within the basal sandstones of the Kalahari sequence in western Zambia may be analogous to the calcrete deposits of Namibia and thus merit investigation, as do the occurrences in the Karoo sediments of the Siavonga area in the Mid-Zambezi Valley.

Coal

Additional coal resources are most likely to be found in the fault-bounded Karoo basins of the Mid-Zambezi Rift, particularly in the Mulungwa Coalfield, the area between the Mulungwa and Siankondobo Coalfields, and in the Siambabala area. Some limited potential also exists in the Luangwa and Luano Valleys.

Coalbed Methane

The potential for coalbed methane in the Lower Karoo coals and carbonaceous shales has yet to be investigated. However, indications of substantial resources of methane in Zimbabwe's Hwange Coalfield in the southern part of the Mid-Karoo graben suggest that this possibility merits thorough evaluation.

Hydrocarbons

The petroleum potential of Zambia can be considered unexplored. The Luangwa and Mid-Zambezi grabens have a favourable history of lower-Karoo hydrocarbon generation and upper-Karoo development of structural traps during rifting. Potential reservoir units occur in the lower-Karoo Luwumbu Formation and upper-Karoo Escarpment Grit in the Luangwa graben and in the Siankondobo and Gwembe Formations of the lower Karoo in the Mid-Zambezi graben.

The Government actively supports, facilitates, and rewards new companies in all sectors of enterprise and this support is equally available to indigenous and foreign-based companies without any discrimination whatsoever against offshore companies. Large and small enterprises are equally welcome. The 1993 Investment Act guarantees foreign investment against compulsory acquisition or nationalization without compensation.

Time-wasting procedures that may confront foreign investors elsewhere have been eliminated in Zambia and legal requirements have been reduced to an absolute minimum. Streamlined processing of paperwork and rapid decisions, guided by the Investment Centre, greatly facilitate all aspects of importation of equipment and export of products.

Investment Centre

Zambia's Investment Centre, located in central Lusaka, was set up under the Government's "Open Door" policy to encourage and support investment in the country by foreign nationals. Tailored fast-track services include:

- ◇ Providing information for the planning stages of a project and organizing exploratory visits to Zambia.
- ◇ Assistance in evaluating projects, preparing proposal documents and obtaining approvals.
- ◇ Formation of local and foreign companies and establishment of joint ventures with indigenous Zambian companies.
- ◇ Sourcing of short-term and long-term equity and loan finance.
- ◇ Company secretarial services and staff recruitment.
- ◇ Feasibility and investment studies to ascertain the technical, commercial and economic viability of projects.

Foreign Exchange System

The economy has been completely liberalized and thus exchange rates are determined entirely by the market forces of supply and demand for foreign currency. There are no exchange controls whatsoever, in line with the absence of restrictions on externalizing profits, dividends or royalties.

Banking Sector

The Central Bank (Bank of Zambia) is responsible for executing and implementing the Government's monetary policy and licensing of commercial banks. The bank is currently pursuing, successfully, a "tight" policy characterized by curtailed money supply in order to reduce both inflation rates and bank lending rates.

Commercial banking is provided by local and international banks which offer a wide range of financial sources. Major international banks include Barclays Bank, Citi Bank, Standard Chartered Bank and Stanbic Bank; the larger local banks include Zambia National Commercial Bank, Finance Bank and Indo-Zambia Bank.

Sources of Financing

Zambia is a member of a number of international and regional organizations through which private-sector companies can seek support for development of new projects. Medium-term funding is available from the European Investment Bank, the Commonwealth Development Corporation (with the Zambia Venture Capital Fund), the Zambia Development Programme (World Bank) and Japanese Grant Aid. Longer term investment can be sought from the International Finance Corporation (World Bank) and the Commonwealth Africa Investment Fund.

Company Registration

Company registration is undertaken through the Registrar of Companies at the Ministry of Commerce, Trade and Industry. The law requires that foreign investors wishing to conduct business in Zambia should apply for and obtain an Investment Certificate from the Zambia Investment Centre. The Centre has a legal department to help such investors register their companies, within three days, and the Centre's Business and Investor Relations department will help investors obtain work permits for any expatriate staff. The Immigration Department meets twice a week to consider applications for work permits, and the Investment Centre has senior liaison officers at the Department to ease the issuance of such permits.

Business and Professional Organizations

The strengthening and expansion of Zambia's economy has seen a growth in the number of business and professional organizations in the country. Chief amongst these are:

- The Zambia Association of Chambers of Commerce and Industry (ZACCI)
- The Zambia Association of Manufacturers (ZAM)
- The Economic Association of Zambia (EAZ)
- The Zambia Institute of Certified Accountants (ZICA)
- The Geological Society of Zambia

The Zambia Association of Manufacturers in particular represents a large number of companies that can offer a range of supporting services to the mining and minerals industry, thus permitting incoming companies to operate on an efficient and low-cost basis.

Due to the monolithic nature of the mining industry in the past (predominantly copper), no Chamber of Mines has been established but, with the growing involvement of private mining companies, the development of such a body is anticipated.

ZAMBIA'S MINERAL AND ENERGY RESOURCES LEGISLATION, RESOURCES AND EXPLORATION POTENTIAL

(Available from Permanent Secretary,
Ministry of Mines and Minerals Development)

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