Critical Minerals in the Northern Territory
2023

resourcingtheterritory.nt.gov.au
Acknowledgement

The Northern Territory Government respectfully acknowledges Aboriginal and Torres Strait Islander peoples as the First Nations people of this country. We acknowledge the continuing connection to lands, waters and communities, and the evolving cultures of all our First Nations peoples. We pay our respects to all Aboriginal and Torres Strait Islander cultures, and to their leaders - past, present and emerging.

Cover image: Copper mineralisation.

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Foreword

The Northern Territory has the critical minerals that are needed to advance new technologies and tackle the issue of climate change.

Global demand is rapidly growing for critical minerals, presenting a substantial economic and strategic opportunity for the Northern Territory and our partners.

Of the world’s critical minerals, the Northern Territory has economically demonstrated resources of 15, with high potential for a further 13.

We want more investment in our critical minerals sector and the Northern Territory Government’s $9.5 million Resourcing the Territory program provides grants to companies exploring greenfields and brownfields sites to find and prove up resources.

We work in partnership with you and have extensive geoscience information to also assist companies.

The Territory is already a global leader in manganese production and has Australia’s only lithium mine outside of WA, located just outside of Darwin.

This document outlines the known resource inventory of the Territory’s critical minerals, which highlights the exciting opportunities presented by existing and developing projects.

We are also ensuring that the right policy settings are in place to be globally competitive, while remaining committed to sustainable practices and mine rehabilitation.

With the increasing focus in our key markets on environmental, social and governance (ESG) credentials and tracking of whole-of-life carbon emissions for critical minerals projects, there are also real opportunities for the Territory to derive a competitive advantage as an ethical and environmentally-responsible supplier of critical minerals.

I’m excited by the opportunities the critical minerals industry presents for the Northern Territory, in creating jobs, growing downstream industries, supporting decarbonisation and growing our economy.

Hon Nicole Manison
Minister for Mining and Industry
Introduction

The Northern Territory is well placed to become an important new player in global supply chains for the critical minerals that are required for new technologies and the energy transition.

This document outlines the Territory’s resource endowment of its current list of 15 critical minerals – aluminium, cobalt, copper, lithium, magnesium, manganese, molybdenum, nickel, phosphate; rare earth elements, titanium, tungsten, vanadium, zinc and zirconium – as well as its geological potential for a further 13 emerging critical minerals.

The demand for critical minerals is expected to keep growing to support renewable energy, battery storage and high-technology industries.

Further exploration is needed to ensure an ongoing pipeline of critical minerals projects that can underpin investment in downstream processing and the development of long-term supply chains.

This presents significant economic and strategic opportunities for the Northern Territory to become a reliable supplier of minerals to support the transition to a decarbonised economy.

To support exploration, the Northern Territory Government provides $9.5 million each year towards the Resourcing the Territory program through exploration grants and innovative geoscience programs to de-risk and accelerate critical minerals exploration in the Territory.
Resourcing the Territory
$9.5 million per year to support exploration

The Territory Government is committed to attracting and supporting increased exploration for critical minerals through the $9.5 million per annum Resourcing the Territory program, which is funded on an ongoing basis. Through the program the Territory Government provides high-quality geoscience data free-of-charge to explorers, and provides grant funding to support eligible industry exploration programs.

Geophysics and Drilling Collaborations grants
A flagship component of Resourcing the Territory is a $3 million per annum competitive exploration grants program that awards co-funding of up to 50% of the cost of drilling (both greenfields and brownfields), regional scale geophysical surveys and innovative exploration targeting.

Co-funding amounts are capped between $100,000 to $200,000 per project dependent on specific eligibility criteria, with the majority of funding directed into projects targeting critical minerals.

In addition to the grants program, the NT Geological Survey (NTGS) applies precompetitive geoscience and partners with the research sector and industry to explore opportunities to identify new sources of critical minerals and help de-risk investment in the sector. This includes:

Documenting the Territory’s critical minerals resources
- compiling and publishing inventories of known resources and occurrences of critical minerals in the Territory.

Geochemical sampling and analysis for critical minerals
- geochemically re-analysing existing sample sets for a full suite of elements including critical minerals
- investigating potential for processing of tailings and other legacy mine waste in the Territory to contain critical minerals, including sample testing and characterisation in partnership with the University of Queensland.

