Ministry of Mines and Minerals Development

Foreign, Commonwealth & Development Office

British Geological Survey

Critical minerals potential of Zambia

Guide to the **geology**, **occurrences**, **exploration** and **mineral production**

2025 Edition

Acknowledgements

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Bibliographical reference

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Front cover photographs

Graphite gneiss and graphite sample pit, Petauke, Eastern Province, Zambia; Manganese ore, Luapula Province.

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2025 Edition

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Ministry of Mines and Minerals Development

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BGS British Geological Survey

Contents

Summary

This first edition of the 'Critical minerals potential of Zambia' guide outlines the current and potential critical mineral resources of Zambia (as defined by the Zambian National Critical Minerals Strategy). It provides insight into the location of operating mines and known occurrences, geological information, exploration activity and production for each critical mineral in Zambia from 2019 to 2023 (Table 1).
This guide is part of a collaboration between the Geological Survey Department of Zambia (GSD) and the British Geological Survey (BGS), with funding provided by the United Kingdom (UK) Government's Foreign, Commonwealth & Development Office (FCDO). It was supported by the BGS International Geoscience Research and Development (IGRD) programme.

The transition to a low-carbon future will lead to a significant increase in the demand for critical minerals (Hund et al., 2023). For example, renewable energy sources, energy storage batteries and the electrification of the transport sector are key aspects of a low-carbon future and require mining of minerals (Mudd, 2022). The importance of these minerals is globally recognised. Many countries publish lists of those minerals that are 'critical' to their energy transition goals and economic stability. These are the result of assessments of their national importance as well as supply and demand risk (Mudd et al., 2024).

In the context of Zambia, critical minerals are the naturally occurring minerals that are essential to modern technologies, the economy and international development (Ministry of Mines and Minerals Development, 2024). The recently published 'National Critical Minerals strategy 2024 to 2028' highlights eleven metals and minerals as critical to Zambia over the next five years (Ministry of Mines and Minerals Development, 2024). These eleven metals and minerals form the focus of the 'Critical mineral potential guide of Zambia':

- cobalt
- columbite-tantalite ('coltan')
- copper
- graphite
- lithium
- manganese
- nickel
- rare earth elements
- sugilite (a complex silicate mineral)
- tin
- uranium

This first edition of 'Critical minerals potential of Zambia' marks a significant milestone in our nation's pursuit of sustainable economic development and global collaboration. In partnership with the British Geological Survey and with support from the UK Government, this guide reflects our commitment to harnessing Zambia's rich geological endowment to meet the growing global demand for critical minerals.

As the world transitions to a low-carbon future, Zambia stands ready to play a vital role by responsibly developing our critical mineral resources. Containing up-to-date insights into the geology, production and exploration of eleven minerals deemed essential to Zambia's future prosperity and the world's clean energy ambitions, this publication provides valuable information for investors, policymakers and researchers alike.

Director of the Geological Survey Department, Zambia (Gerald Mwila)

We are proud to have partnered with the Geological Survey Department of Zambia to produce this first edition of 'Critical minerals potential of Zambia'. The project was managed by BGS through the UK Government's Growth Gateway programme, which is supported by the Foreign, Commonwealth & Development Office, with additional backing from the BGS International Geoscience Research and Development programme.

This guide is a product of close international collaboration and shared expertise, offering valuable insights into Zambia's critical mineral resources. It will help inform policy, attract responsible investment, and contribute to the global transition to a sustainable, low-carbon future. We are pleased to support Zambia's ambitions through this important initiative.

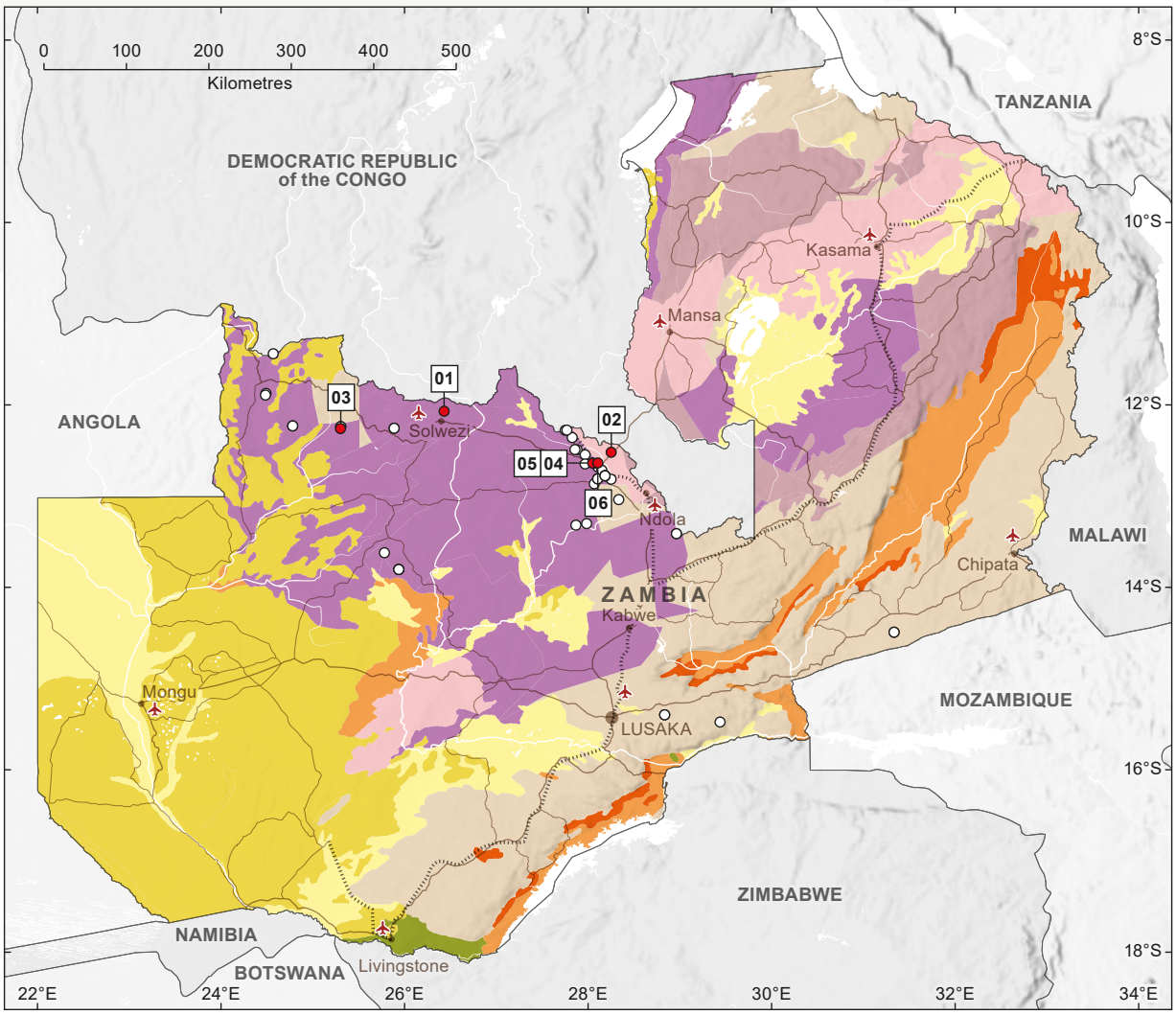
Director of the British Geological Survey (Karen Hanghøj)

Table 1 Mineral production statistics for Zambia critical minerals 2019–2023 (Idoine et al., 2025).

	Tonnes (metal content)				
Commodity	**2019**	**2020**	**2021**	**2022**	**2023**
Cobalt, mined	379	316	247	252	207
Cobalt, refined	1271	0	0	0	0
Copper, mined	789 942	868 671	800 696	763 550	698 566
Copper, refined	264 500	378 400	353 900	348 600	202 500
Copper, smelter	638 500[a]	750 600[a]	758 468[a]	771 544[a]	648 900
Manganese ore	15 904	46 515	132 241	161 611	171 066
Nickel, mined	2500	3226	3834	4059	7980

a including leach cathodes

Cobalt



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- Basement Complex: Granite, Palaeoproterozoic
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- 01 Kansanshi Mine
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Cobalt-bearing chalcopyrite and chalcocite ore, Chibuluma, Copperbelt Province

Highlights

The electric vehicle (EV) and portable battery sectors are the key drivers of cobalt demand at present, accounting for around 70 per cent of end-use applications in 2022 (Cobalt Institute, 2024). Other end uses include superalloys, hard metals, catalysts and ceramics (Cobalt Institute, 2024). Total global demand for cobalt is projected to increase by almost 50 per cent between 2024 and 2040 (IEA, 2025).

In 2023, the Democratic Republic of the Congo (DRC), Indonesia and Russia were the top producers of cobalt and accounted for around 68.5, 10.6, and 4.4 per cent of global production, respectively (Idoine et al., 2025). The UK, European Union (EU), United States of America (USA), Canada and Australia all list cobalt as critical in their latest criticality assessments (Mudd et al., 2024).

As of mid-2024, Zambia had six mining or smelting operations producing cobalt, all from copper-cobalt deposits (Table 2). These deposits are part of the stratiform sediment-hosted (SSH) copper-cobalt type found in the Central African Copperbelt, the world's largest concentration of such deposits (Dehaine et al., 2021; Cailteux et al., 2005). The main cobalt-hosting mineral is carrollite, a sulfide ore, but oxides like heterogenite in weathered zones also host significant amounts of cobalt (Dehaine et al., 2021).

Globally, 58 per cent of resources and reserves are in SSH-type deposits in the DRC and Zambia (Dehaine et al., 2021). However, Zambia's cobalt production has declined from around 5600 tonnes (t) in 2012 to about 252 t in 2022, likely due to decreasing copper production (Barry, 2023). Sustainable cobalt sourcing is crucial, as older roasting equipment in Zambia and the DRC emits more sulfur dioxide than modern equipment (Usmani et al., 2019). To increase cobalt production sustainably, Zambia may need to invest in its cobalt-processing capacity as it ramps up copper production into the 2030s.

Zambia is set to host Africa's first cobalt sulfate refinery by the end of 2025, marking a major milestone in diversifying the global battery supply chain. The facility will be one of the few outside China capable of producing cobalt sulfate, a key component in lithium-ion batteries. The project is led by Kobaloni Energy, backed by Vision Blue, and is expected to benefit from a US$100 million investment from the Africa Finance Corporation (AFC). AFC plans to make a final investment decision within a few months and production could begin 18 months after financing is secured. The refinery could play a crucial role in reshaping Africa's position in the global energy transition (Mining.com, 2024).

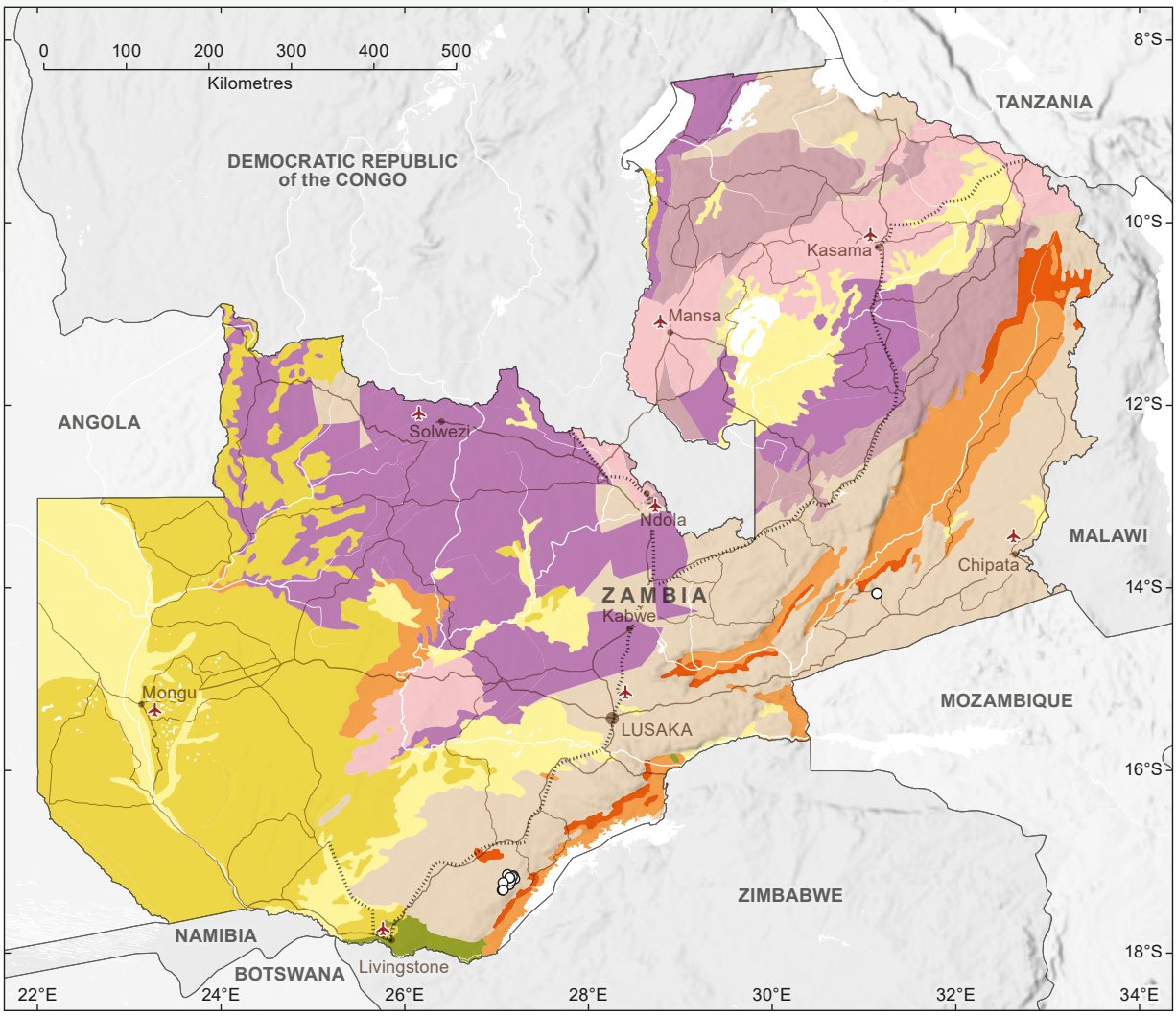
Finally, US-based company Terra Metals is recommissioning a copper and cobalt acid leach plant in the Kabompo Dome area situated around 130 km west of First Quantum Minerals' Sentinel and Kalumbila mines and 180 km west of Barrick Gold's Lumwana Mine. The project is expected to be operational by the end of the first quarter of 2025. This plant will process oxide ores and is part of a broader initiative that includes a 1 Mt per annum flotation plant, processing both copper and cobalt. Terra Metals is also integrating two 200 MW solar plants into the project, one in Northern Province and another near their mining operations in North-Western Province, reducing their reliance on fossil fuels (Globenewswire, 2025).

Table 2 Active Zambian cobalt mines and smelter facilities in 2024 (Ministry of Mines and Minerals Development, 2025).

Deposit	Commodity	Owner
Kansanshi	Cu-Co-Ni	FQM (80%) Kansanshi Mining Plc (20%)
Mopani	Cu-Co-Ni	CMCL - Delta Mining Ltd (51%) ZCCM-IH (49%)
Chambishi copper smelter	Cu-Co	ERG-A (90%) ZCCM-IH (10%)
Sentinel	Cu-Co-Ni	FQM Trident Ltd
Chambishi Mine	Cu-Co-Ni	NFCA - CNMCL (85%) ZCCM-IH (15%)
Chambishi Mine	Cu-Co-Ni	SMLZ (subsidiary of CNMCL)

FMQ: First Quantum Minerals; MCML: Mopani Copper Mines Ltd; ZCCM-IH: Zambia Consolidated Copper Mines Investments Holdings; ERG-A: Eurasian Resources Group-Africa; NFCA: Non Ferrous Company Africa Mining; CNMCL: China Non-ferrous Metals Company Ltd; SMLZ: Sino Metals Leach Zambia.

Columbite-tantalite



Columbite-tantalite mineralisation, Kalomo District, Southern Province

Highlights

Columbite-tantalite ore, more commonly known as coltan, is one of the primary sources of tantalum and niobium. Tantalum is an essential metal in high-tech electronics, superalloys and the aerospace, energy and chemicals industries (Schütte and Näher, 2020). It is mainly produced from coltan ore but can be processed from tin ore slag (Idoine et al., 2024). Niobium is predominantly used as a ferro-niobium alloy steel in structural, automobile and pipeline applications, with other uses including as a component of superalloys, chemicals, superconductors and magnets (Schulz et al., 2017, Laverick, 1988).

In 2023, the DRC produced 44.4 per cent of global tantalum followed by Nigeria (17.9 per cent) and Rwanda (16.1 per cent). In the same year, Brazil produced 92.7 per cent of global niobium followed by Canada (3.9 per cent, from pyrochlore) and the DRC (0.9 per cent, from coltan ore) (Idoine et al., 2025). Both tantalum and niobium are listed as critical by the UK, EU, USA, Canada and Australia. The UK's 2024 criticality assessment also identified niobium as having the highest criticality score of all 82 elements and industrial minerals assessed (Mudd et al., 2024).

Niobium and tantalum minerals are found across a variety of deposit types:

- carbonatites and associated alkaline rocks (niobium-dominant)
- alkaline to peralkaline granites and syenites (niobium-dominant)
- rare-metal granites and pegmatites of the lithium-caesium-tantalum (LCT) family (tantalum-dominant)

(Schulz et al., 2017.)

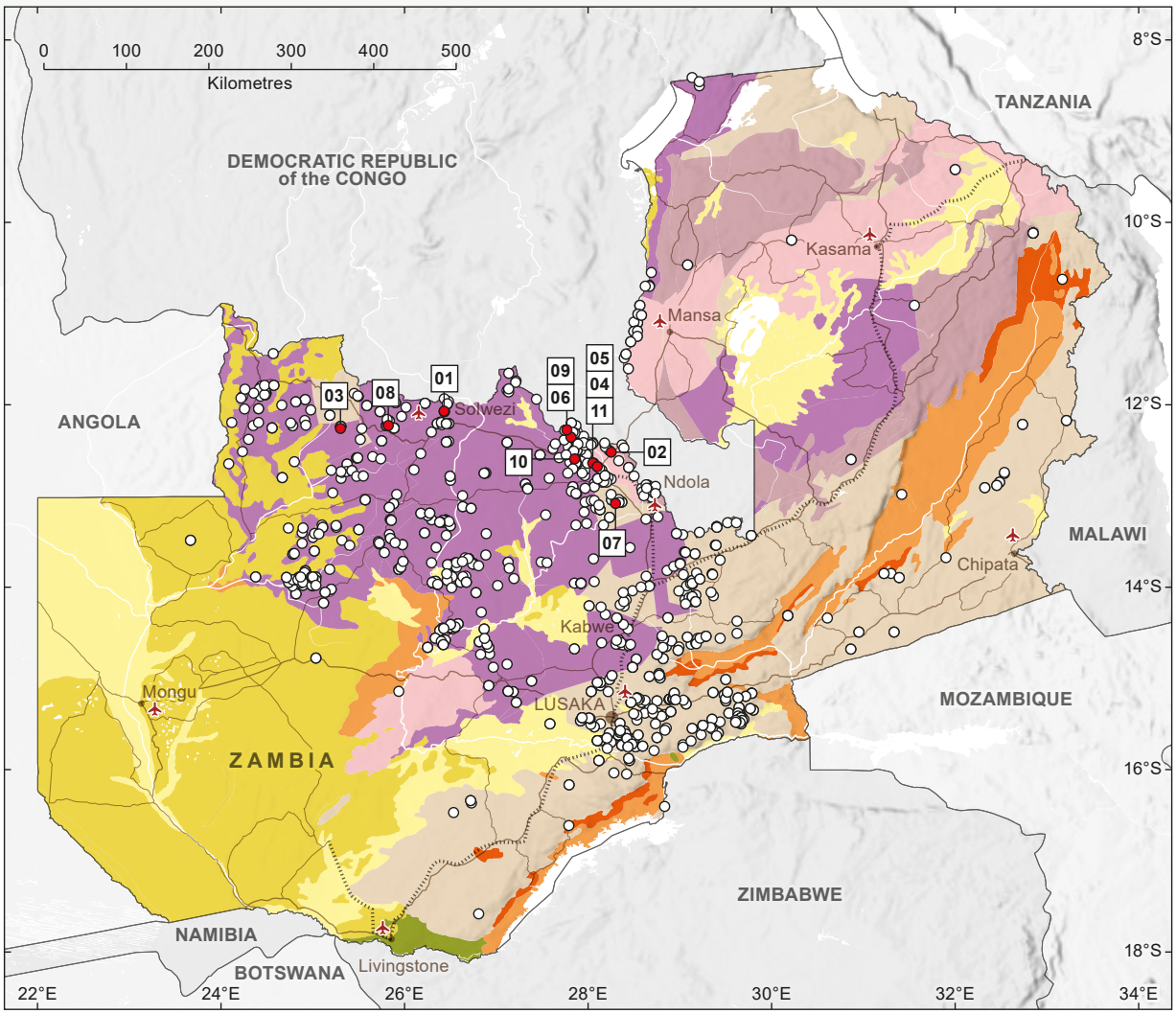
Total global demand for niobium and tantalum in the clean energy sector is projected to increase by 110 and 525 per cent between 2024 and 2040, respectively (IEA, 2025). The economically important niobium-tantalum minerals are all oxides, with the most important economic minerals being pyrochlore (niobium) and tantalite (tantalum) (Schulz et al., 2017). Pyrochlore also tends to contain significant amounts of uranium, light rare earth elements and barium and is therefore radioactive (Schulz et al., 2017).