New geoscience on critical minerals
- upgrading regional geophysical datasets to assist exploration targeting
- undertaking geoscience and mineral system studies in the Pine Creek region and Aileron Province that will aid assessment of potential for critical minerals such as rare earths, lithium, nickel, antimony, platinum group elements, tin and cobalt
- developing research collaborations to apply science to support critical minerals exploration such as improving targeting for lithium bearing pegmatites, fingerprinting ironstones that are fertile for copper-gold-cobalt-bismuth mineralisation and investigating rare earths deposit styles across the Territory
- participating in ongoing geoscience studies and collaborations on the Territory’s vast Proterozoic basins that have high potential for sediment-hosted copper-cobalt, zinc and manganese.

For more information visit, resourcingtheterritory.nt.gov.au
What are critical minerals?

Geoscience Australia defines critical minerals as metals, non-metals and minerals that are considered vital for the economic well-being of the world’s major and emerging economies, yet whose supply may be at risk due to geological scarcity, geopolitical issues, trade policy or other factors.

Among these important commodities are metals and semi-metals used in the manufacture of wind turbines, electric vehicles, solar panels, rechargeable batteries, mobile phones and computers, flat screen monitors, fibre-optic cables, semi-conductors, defence industry technology and products, as well as aerospace, medical and high-tech applications.

Criticality is a subjective concept and individual countries develop their own lists of critical minerals based on the relative importance of particular minerals to their industrial and strategic requirements. Assessments of criticality are also essentially snapshots at a particular time and are subject to change. A summary and comparison of the minerals currently defined as critical by some of Australia’s important trading partners is shown below.

**Minerals identified as ‘Critical’**

by United States, Japan, and the European Union

- **Japan**
  - Barium (Ba)
  - Molybdenum (Mo)
  - Rhenium (Re)
  - Selenium (Se)
  - Thallium (Tl)

- **Japan + EU**
  - Boron (B)
  - Silicon metal (Si)
  - Strontium (Sr)

- **USA + Japan**
  - Cesium (Cs)
  - Chromium (Cr)
  - Manganese (Mn)
  - Nickel (Ni)
  - Rubidium (Rb)
  - Tellurium (Te)
  - Zirconium (Zr)

- **USA + Japan + EU**
  - Antimony (Sb)
  - Beryllium (Be)
  - Bismuth (Bi)
  - Cobalt (Co)
  - Fluorine (F)
  - Gallium (Ga)
  - Germanium (Ge)
  - Graphite (C)
  - Hafnium (Hf)
  - Indium (In)
  - Lithium (Li)
  - Magnesium (Mg)
  - Niobium (Nb)
  - Tantalum (Ta)
  - Titanium (Ti)
  - Tungsten (W)
  - Vanadium (V)
  - Platinum group metals
  - Rare earth elements

- **USA**
  - Arsenic (As)
  - Tin (Sn)
  - Zinc (Zn)

- **USA + EU**
  - Aluminium (Al)
  - Bauxite
  - Barite (BaSO4)
  - Scandium (Sc)

- **EU**
  - Phosphorus (P)
  - Coking coal
  - Phosphate rock
  - Rubber (natural)

Australia’s 26 critical minerals shown in orange (also includes helium)

The Territory’s list of critical minerals are those minerals defined as critical by Australia or key trading partners for which the Territory has economically demonstrated resources with potential for future production.

The table below lists the Northern Territory’s 15 critical minerals. Of these, 9 are on the Australia’s critical minerals list and 5 are on critical mineral lists published by key trading partners (USA, UK, EU, Japan and India). Copper, which is on the Canadian critical minerals list, is also considered by the Northern Territory to be a critical mineral given the increasing demand for copper to support global electrification.

<table>
<thead>
<tr>
<th>The Territory’s critical minerals</th>
<th>Emerging critical minerals in the Territory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium</td>
<td>Antimony</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Bismuth</td>
</tr>
<tr>
<td>Copper</td>
<td>Gallium</td>
</tr>
<tr>
<td>Lithium</td>
<td>Germanium</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Graphite</td>
</tr>
<tr>
<td>Manganese</td>
<td>Helium</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>High purity alumina</td>
</tr>
<tr>
<td>Nickel</td>
<td>Niobium</td>
</tr>
<tr>
<td>Phosphate</td>
<td>Platinum-group elements</td>
</tr>
<tr>
<td>Rare earth elements</td>
<td>Scandium</td>
</tr>
<tr>
<td>Titanium</td>
<td>Silicon</td>
</tr>
<tr>
<td>Tungsten</td>
<td>Tantalum</td>
</tr>
<tr>
<td>Vanadium</td>
<td>Tin</td>
</tr>
<tr>
<td>Zinc</td>
<td></td>
</tr>
<tr>
<td>Zirconium</td>
<td></td>
</tr>
<tr>
<td>Antimony</td>
<td></td>
</tr>
<tr>
<td>Bismuth</td>
<td></td>
</tr>
<tr>
<td>Gallium</td>
<td></td>
</tr>
<tr>
<td>Germanium</td>
<td></td>
</tr>
<tr>
<td>Graphite</td>
<td></td>
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<tr>
<td>Scandium</td>
<td></td>
</tr>
<tr>
<td>Silicon</td>
<td></td>
</tr>
<tr>
<td>Tantalum</td>
<td></td>
</tr>
<tr>
<td>Tin</td>
<td></td>
</tr>
</tbody>
</table>

Of these 15 critical minerals, the Territory currently produces manganese, lithium, aluminium (as bauxite), zinc and titanium (as ilmenite). There are also opportunities for significant near-term production of additional critical minerals including rare earth elements, phosphate, copper, cobalt, magnesium, vanadium and tungsten from advanced projects in the Territory.

Thirteen critical minerals with known occurrences and exploration potential in the Territory are also listed above and are considered to be the Territory’s emerging critical minerals. These emerging critical minerals are all on Australia’s critical mineral list, with the exception of tin, which is considered critical by the USA.
The Territory's enabling infrastructure

WIND TURBINES
Wind turbines require concrete, steel, iron, fibreglass, polymers, aluminium, copper, zinc and rare earth elements.

ELECTRIC VEHICLES
Electric vehicle battery chemistries depend on five critical minerals: lithium, cobalt, manganese, nickel, and graphite.

BATTERY STORAGE
Lithium, nickel, cobalt, manganese and graphite are crucial to battery performance, longevity and energy density.

HIGH TECH AND ELECTRONICS
Cobalt, copper, lithium, nickel, and rare earth elements are all essential for producing electronics and other high tech products.

SHIPPING
Australia's closest deepwater port to east Asian markets.

RAILWAY
North-south rail corridor linking to Darwin port.

ENERGY
Large natural gas resources with network of pipelines. World-class solar irradiation supporting renewable energy generation.
Potential applications of the Territory’s critical minerals

Renewable energy

Electric vehicles

Energy storage

High tech industries and electronics

Producing in the NT  Defined resources in the NT  Emerging potential in the NT
Critical minerals mines, projects and resources.

The Territory has six operating mines for critical minerals, nine critical minerals projects at various stages of regulatory approvals or project financing, and a pipeline of earlier stage projects with defined resources.

There are opportunities to become involved in the Territory’s critical minerals industry including early-stage exploration opportunities through to project financing, equity or offtake.

More detail on advanced critical minerals projects in the Territory can be found in the *Australian Critical Minerals Prospectus 2022*. 
Northern Territory’s critical minerals endowment

Critical minerals occurrence by mineral:
- bauxite
- cobalt
- copper
- lithium
- magnesium
- manganese
- mineral sands (titanium, zircon, ilmenite)
- nickel
- RED
- tantalum
- tungsten
- vanadium
- zinc
- other critical minerals occurrence

Operating mines:
- Gove Bauxite
- Dhupuma Plateau Bauxite
- Finnis Lithium
- GEMCO Manganese
- Sill 80 Ilmenite
- McArthur River Zinc, Lead, Silver
- Peko Tailings Iron, Gold, Copper, Cobalt
- Tanami Operations Gold
- McArthur River Zinc, Lead, Silver
- Peko Tailings Iron, Gold, Copper, Cobalt
- Tanami Operations Gold

Critical minerals occurrence by mineral:
- bauxite
- cobalt
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- nickel
- RED
- tantalum
- tungsten
- vanadium
- zinc
- other critical minerals occurrence

Major proposed critical minerals mining projects:
- Winchester Magnesium
- Huandot Magnesium
- Winchelsea Manganese
- Jervois Copper, Silver, Gold
- Ammaroo Phosphate
- Wonarah Phosphate
- Nolans Rare Earths, Phosphate
- Jervois Copper, Silver, Gold

Existing infrastructure:
- Railway
- Road
- Minor road

Past and present mineral sands (titanium, zircon, ilmenite)
- Neoproterozoic-Cenozoic basin
- Neoproterozoic-Palaeozoic orogen
- Palaeo-Mesoproterozoic basin
- Palaeo-Mesoproterozoic orogen
- Archaean