Maamba Collieries Ltd currently have an exploration licence for tantalum in Southern Province (ZCMM-IH, 2024). Marula Mining Plc once held a licence for the Nkombwa Hill Project in Zambia, but released its stake in the niobium-tantalum-rare earth elements deposit in late 2024 (Marula Mining Plc, 2024). Other areas of potential for niobium-tantalum mineralisation may exist in the Choma Tin Belt across Southern Province, in the Hook Granite Complex, and in scheelite mineralisation of the Undaunda area, around 80 km east of Lusaka (Zambia Mining, 2025).

Malaika Exploration Limited, a GEM Resources project, holds two large-scale exploration licences covering around 1300 km^2 in north-eastern Zambia. The area includes prospectively viable coltan, graphite, lithium and rare earth elements (GEM Resources, 2025).

No coltan production is known for Zambia.

Copper



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- 02 Mopani Copper Mines, Gate 1
- 03 Sentinel Copper Mine
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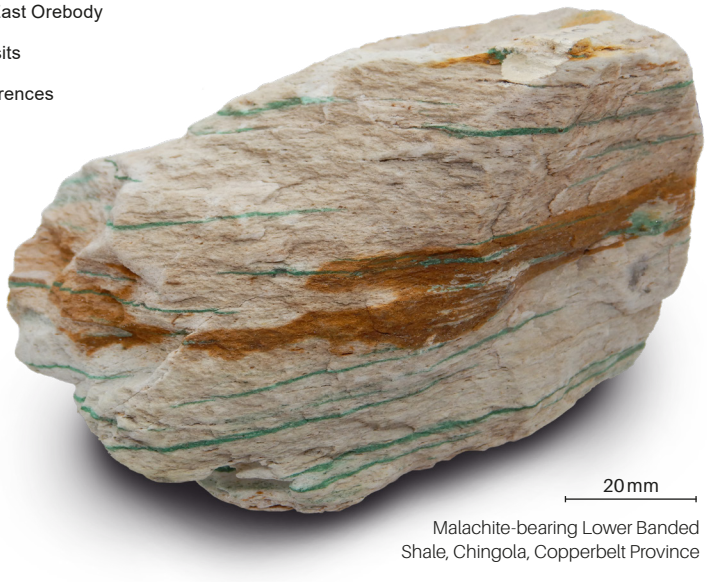


Malachite-bearing Lower Banded Shale, Chingola, Copperbelt Province

Highlights

Copper is essential across power, telecommunications, digital technology, chemicals and infrastructure sectors (Mudd et al., 2024). In 2023, Chile, the DRC and Peru led global production, contributing 23.4, 13.7 and 12 per cent, respectively (Idoine et al., 2025). Zambia ranked tenth globally, with about 3 per cent of total output, and remains Africa's second-largest producer after the DRC. Copper is classified as a critical mineral in Canada and the EU, with the UK potentially following under certain circumstances (Mudd et al., 2024). Global copper demand is expected to rise by over 25 per cent between 2024 and 2040 (IEA, 2025).

Zambian copper deposits are predominantly hosted by marginal marine and terrestrial metasedimentary rocks (Selley et al., 2005). The Copperbelt's ore deposits are stratiform, with argillite-hosted (70 per cent) more common in the DRC and arenite-hosted (30 per cent) more common in Zambia (Selley et al., 2005; Cailteux et al., 2005). The dominant mineralisation consists of disseminated and vein-hosted copper-cobalt sulfides, including chalcopyrite, bornite, chalcocite and digenite (Cailteux et al., 2005). In 2023, FQM-Trident's Sentinel mine was the top producer of copper in Zambia (Table 3).

The following Zambian copper projects are at an advanced stage.

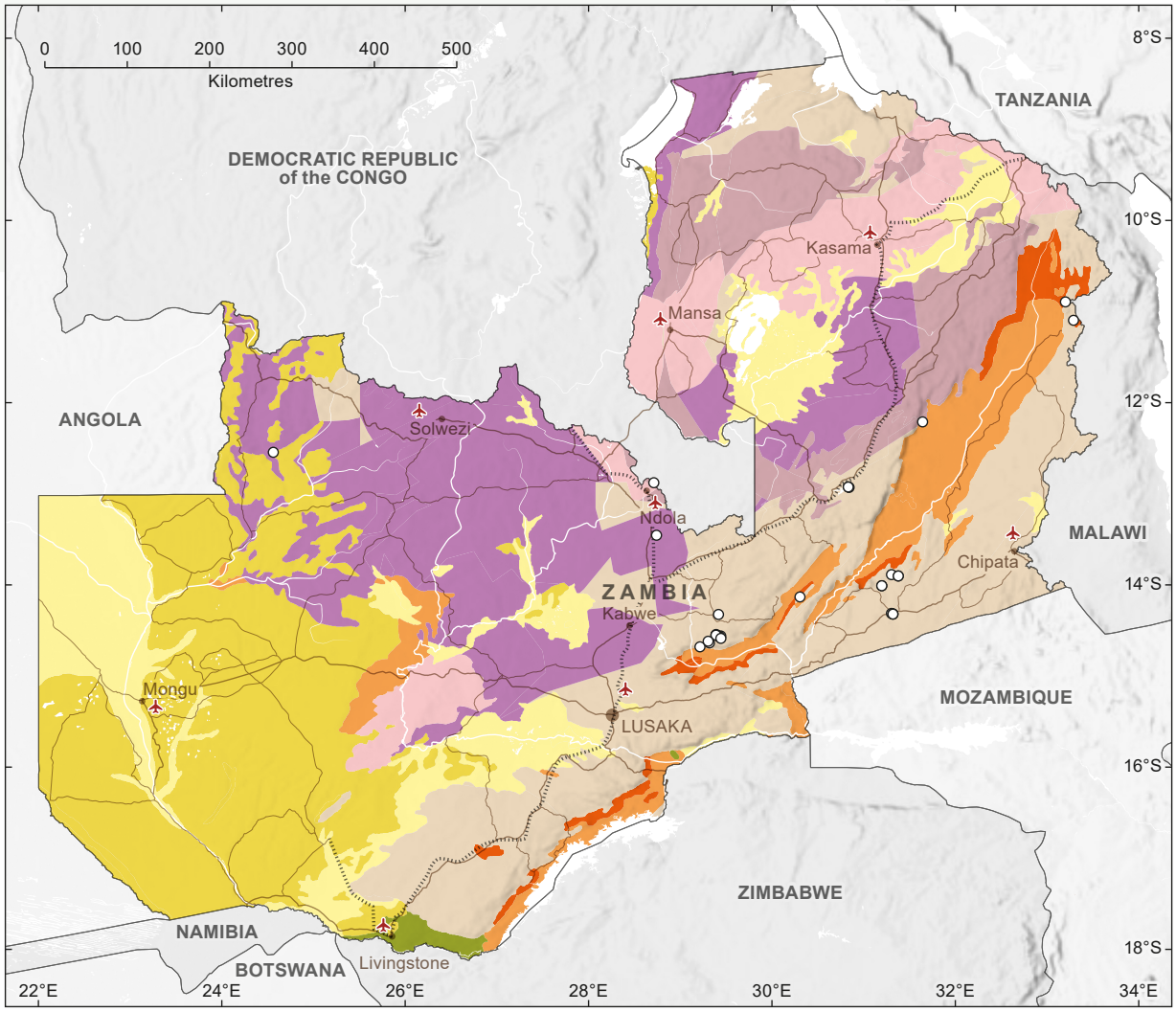
- A joint venture between Arc Minerals and Anglo American, spanning 870 km^2 in the Domes region of the Copperbelt has been initiated (Arc Minerals, 2025a). Arc Minerals also announced that their subsidiary, Foreland Minerals, is acquiring the 311 km^2 Chingola Project in the Copperbelt (Arc Minerals, 2025b)
- Sinomine Resources plans to begin production at the Kitumba Copper Mine in late 2026, backed by a $600 million government investment. The mine holds 21.9 Mt of ore at 2.2 per cent copper and aims to produce 50 kt annually, creating 2500 jobs (Intrepid Mines Ltd, 2015; Presidential Delivery Unit, 2024a)
- Mimosa Resources, supported by FQM, will launch the Kashime Copper Mine in 2026, targeting 30 kt per year by 2030 (Mining Technology, 2023; Mining Weekly, 2025)
- Kobold Metals, in partnership with ZCCM-IH, are developing the Mingomba project, with over 50 000 m of core drilled so far. With ore grades as high as 8 per cent, Mingomba could become Zambia's largest copper mine (Presidential Delivery Unit, 2024b). Shaft sinking is expected to begin in early 2026 (Zambia Monitor, 2024)

Table 3 Active Zambian copper production 2023. (Ministry of Mines and Minerals Development, 2025).

Deposit	Commodity	Owner	2023 production
Konkola	Cu	Vedanta (79.4%) ZCCM-IH (20.6%)	39 598
Chibuluma	Cu	Jinchuan Group (85%) ZCCM-IH (15%)	3697
Kansanshi	Cu-Co-Ni	FQM (80%) Kansanshi Mining Plc (20%)	134 821
Mopani	Cu-Co-Ni	CMCL – Delta Mining Ltd (51%) ZCCM-IH (49%)	35 048
Muliashi	Cu	CNMCL (80%) ZCCM-IH (20%)	48 904
Sentinel	Cu-Co-Ni	FQM-Trident Ltd	214 224
Lumwana	Cu	Barrick Gold – operated by LMC	118 001
Chambishi	Cu-Co-Ni	NFCA, CNMCL (85%) ZCCM-IH (15%)	68 760
Lubambe	Cu	ERM Capital Resources (80%) ZCCM-IH (20%)	15 495
Chambishi smelter	Cu-Co-Ni	SMLZ – subsidiary of CNMCL	12 925
Mimbula	Cu	Moxico Resources Plc (85%) Mimbula Minerals Ltd (15%)	7093

LMC: Lumwana Mining Company Limited; FQM: First Quantum Minerals; MCML: Mopani Copper Mines Ltd; ZCCM-IH: Zambia Consolidated Copper Mines Investments Holdings; NFCA: Non Ferrous Company Africa Mining; CNMCL: China Non-ferrous Metals Company Ltd; SMLZ: Sino Metals Leach Zambia.

Graphite



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Flake graphite concentrate, Petauke, Eastern Province

Highlights

Graphite has many useful physical properties like high electrical conductivity, a high melting point, resistance to corrosion, and lubricity. This makes it a key component for industrial applications, digitisation and electronics, lubrication, steel production, hydrogen electrolysers and fuel cells, and EV battery manufacturing (Simandl et al., 2015; Mudd et al., 2024).

Total world production of graphite was over 1.74 Mt in 2023, an increase of around 10.9 per cent since 2019 despite dips in production during the COVID-19 pandemic (Idoine et al., 2025). In 2023, the top graphite producers were China (70.5 per cent), India (7.4 per cent), and both Mozambique and Madagascar (5.7 per cent each) (Idoine et al., 2025). Tanzanian production is expected to rise rapidly in coming years as several projects, like Lindi Jumbo, ramp up production (TanzaniaInvest, 2025).

Total global demand for graphite is projected to increase by over 130 per cent between 2024 and 2040 (IEA, 2025). Graphite is the most prominent critical mineral by weight in a typical EV or energy storage battery (IEA, 2025). The EV industry is forecast to consume around 5.4 Mt by 2030, which is higher than the previous three years (2021 to 2023) of total global production combined (IEA, 2024). Graphite is listed as critical on the most recent UK, EU, Canadian and Australian criticality assessments (Mudd et al., 2024).

Graphite is predominantly concentrated into three types of mineral deposit:

- amorphous graphite: microcrystalline graphite formed by metamorphism of coal, petroleum or carbon-rich sediments
- flake graphite: disseminated graphite flakes associated with metamorphic rocks
- vein graphite: veins or fracture-fillings in igneous and metamorphic rocks

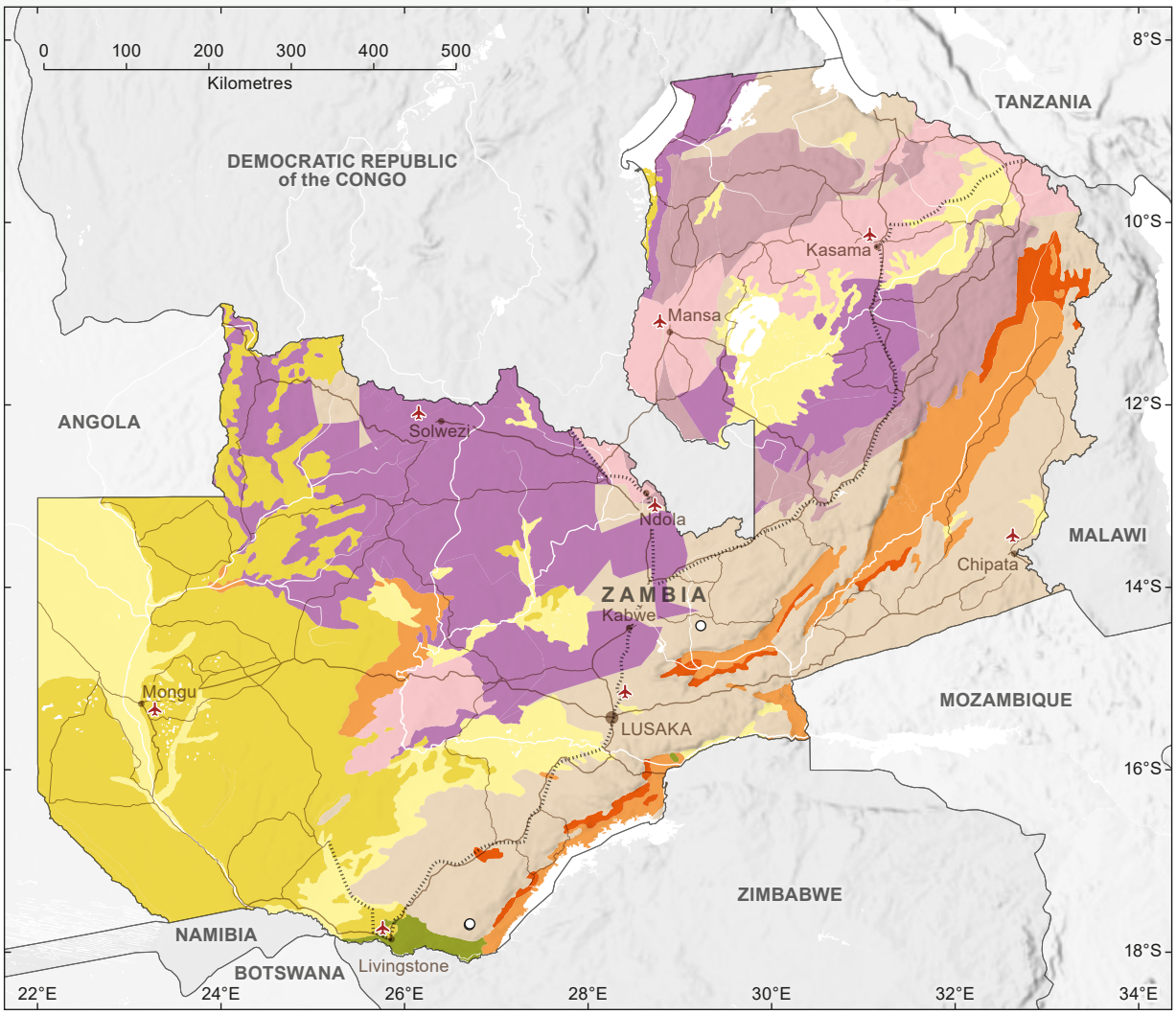
(Mitchell and Deady, 2021.)

Zambia has the potential for exploration and exploitation of graphite. Eastern (Petauke and Lundazi) and Central (Kapiri Mposhi) provinces of Zambia are the most likely prospective areas (Drysdall, 1960a; Mitchell and Deady, 2021; Mitchell and Currie, 2024). Earliest reports of graphite exploration are from 1934 at Njoka, Lundazi District, with up to 15 per cent graphitic carbon in gneiss (Drysdall, 1960b). Historic field investigation at Njoka documents average grade estimates of around 12 per cent for several kilotonnes of graphite hosted in gneiss (Drysdall, 1960b). Graphite occurrences recorded in the Petauke District include the Sasare, Mkonda and Mvuvye deposits, which, when grouped together, cover over 900 km^2 (around 350 square miles) and contain up to 17 per cent graphitic carbon hosted in paragneiss and granulite, which are commonly heavily weathered (Drysdall, 1960a). The most recent study of the Mvuvye deposit found crystalline flake graphite ranging from large to super jumbo in size (Currie and Mitchell, 2024). Crystalline flake graphite of these sizes is noted as the most applicable for specialist applications like EV battery production (Jara et al., 2019). Malaika Exploration Limited's two large-scale exploration licences for north-eastern Zambia (see coltan section) include the aforementioned Njoka graphite deposit (GEM Resources, 2025).

Exploration of related geology in neighbouring countries has led to the development of significant graphite production, for example Balama mine in Mozambique, which is one of the largest graphite mines in the world (Syrah Resources Ltd, 2024). There is a strong likelihood that the graphite resources in Zambia will have the potential to be developed as significant producers and become a valuable addition to the Zambian mining economy.

No graphite production is currently known in Zambia.

Lithium



Lepidolite pegmatite, Kalomo District, Southern Province

Highlights

Over the past two decades, there has been a substantial increase in global demand for lithium, driven by the demand for EV batteries (Mudd et al., 2024). In addition, lithium plays a key role in the glass, ceramic and pharmaceutical sectors, as well as being used in greases for industrial applications. Total global demand for lithium is projected to increase by over 350 per cent between 2024 and 2040 (IEA, 2025).

In 2023, Australia, Chile and China were the top producers of lithium and accounted for around 47.8, 24.4 and 18.3 per cent of global production, respectively (US Geological Survey, 2025). Zimbabwe was the top lithium producer in Africa in 2023, accounting for around 1.9 per cent of global production (Idoine et al., 2025). Zimbabwe produces lithium from petalite in pegmatite. Lithium is listed as being critical in the latest criticality assessments of the UK, EU, the USA, Canada and Australia (Mudd et al., 2024).

In economic deposits, lithium is typically hosted in:

- spodumene, lepidolite and petalite in pegmatites
- lithium-bearing continental brines such as the 'salars' or salt pans of the central Andes
- geothermal and oilfield brines

(Brown, 2016.)

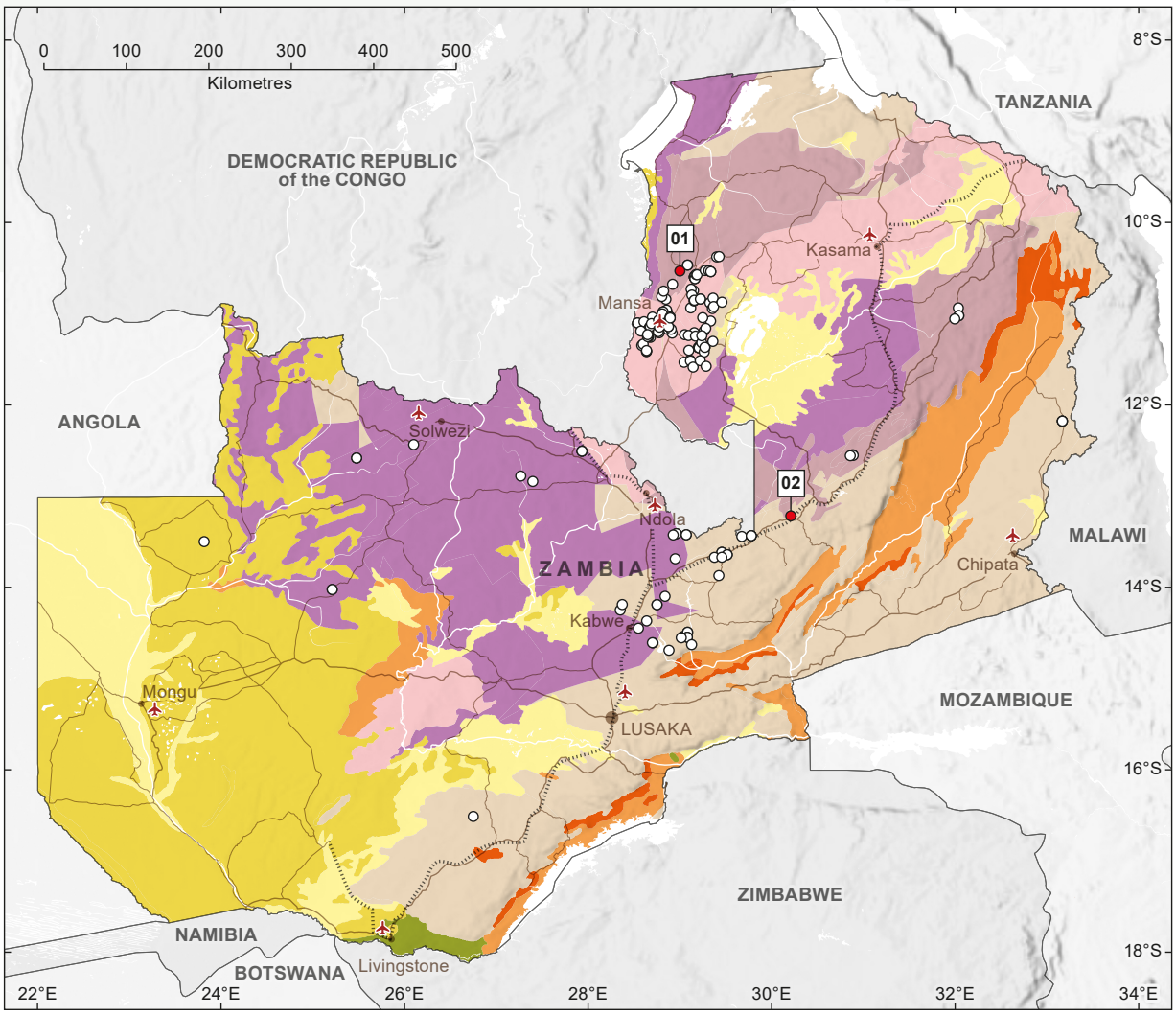
Interest in lithium in Zambia is focused on the Choma Belt of Southern Province. First Africa Metals Ltd (FAM), a UK-based exploration company in partnership with a local Zambian partner, recently announced that rock-chip sampling has confirmed high-grade lithium-bearing pegmatites at its Misika Project, Southern Province (First Africa Metals Ltd, 2024). FAM reports grades of up to 10 per cent lithium oxide (Li_2O) in montebrasite and reports lithium-bearing spodumene, pollucite and lepidolite at lower grades (First Africa Metals Ltd, 2024). The project is fully permitted and ASTER surveying has identified 132 pegmatite targets with a further 48 targets identified at the Kandela project nearby. FAM also holds three other large-scale licences — Tonga, Konayuma and Rock Valley — covering around 90 km^2, all believed to be highly prospective for both lithium and tin (First Africa Metals, 2024).