Future enabling infrastructure:
- Middle Arm Sustainable Development Precinct
- AROWS Water Supply Project

Operating mine
- In approvals process
- Under feasibility
- JORC resource

Darwin Port
- Gove Port
- Alyangula Port
- Port Melville
- Bing Bong Loading/Export Facility

Existing infrastructure:
- Railway
- Road
- Minor road

Northern Territory's critical minerals endowment 2023

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## Northern Territory’s critical minerals resource inventory

<table>
<thead>
<tr>
<th>Critical mineral</th>
<th>On trading partners’ lists</th>
<th>Unit</th>
<th>NT defined resources (2021-22)</th>
<th>Territory annual production (2021-22)</th>
<th>NT total past production</th>
<th>Australian economic demonstrated resources (2020)</th>
<th>Australian production (2020)</th>
<th>Global production (2020)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithium (Li)</td>
<td>US, EU, UK, Japan, India</td>
<td>kt Li</td>
<td>186.2 kt</td>
<td>2.2 kt*</td>
<td>0</td>
<td>6,174</td>
<td>40⁹</td>
<td>82</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>US, Japan</td>
<td>Mt Mn ore</td>
<td>172.4 Mt</td>
<td>6.06 Mt</td>
<td>141</td>
<td>276</td>
<td>4.8⁹</td>
<td>17.2¹⁰</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>US</td>
<td>Mt Zn</td>
<td>23.8 Mt¹¹</td>
<td>0.279 Mt¹²</td>
<td>4.9</td>
<td>66.41</td>
<td>1.31</td>
<td>12</td>
</tr>
<tr>
<td>Aluminium (Al)</td>
<td>US, EU</td>
<td>Mt bauxite</td>
<td>&gt;98 Mt¹⁵</td>
<td>11.7 Mt</td>
<td>311</td>
<td>5,132</td>
<td>103.6</td>
<td>365</td>
</tr>
<tr>
<td>Titanium (Ti)</td>
<td>US, EU, Japan</td>
<td>kt ilmenite</td>
<td>&gt;368 kt</td>
<td>45 kt</td>
<td>&gt;100</td>
<td>274,000</td>
<td>1,100¹⁴</td>
<td>12,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>kt rutile</td>
<td>57 kt</td>
<td>0</td>
<td>no data</td>
<td>35,300</td>
<td>200¹⁵</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>kt TiO₂</td>
<td>8,501 kt</td>
<td>100 kt*</td>
<td>0</td>
<td>no data</td>
<td>no data</td>
<td>no data</td>
</tr>
<tr>
<td>Rare earth elements (REE)</td>
<td>US, EU, UK, Japan, India</td>
<td>kt oxide</td>
<td>1,698 kt</td>
<td>5 kt*</td>
<td>0</td>
<td>4,200</td>
<td>20¹⁶</td>
<td>240</td>
</tr>
<tr>
<td>Vanadium (V)</td>
<td>US, EU, UK, Japan, India</td>
<td>kt V</td>
<td>458.1 kt</td>
<td>6 kt*</td>
<td>0</td>
<td>7,408</td>
<td>0</td>
<td>86</td>
</tr>
<tr>
<td>Cobalt (Co)</td>
<td>US, EU, UK, Japan, India</td>
<td>kt Co</td>
<td>87.1 kt</td>
<td>0</td>
<td>0</td>
<td>1,495</td>
<td>5.6¹⁷</td>
<td>135</td>
</tr>
<tr>
<td>Phosphate (P₂O₅)</td>
<td>EU</td>
<td>Mt phosphate rock</td>
<td>2036 Mt</td>
<td>0</td>
<td>0</td>
<td>1,081</td>
<td>1.33¹⁸</td>
<td>222</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mt P₂O₅</td>
<td>323.5 Mt</td>
<td>0</td>
<td>0</td>
<td>178</td>
<td>no data</td>
<td>no data</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>EU</td>
<td>Mt Cu</td>
<td>1.25 Mt¹⁹</td>
<td>0</td>
<td>1.98</td>
<td>96.65</td>
<td>0.88</td>
<td>20.2</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>US, EU, Japan, UK</td>
<td>Mt magnesite</td>
<td>25.7 Mt</td>
<td>0</td>
<td>0</td>
<td>286</td>
<td>0.79⁹⁰</td>
<td>26²¹</td>
</tr>
<tr>
<td>Tungsten (W)</td>
<td>US, EU, Japan, UK</td>
<td>kt W</td>
<td>13.4 kt</td>
<td>0</td>
<td>6</td>
<td>577</td>
<td>&lt;1²²</td>
<td>84</td>
</tr>
<tr>
<td>Molybdenum (Mo)</td>
<td>Japan</td>
<td>kt Mo</td>
<td>4.4 kt</td>
<td>0</td>
<td>no data</td>
<td>403</td>
<td>0</td>
<td>300</td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>US, Japan</td>
<td>Mt Ni</td>
<td>0.05 Mt</td>
<td>0</td>
<td>0</td>
<td>21.4</td>
<td>0.17</td>
<td>2.5</td>
</tr>
<tr>
<td>Zirconium (Zr)</td>
<td>US, Japan, India</td>
<td>kt Zircon</td>
<td>403 kt</td>
<td>0</td>
<td>No data</td>
<td>79,300</td>
<td>400²³</td>
<td>2,000</td>
</tr>
</tbody>
</table>