In July of 2024, Maamba Collieries was granted two large-scale exploration licences for lithium, gemstones, tantalum and titanium in Southern Province of Zambia (ZCMM-IH, 2024). The exploration licences were granted for a four-year period and exploration for these minerals is set to commence soon (ZCMM-IH, 2024) (at time of writing, January 2025). Illegal mining of lithium-bearing material around the Choma and Kalomo regions has been identified recently and calls from Zambia's Chamber of Mines to take a more structured approach to lithium mining have been made to the public and potential investors.

Malaika Exploration Limited's two large-scale exploration licences for north-eastern Zambia (see coltan section) include areas that are prospectively viable for lithium (GEM Resources, 2025).

No lithium is currently produced or processed in Zambia (on a formal basis).

Manganese



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Manganese-rich breccia, Luapula Province

Highlights

The global demand for manganese is dominated by the production of steel and battery cathodes. From 2019 to 2023, South Africa was the largest producer of manganese globally, accounting for around 36 per cent of total production, with Gabon and Australia accounting for around 19.4 and 12.3 per cent, respectively (Idoine et al., 2025). Total global demand for manganese in the clean energy sector is projected to increase by almost 1500 per cent between 2024 and 2040 (IEA, 2025). Zambia has an active manganese mining sector and was the fifth-largest producer in Africa in 2023 (Idoine et al., 2025). Manganese is listed as critical by the UK, EU, the USA, Canada and Australia (Mudd et al., 2024).

Manganese deposits in Zambia are categorised into lateritic-type in conglomeratic and reef formations, or in lenses or bands of ore (Coats et al., 2001). Laterite occurrences often extend into higher-grade lenses or bands at depth (Coats et al., 2001). The Mansa deposits, which account for most manganese occurrences in Zambia, are located in Luapula Province. The occurrences run in north-to-south trending veins, following quartz veins and mylonitic rocks (Coats et al., 2001). These veins, hosted by granite and contemporaneous volcanics, contain minerals such as psilomelane, hausmannite, manganite, pyrolusite and, occasionally, sugilite (Coats et al., 2001; Geological Survey Department, 2023).

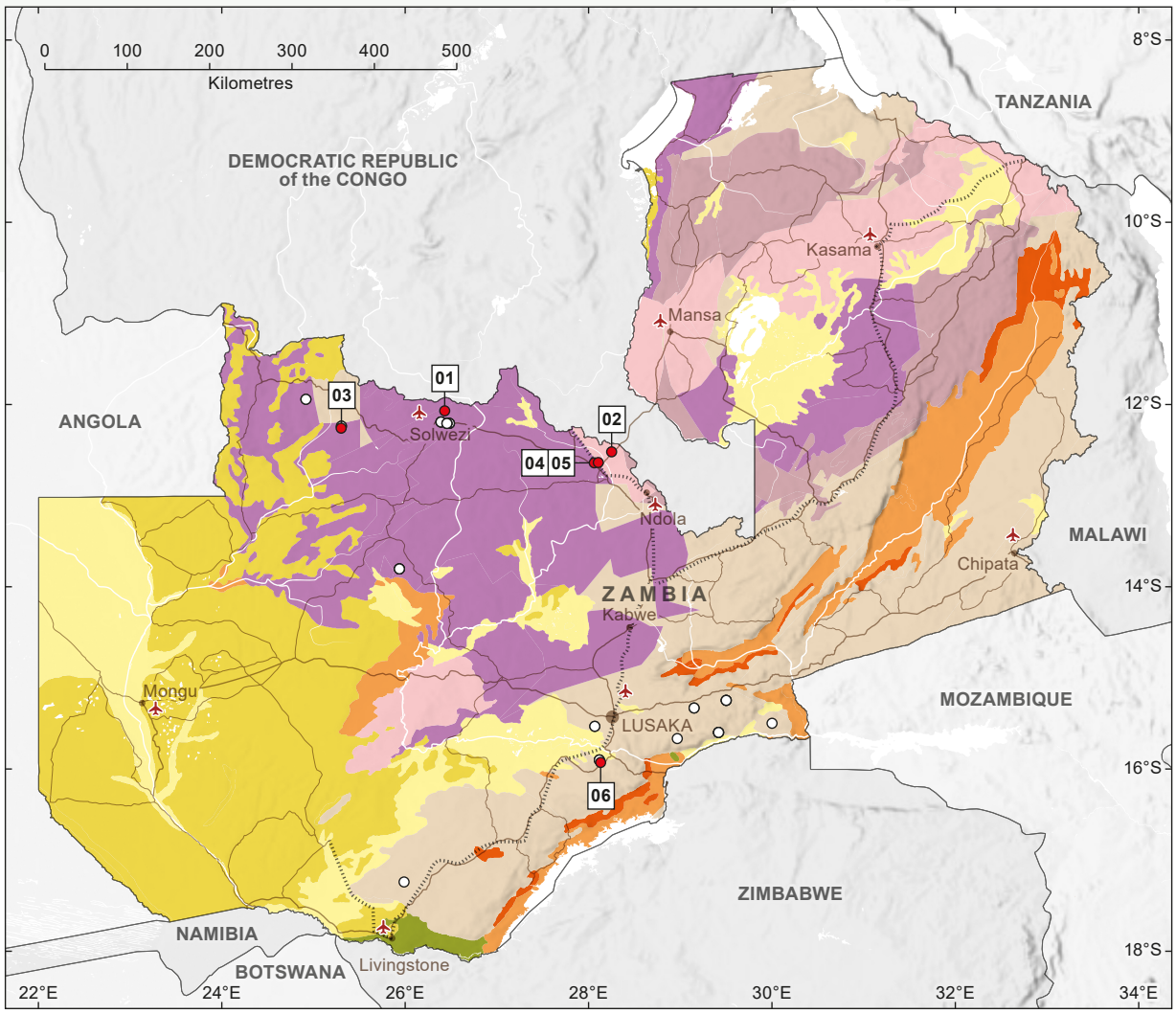
Musamu Resources Ltd is an indigenous Zambian mining company (International Manganese Institute, 2024). It launched the Luongo Manganese Open Pit Mine in 2022, the first large-scale manganese mine wholly owned by Zambians (International Manganese Institute, 2024). The mine has a manganese resource of 40 Mt at an average grade of 43 per cent, containing 17.2 Mt manganese (International Manganese Institute, 2024). Proven reserves are 1 Mt, with 430 kt of contained manganese and highest grades of around 50 per cent manganese (International Manganese Institute, 2024). Musamu Resources Ltd is expecting production to ramp up to around 1 Mt annually by 2027 (International Manganese Institute, 2024).

Manganese mining in Serenje, Central Province, is operated by Kabundi Resources Ltd, founded by ZCCM-IH in May 2019 (ZCCM-IH, 2023). Since May 2020, it has expanded production, running two washing plants with capacities of 1200 t per day and 150 t per hour (ZCCM-IH, 2023). The ore averaged 45 per cent manganese and, in 2023, it produced 2325 t manganese. Future plans include a 60 kt per annum manganese plant over the course of a three-phase development plan (ZCCM-IH, 2023).

Historically, the mining of manganese in Zambia has been intermittent due to the fluctuation in demand of the commodity. However, production has risen steadily since the COVID-19 pandemic (Idoine et al., 2025) and, with the current rising demand, a realisation of Zambia's potential to be a key producer of this commodity is apparent (Ministry of Mines and Minerals Development, 2024a).

In 2024, around 16 companies were producing manganese alloys in Zambia.

Nickel



- Alluvium, Quaternary
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- Muva Supergroup, Palaeoproterozoic to Mesoproterozoic
- Basement Complex: Granite, Palaeoproterozoic
- Basement Complex: undifferentiated, Archaean

- Nickel deposits
- Nickel occurrences
- Road
- Rail
- Airport

01 Kansanshi Mine

02 Mopani Copper Mines, Gate 1

03 Sentinel Copper Mine

04 NFC Africa Copper Mine

05 Chambishi Copper Smelter

06 Munali Nickel Mine

Nickel ore, Munali Nickel Mine, Southern Province

Highlights

The global demand for nickel is dominated by stainless steel manufacturing, with batteries, alloying and plating also driving demand (Mudd et al., 2024). From 2019 to 2023, Indonesia was the largest producer of nickel globally, accounting for around 53.7 per cent of total production, with the Philippines and Russia second and third, accounting for around 10.2 and 6.8 per cent, respectively (Idoine et al., 2025). Total global demand for nickel is projected to increase by almost 70 per cent between 2024 and 2040 (IEA, 2025). Nickel is listed as critical by the UK, the USA, Canada and Australia, and as strategic by the EU (Mudd et al., 2024).

Zambia has two operating nickel mines: Enterprise Nickel Project (associated with the Sentinel copper deposit) and Munali Nickel Mine. Enterprise is operated and owned by First Quantum Minerals Trident Ltd; Munali is owned by Consolidated Nickel Mines Ltd and operated by Mabiza Resources Ltd. Overall, nickel production in Zambia has increased year-on-year since 2019 (Idoine et al., 2025). Several other mines process nickel as part of their copper-mining activities (Table 4). Nickel production in Zambia has risen steadily year on year from around 2500 t in 2019 to almost 8000 t in 2023 (Idoine et al., 2025).

Enterprise, located in North-Western Province, is 12 km from First Quantum Minerals' Sentinel copper mine. It is a nickel sulfide deposit containing approximately 431 kt of nickel contained within 40 Mt of ore (First Quantum Minerals, 2025a). The mine began production in the third quarter of 2024, producing 4827 t nickel (First Quantum Minerals, 2025b). The Enterprise processing plant shares infrastructure with Sentinel, including tailings management facilities (First Quantum Minerals, 2025a).

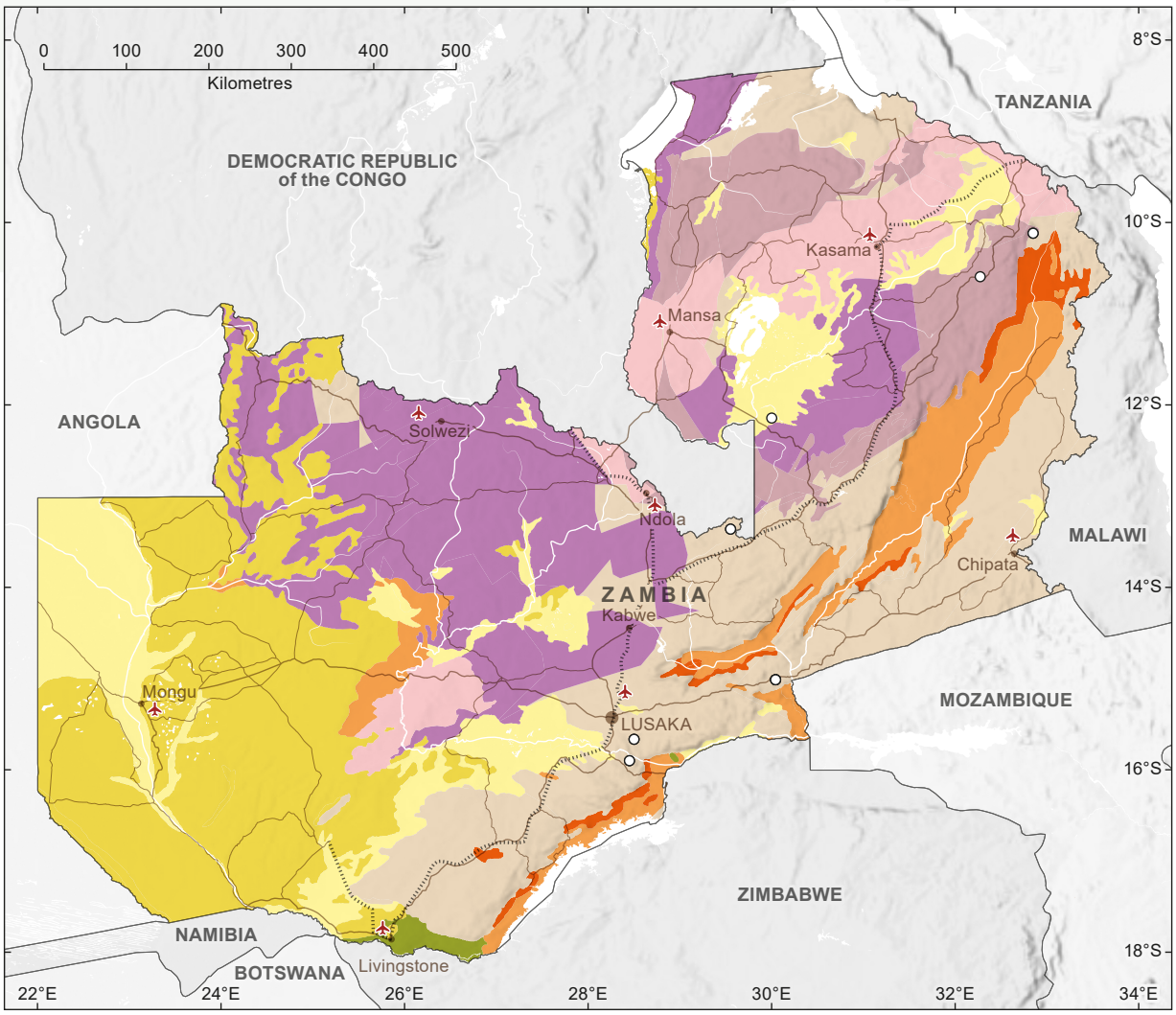
Munali, located 75 km south of Lusaka, has been in continuous production for five years. The deposit is part of the Munali Intrusive Complex, a Neoproterozoic mafic-ultramafic system with sulfide-bearing rocks (Blanks et al., 2022). Sulfide minerals like pyrrhotite, pentlandite, chalcopyrite and pyrite are found in three zones: Enterprise, Intrepid and Voyager (Consolidated Nickel Mines Ltd, 2020). The mine has an estimated 6 Mt of resources at 1 per cent nickel (Consolidated Nickel Mines Ltd, 2020).

Table 4 Active Zambian nickel mines and smelter facilities in 2024 (Ministry of Mines and Minerals Development, 2025).

Deposit	Commodity	Owner
Kansanshi	Cu-Co-Ni	FQM (80%) Kansanshi Mining Plc (20%)
Mopani	Cu-Co-Ni	CMCL - Delta Mining Ltd (51%) ZCCM-IH (49%)
Enterprise	Cu-Co-Ni	FQM Trident Ltd (100%)
Chambishi	Cu-Co-Ni	NFCA - CNMCL (85%) ZCCM-IH (15%)
Chambishi	Cu-Co-Ni	SMLZ - subsidiary of CNMCL
Munali Nickel Mine	Ni	CNM (100%) – operated by Mabiza Resources Ltd.

FQM: First Quantum Minerals; ZCCM-IH: Zambia Consolidated Copper Mines Investments Holdings; NFCA: Non Ferrous Company Africa Mining; CNMCL: China Non-ferrous Metals Company Ltd; SMLZ: Sino Metals Leach Zambia; CNM Consolidated Nickel Mines Ltd.

Rare earth elements



Monazite mineralisation in carbonatite, Nkombwa Hill, Northern Province

Highlights

Over the past few decades, the rare earth elements, most notably neodymium, praseodymium, dysprosium and terbium, have become integral in the high-strength permanent magnet and catalyst sectors. Both are crucial for EVs and renewable technologies (Mudd et al., 2024). Other significant uses for rare earth elements include polishing powders in metallurgy, glass and ceramics, and batteries (Natural Resources Canada, 2024).

China dominates the mining, refining and manufacturing stages associated with rare earth elements and their final products (IEA, 2024). In 2023, China, Myanmar and the USA were the top three rare earth element oxide producers and accounted for around 66.2, 19.9 and 7.1 per cent of global production respectively (Idoine et al., 2025). Total global demand for the rare earth elements is projected to increase by around 65 per cent between 2024 and 2040 (IEA, 2025). The UK, EU, USA, Canada and Australia all list rare earth elements as critical in their latest criticality assessments (Mudd et al., 2024).

The majority of rare earth element resources are associated with three minerals: bastnäsite, monazite and xenotime (Walters and Lusty, 2011). Bastnäsite and monazite typically host the light rare earth elements like cerium, lanthanum and neodymium, whereas xenotime is dominated by the heavier rare earth elements like dysprosium, yttrium, erbium, ytterbium and holmium (Harben, 2002).

Rare earth mineral deposits occur across a broad range of geological environments and are often influenced by primary hydrothermal and magmatic processes or secondary weathering processes (Walters and Lusty, 2011). In primary deposits, rare earth elements can be associated with:

- quartz- and fluorite-bearing veins and breccia zones, skarns and pegmatites
- carbonatites
- alkaline igneous rocks
- iron/rare earth element/iron oxide/copper/gold deposits

(Walters and Lusty, 2011.)

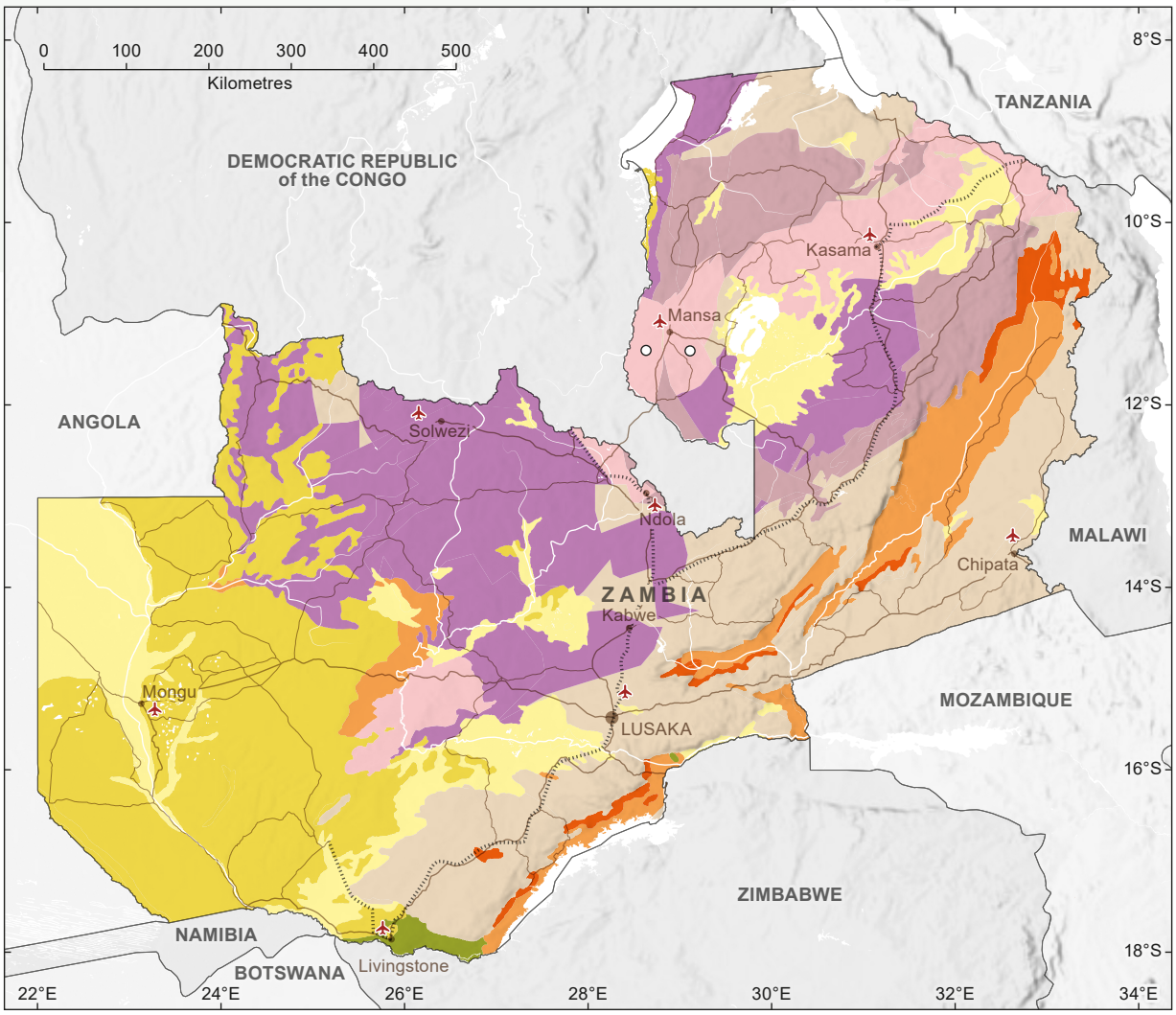
Secondary deposits include marine, alluvial and palaeo-placers, laterites and ion-adsorption clays (Walters and Lusty, 2011).