Modified from Australian and global commodity data from Geoscience Australia’s Table 3: Australia’s Identified Mineral Resources as at December 2020.
Find the full list of footnotes here.
Northern Territory (NT) defined resources include all publicly announced total JORC mineral resources (Measured, Indicated and Inferred). Find the online reference links here.
*proposed future annual production
Global lithium demand continues to increase driven by the lithium-ion batteries for electric vehicles and consumer electronics.

The Territory is Australia’s only lithium producer outside of Western Australia and is well-placed to help meet this demand.

The Territory has significant lithium resources and exploration potential associated with spodumene-bearing pegmatites in the Bynoe pegmatite field, located close to the port of Darwin, where the Territory’s first lithium mine is in production.

Ongoing exploration by multiple companies is expected to significantly grow the resource base in the Bynoe field. There are also numerous earlier stage exploration projects underway, including in the Barrow Creek and Anningie pegmatite fields in the Aileron Province of Central Australia.

### Lithium mineral resources

<table>
<thead>
<tr>
<th>Name</th>
<th>Total JORC mineral resource</th>
<th>Contained Li (kt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finniss</td>
<td>30.6 Mt @ 1.31% Li$_2$O</td>
<td>186.2</td>
<td>Core Lithium Ltd</td>
</tr>
</tbody>
</table>

### Case study: Finniss

Core Lithium Ltd commenced production at the Territory’s first lithium mine at the Finniss project near Darwin in late 2022 with the first Direct Shipping Ore (DSO) exported in January 2023. When fully operational, the mine will produce 173 kt/year of spodumene concentrate at 5.8% Li$_2$O.

Ore is currently mined from the Grants open pit, to be followed by underground mining at the BP33 deposit. Staged development is planned across other deposits at the Finniss project and scoping is underway for potential lithium hydroxide production.

### Current lithium explorers in the Territory include:

- Core Lithium Ltd, Lithium Plus Minerals Ltd, Ragusa Minerals Ltd, Charger Metals NL, Evergreen Lithium Ltd and DeSoto Resources Ltd exploring near Darwin, including the Bynoe pegmatite field.
- Askari Metals Ltd, Australasian Metals Ltd, Encounter Resources Ltd, Core Lithium Ltd, Eastern Metals Ltd, Lithium Springs Ltd, Oceana Lithium Ltd and Tivan Ltd are commencing exploration in the Aileron Province in central Australia including the Barrow Creek and Anningie pegmatite fields.
The Territory is a world leader in manganese production, and will continue to be a major supplier of manganese to meet demand for alloying and battery applications.

GEMCO’s Groote Eylandt manganese mine is the world’s largest and lowest cost manganese mine. The mine has been in operation since 1966, it produces more than 15% of global production and is the largest contributor annually to the NT mineral production value. GEMCO is planning an expansion into their Eastern Leases, which should increase the life of mine beyond 2030. OM Manganese Ltd’s Bootu Creek mine was in operation from 2006-2021 and a new manganese mine is proposed on Winchelsea Island, near Groote Eylandt.

### Manganese mineral resources

<table>
<thead>
<tr>
<th>Deposit</th>
<th>Total JORC mineral resource</th>
<th>Manganese ore (Mt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEMCO (ROM)</td>
<td>138 Mt @ 43.6% Mn</td>
<td>138</td>
<td>South 32 Ltd</td>
</tr>
<tr>
<td>GEMCO (sands)</td>
<td>9 Mt @ 19.5%Mn</td>
<td>9</td>
<td>South 32 Ltd</td>
</tr>
<tr>
<td>Winchelsea</td>
<td>18.5 Mt @ 20.9% Mn</td>
<td>18.5</td>
<td>Winchelsea Mining Pty Ltd</td>
</tr>
<tr>
<td>Bootu Creek</td>
<td>6.92 Mt @ 13.18% Mn</td>
<td>6.9</td>
<td>OM Manganese Ltd</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>172.4</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Case study: Winchelsea

**Winchelsea Mining Pty Ltd**

www.wmining.com.au

Winchelsea Mining Pty Ltd are progressing the approvals process for a new manganese mine on Winchelsea Island, off the coast of Groote Eylandt, targeting production for 2024.

The proposed project involves low-cost shallow mining with little or no overburden and is majority owned by the local Traditional Owners through the Anindilyakwa Advancement Aboriginal Corporation.

Under feasibility **CAPEX** A$100M Jobs 100 construction 155 mining 16 year initial mine life Mining agreement with Anindilyakwa Land Council Mineral lease granted 2022

### Manganese production in the Territory:

- $14.6 billion worth of manganese produced in the Territory in the past decade.


- Exploration opportunities for sedimentary and hydrothermal manganese deposits.
The Territory is a major zinc producer, and is highly prospective for a range of zinc mineralisation styles.

Glencore’s McArthur River mine has been continuously mined since 1995 and is one of Australia’s largest zinc mines with a mine life past 2040. Teck Resources Ltd’s, Teena deposit, located close to McArthur River is the largest recent zinc discovery in Australia. The greater McArthur Basin, South Nicholson Basin and Lawn Hill Platform remain highly prospective for sediment-hosted zinc. This forms part of the Carpentaria Zinc Belt which extends into Queensland and is the world’s most productive zinc province with substantial undercover potential in the NT.

The Pine Creek Orogen, Aileron Province and Bonaparte Basin also have known resources and high potential for polymetallic zinc, lead and silver deposits.

**Select zinc mineral resources**

<table>
<thead>
<tr>
<th>Deposit</th>
<th>Total JORC mineral resource</th>
<th>Contained Zn (Mt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>McArthur River Mine</td>
<td>152 Mt @ 9.9% Zn, 4.5% Pb, 46 g/t Ag</td>
<td>15.1</td>
<td>Glencore PLC</td>
</tr>
<tr>
<td>Teena</td>
<td>58 Mt @ 11.1% Zn, 1.6% Pb</td>
<td>6.4</td>
<td>Teck Resources Ltd</td>
</tr>
<tr>
<td>Myrtle</td>
<td>43.6 Mt @ 4.1% Zn, 0.9% Pb</td>
<td>1.8</td>
<td>Teck Resources Ltd</td>
</tr>
<tr>
<td>Explorer 108</td>
<td>11.9 Mt @ 3.2% Zn, 2.0% Pb, 11.1 g/t Au, 124 g/t Ag, 0.25% Cu</td>
<td>0.4</td>
<td>Castile Resources Ltd</td>
</tr>
<tr>
<td>Hayes Creek</td>
<td>4.1 Mt @ 4.35% Zn, 0.91% Pb, 1.8 g/t Au, 124 g/t Ag, 0.25% Cu</td>
<td>0.2</td>
<td>PNX Metals Ltd</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>23.8</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Case study: Teena**

Teck Resources Ltd’s Teena zinc project is the largest zinc deposit discovered in Australia in the past thirty years, and is located 8km west of the McArthur River mine. It is a large shale-hosted zinc-lead deposit of a similar style to McArthur River. It was discovered in 2013 by Teck Resources in a joint venture with Rox Resources Ltd, with a maiden resource announced in 2016. Teck are now 100% owners of the project, and have continued to advance exploration.

In 2022, Teck announced that Teena is one of five zinc projects globally that are being assessed to identify development options and paths to realise value of the assets.

**Zinc production in the Territory:**

- McArthur River is the world’s 5th largest zinc mine, and is part of the world’s most productive zinc province.
Aluminium is an essential material for the energy transition, as an element of electrical infrastructure, solar panels, and wind turbines, and also has application in some batteries and permanent magnets.