The recovery of rare earth elements is typically as a by-product of other mined material like iron ore at Bayan Obo, China, for example. Examples exist of rare earth elements being the primary ore product, like at Mountain Pass in the USA and Mount Weld in Australia (Walters and Lusty, 2011).

In Zambia, active mineral exploration for rare earth elements is currently ongoing. Around 90 km south of Lusaka in Southern Province, Antler Gold's Kesya Rare Earth Element Project has shown promising total rare earth element oxide mineralisation in monazite and bastnäsite, with up to 0.66 per cent total rare earth element oxide content (Antler Gold, 2025). A suite of rare earth element-bearing minerals, including bastnäsite and monazite, have been described from Nkombwa Hill carbonatite area, Isoka District, north-east Zambia (Zambezi et al., 1997). Following Marula Mining's withdrawal from the Nkombwa Hill project, X-ram Traws (an 80 per cent-owned subsidiary of African Prospects) has taken over the mining licence (Marula Mining Plc, 2024).

No rare earth element production is known for Zambia.

Sugilite



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- Sugelite occurrences
- Road
- Rail
- Airport

Sugilite mineralisation, Mansa, Luapula Province

Highlights

Sugilite is a rare silicate mineral that is valued as a decorative stone and gemstone. It is known in a few countries in the world, such as Japan, South Africa, India and Australia (Kawachi et al., 1994; Dixon, 1988; Shigley et al., 1987; Murakami et al., 1976).

In Zambia, sugilite is generally pink to purple in colour and exhibits massive crystal habit; very rarely it occurs as a clear, gel-like gemstone that is highly sought after. In 2023, sugilite occurrences were discovered in Mansa and Milenge Districts in Luapula Province (Geological Survey Department, 2023).

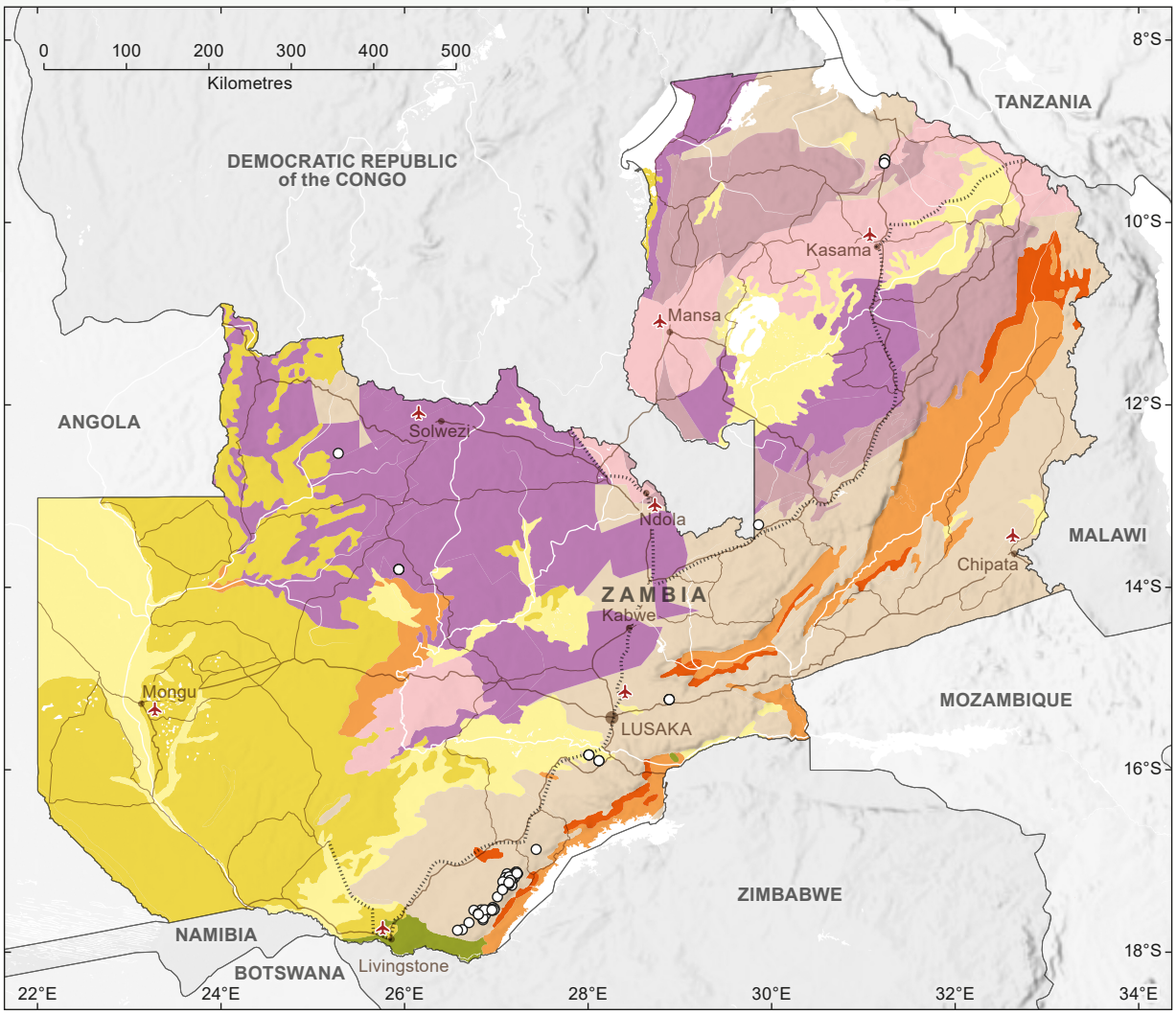
The geological formation of sugilite occurrences in Zambia is unclear (Geological Survey Department, 2023). It has been found in manganese deposits hosted in fractures and shear zones as vein-type deposits. The veins, composed of psilomelane, hausmannite, manganite and pyrolusite, appear to follow quartz veins and mylonitic rocks, suggesting supergene enrichment along pre-existing brittle fractures and shear zones (Coats et al., 2001).

The Zambian government, with support from the Geological Survey Department, has shown interest in exploring for potential sugilite resources due to its economic significance. It has invested resources in studying and understanding the geological characteristics of the known sugilite occurrences. The discovery of sugilite in Mansa has focused more attention on other manganese deposits in Zambia that may potentially host sugilite as a secondary mineral.

More resources are needed to understand the full potential of the sugilite deposits. With the government's willingness to work with the private sector, this represents an opportunity for private companies and individuals to invest in exploration for this commodity.

No production figures for sugilite are currently known for Zambia.

Tin



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- Tin occurrences
- Road
- Rail
- Airport

Cassiterite-bearing muscovite quartz pegmatite, Choma Tin Belt, Southern Province

Highlights

Tin is a metallic element that is used in solders, chemicals, tinplate, batteries, alloys and electronics (Muderawan et al., 2024). In 2023, China, Indonesia and Myanmar were the top producers of tin and accounted for around 22.9, 17.4 and 16.2 per cent of global production, respectively (Idoine et al., 2025). Of the seven countries producing tin in Africa, the DRC was the top producing country in 2023 and accounted for around 6.4 per cent of global production (Idoine et al., 2025). Tin is listed as being critical in the latest criticality assessments of the UK, the USA and Canada and as non-critical for the EU (Mudd et al., 2024).

In Zambia, tin is principally found in pegmatites and placers, mainly in the tin province (or tin belt) of Southern Province and in sporadic occurrences in Eastern, North-Western and Central provinces. Occurrences in the tin belt of Southern Province are found in a south-west to north-east striking belt, 110 km long and 6 to 7 km wide, stretching between Chirobi in the south-west and Mazuma in the north-east (Legg, 1972).

The primary ore for tin deposits in Zambia is cassiterite hosted in pegmatites. The cassiterite content in the pegmatites is relatively low, averaging 0.1 per cent tin oxide. Vein zones are known to reach 1.5 per cent tin oxide and may also contain coltan minerals. In north-east Zambia, along the sources of the Chambeshi river near Mbala, relatively extensive but low-grade eluvial cassiterite placers are known (Legg, 1972).