The Territory is long term producer of bauxite from Rio Tinto’s Gove bauxite mine in the Carpentaria Basin in north-eastern Arnhem Land. Gove has been mined continuously for more than 40 years with a mine life extending to 2030. Gove produces around 11 million tonnes per annum (tpa) of bauxite and accounts for nearly all past bauxite production and 90% of identified bauxite resources in the NT.

A smaller mine run by the Aboriginal-owned Gulkula Mining Company has been in operation at the Dhupuma Plateau near Gove since 2017 and produces around 500,000 tpa of bauxite. Further lateritic bauxite deposits occur along the northern coastline of Arnhem Land and adjacent islands.

**Aluminium/bauxite mineral resources**

<table>
<thead>
<tr>
<th>Name</th>
<th>Total JORC mineral resource</th>
<th>Contained Al₂O₃ (Mt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gove</td>
<td>98.4 Mt @ 49.3% Al₂O₃</td>
<td>48.5</td>
<td>Rio Tinto</td>
</tr>
<tr>
<td>Dhupuma Plateau</td>
<td>Not publicly announced</td>
<td></td>
<td>Gulkula Mining Co. Pty Ltd</td>
</tr>
</tbody>
</table>

**Titanium**

Australian Ilmenite Resources Pty Ltd’s Sill 80 ilmenite mine produces high quality ilmenite (titanium-iron oxide) from mineral sands associated with weathered dolerite. While there is no publicly available JORC resources, production is expected to continue past 2030. Ilmenite also occur in other mineral sands deposits in the NT, including coastal sands on the Tiwi Islands.

The Territory’s largest titanium project is Tivan Ltd’s Mount Peake project in the northern Aileron Province, which contains a significant titanium resource associated with vanadium-rich magnetite in a layered mafic intrusion. Tivan are planning production of 100 kt/year of titanium oxide pigment through downstream processing in the NT.

**Titanium mineral resources**

<table>
<thead>
<tr>
<th>Name</th>
<th>Total JORC mineral resource</th>
<th>Contained TiO₂ (kt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sill 80</td>
<td>No published JORC resource</td>
<td>No published</td>
<td>Australian Ilmenite Resources Pty Ltd</td>
</tr>
<tr>
<td>Mount Peake</td>
<td>160.4 Mt @ 0.28% V₂O₅, 5.3% TiO₂, 23% Fe</td>
<td>8,501</td>
<td>Tivan Ltd</td>
</tr>
</tbody>
</table>
There is strong demand for cobalt to accommodate the rapid growth of the lithium-ion battery market for electric vehicles.

The Territory is an emerging producer of cobalt associated with ironstone-hosted copper-gold mineralisation in the Tennant Creek and Rover mineral fields. In the Rover field, Castile Resources Ltd have defined a cobalt resource at the Rover 1 copper-gold deposit, and are planning future production of pure cobalt metal. High-grade copper and cobalt intersections have been reported at Emmerson Resources Ltd’s Hermitage and Jasper Hills prospects north of Tennant Creek. Opportunities also exist to extract cobalt from tailings associated with historic mines in the Tennant Creek field. Elmore Ltd’s Peko Tailings project is currently producing magnetite, and is planning to commence extracting cobalt and copper from the tailings in 2023.

The largest known cobalt resource in the NT is at the Browns deposit near Batchelor in the Pine Creek Orogen, where cobalt occurs within a large resource that also contains copper, nickel and lead.

Sediment hosted cobalt-nickel-copper mineralisation occurs in the McArthur Basin, with significant exploration underway for sediment-hosted copper-cobalt mineralisation.

In Central Australia, laterite-hosted nickel-cobalt occurs in the southwestern Aileron Province and mafic-hosted copper-cobalt resources have been defined in the Irindina Province.