Between the early 1930s and 1961, an average of 8 t of cassiterite was mined annually in Zambia. Resource estimations for a number of occurrences concentrated in the following areas are known:

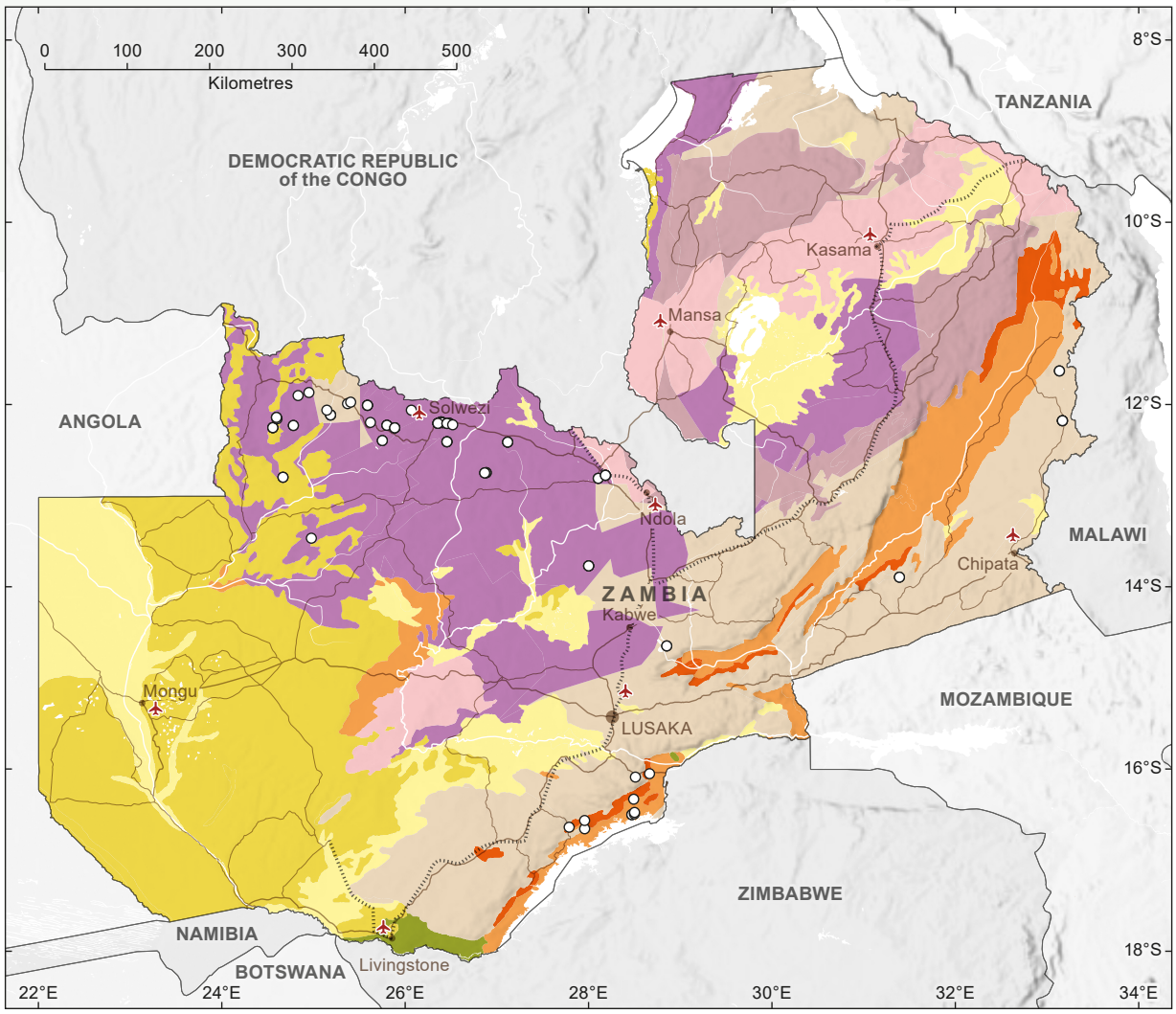
- Chisuku group: in pegmatites and eluvial deposits (94 t)
- Kalela: in pegmatite and eluvial deposits (13.6 t)
- Chimwami group: in pegmatites and eluvial and alluvial deposits (9 t)
- Masuku: in pegmatites and eluvial deposits (9 t)
- Machinga: in pegmatites and eluvial deposits (7.25 t)
- Buffalo: in pegmatites and eluvial deposits (6.35 t)

(Legg, 1972.)

These resources were estimated at a shallow depth, but more substantial resources are expected at deeper levels. Modern exploration would be beneficial to provide baseline data for future exploitation of Zambian tin occurrences. FAM, a private UK exploration company, is advancing lithium and tin exploration in Zambia's Choma Belt with its flagship Misika project (see lithium section).

No production of tin is currently known for Zambia.

Uranium



Sklodowskite-bearing schist, Kawanga, Northwestern Province

Highlights

Uranium end-use applications are dominated by energy production, with other uses in the medical, industrial and defence sectors (World Nuclear Association, 2024a). In 2023, Kazakhstan, Canada and Namibia were the top producers of uranium and accounted for around 39.3, 21.3, and 13.1 per cent of global production of triuranium oxide, respectively (Idoine et al., 2025). Namibia and South Africa are the only known uranium-producing African nations (Idoine et al., 2025). Uranium is listed as critical in the latest Canadian criticality assessment and as non-critical by the UK (Mudd et al., 2024).

Uranium is found in a wide variety of geological settings, including intrusive igneous, volcanic, polymetallic iron-oxide breccia complexes, metasomatic and metamorphic, unconformity-related, sandstone-hosted, coal, carbonates, phosphates and black shales (World Nuclear Association, 2024b). In Zambia, uranium is either found in the same geological settings as copper or in the Early Triassic Escarpment Grit Formation (Money and Prasad, 1979).

In Zambia, six deposits at two locations are at advanced exploration stages (Table 5). Sporadic uranium mineralisation is known at Lumwana Mine, but Barrick have not produced uranium from the mine. Uranium exploration at Lumwana began in 1981, with significant drilling and feasibility studies conducted between 1990 and 2008 (Londono and Sanfurgo, 2014). In 2012, six mining licenses were granted for various minerals, including uranium as a by-product of copper. The mine consists of the Chiwungo and Malundwe deposits, primarily producing copper, with uranium present as uraninite (Londono and Sanfurgo, 2014). Probable and inferred uranium resources are 3.3 Mt at 0.123 per cent triuranium oxide and 2.4 Mt at 0.078 per cent triuranium oxide (PorterGeo, 2025).

GoviEx Uranium holds several uranium exploration licenses in Southern Province, around 200 km south of Lusaka (GoviEx Uranium, 2025). These deposits, which include Gwabi, Njame, Muntanga, Dibwi and Dibwi East, are at an advanced stage with feasibility studies in progress (GoviEx Uranium, 2025) and an Environmental and Social Impact Assessment was recently filed with the Zambian Environmental Management agency (GoviEx Uranium, 2025) (Table 5).

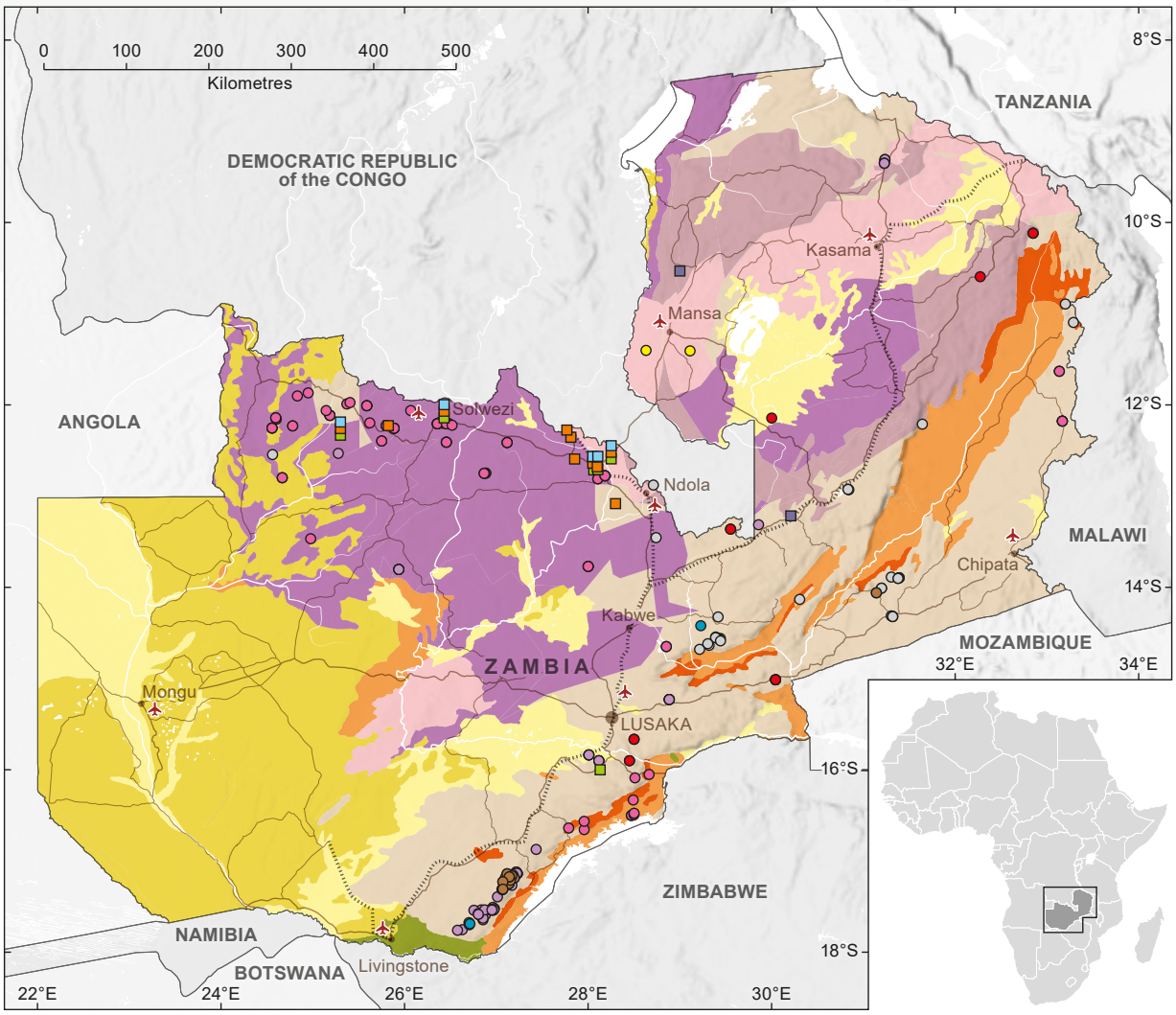
Production at the Mutanga project is forecast to start in 2028, with an expected life-of-mine of around 12 years. According to GoviEx, the project features low-cost, low-risk operations, shallow open-pit mining of easily processed soft rock, and efficient heap leaching with low acid consumption supplied by Zambian acid production (GoviEx Uranium, 2025).

No production of uranium is currently known for Zambia.

Table 5 Uranium exploration projects in Zambia in 2024.

Deposit	Commodity	Owner	Estimated resources (Mt)	Grades (U) (ppm)
Njame	U_3O_8	Gioviex	3	374
Gwabi	U_3O_8	Gioviex	3.8	314
Muntanga	U_3O_8	Gioviex	7.5	360
Dibwi	U_3O_8	Gioviex	3.1	374
Dibwi East	U_3O_8	Gioviex	25.2	374
Lumwana	U_3O_8	Barrick Gold	5.7	1000

Critical minerals in Zambia



Geological map of Zambia highlighting locations of active mines and mineral occurrences. Active mines are designated as 'deposit'. Mineral occurrences of cobalt, copper, manganese and nickel have been omitted to make the map more readable.

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Digital copies of the 'Critical minerals potential of Zambia' guide can be downloaded from the BGS MineralsUK website:

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