### Cobalt mineral resources

<table>
<thead>
<tr>
<th>Name</th>
<th>Total JORC mineral resource</th>
<th>Contained Co (kt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rover 1</td>
<td>5.94 Mt @ 1.68 g/t Au, 1.51% Cu and 5.58 Mt 0.07% Co, 23.2% magnetite</td>
<td>3.9</td>
<td>Castile Resources Ltd</td>
</tr>
<tr>
<td>Peko Tailings</td>
<td>3.62 Mt @ 1.1 g/t Au, 0.22% Cu, 0.1% Co</td>
<td>3.6</td>
<td>Elmore Ltd</td>
</tr>
<tr>
<td>Basil</td>
<td>26.5 Mt @ 0.57% Cu, 0.05% Co</td>
<td>13.3</td>
<td>Typhon Minerals Pty Ltd</td>
</tr>
<tr>
<td>Stanton</td>
<td>0.94 Mt @ 0.13% Co, 0.12% Cu, 0.061% Ni</td>
<td>1.2</td>
<td>Resolution Minerals Ltd</td>
</tr>
<tr>
<td>Browns Sulfide</td>
<td>45.1 Mt @ 0.35% Cu, 3.74% Pb, 0.73% Zn, 0.09% Co, 0.07% Ni</td>
<td>40.6</td>
<td>Northern Territories Resources Pty Ltd</td>
</tr>
<tr>
<td>Browns Oxide</td>
<td>9.4 Mt @ 0.82% Cu, 0.14% Co, 0.14% Ni</td>
<td>13.2</td>
<td>Northern Territories Resources Pty Ltd</td>
</tr>
<tr>
<td>Area 55</td>
<td>8.7 Mt @ 0.51 % Cu, 0.13 % Co, 0.15 % Ni</td>
<td>11.3</td>
<td>Northern Territories Resources Pty Ltd</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>87.1</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Case study: Rover 1

Castile Resources Ltd’s Rover 1 is a polymetallic iron-oxide copper-gold (IOCG) deposit located 80km southwest of Tennant Creek.

The project has completed a pre-feasibility study proposing an underground operation producing gold dore, pure copper metal, pure cobalt metal and high grade industrial magnetite from an onsite processing plant.

Potential for resource growth exists with the deposit open at depth and similar ore bodies identified nearby. Castile Resources Ltd plan to commence development approvals in early 2023.
Copper remains key to global decarbonisation and electrification with demand rapidly expected to outgrow supply. The Territory remains underexplored for copper with opportunities across many provinces and mineralisation styles.

The Aileron province is a significant emerging greenfields copper province with a variety of mineralisation styles identified across a large area. The most advanced project is KGL Resources Ltd’s Jervois copper project, which has mining approvals in place.

The Warramunga Province hosts the Tennant Creek mineral field, where the majority of the Territory’s past copper production has been sourced from ironstone-hosted gold-copper-bismuth deposits. Significant copper-gold resources remain in the field, and the associated Rover field, including Castile’s Rover 1 deposit. Recent high grade copper-gold discoveries near Tennant Creek include the Hermitage and Bluebird prospects. Vast areas east of Tennant Creek have high potential for copper-gold deposits beneath sedimentary cover.

The greater McArthur Basin, and equivalent successions in the South Nicholson Basin and Lawn Hill Platform have substantial and largely untested potential for sediment-hosted copper mineralisation. Majors including BHP, South32 and OZ Minerals are undertaking regional scale greenfields exploration programs for sediment-hosted copper.

Select copper mineral resources

<table>
<thead>
<tr>
<th>Deposit</th>
<th>Total JORC mineral resource</th>
<th>Contained Cu (kt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jervois</td>
<td>23.8 Mt @ 2.02% Cu, 25.3 g/t Ag, 0.25 g/t Au</td>
<td>480.8</td>
<td>KGL Resources Ltd</td>
</tr>
<tr>
<td>Rover 1</td>
<td>5.94 Mt @ 1.68 g/t Au, 1.51% Cu and 5.58 Mt @ 0.07% Co, 23.2% magnetite</td>
<td>89.7</td>
<td>Castile Resources Ltd</td>
</tr>
<tr>
<td>Home of Bullion</td>
<td>2.5 Mt @ 1.8% Cu, 2.0% Zn, 1.2% Pb, 36 g/t Ag, 0.14 g/t Au, 0.02% Co</td>
<td>45.0</td>
<td>Eastern Metals Ltd</td>
</tr>
<tr>
<td>Basil</td>
<td>26.5 Mt @ 0.57% Cu, 0.05% Co</td>
<td>151.1</td>
<td>Typhon Minerals Pty Ltd</td>
</tr>
<tr>
<td>Hendrix</td>
<td>2.6 Mt @ 6.7% Zn, 0.9% Cu, 1.5% Pb, 35 g/t Ag</td>
<td>23.4</td>
<td>Todd River Resources Ltd</td>
</tr>
<tr>
<td>Explorer 142</td>
<td>176,000 t @ 5.21% Cu, 0.21 g/t Au</td>
<td>9.2</td>
<td>Castile Resources Ltd</td>
</tr>
<tr>
<td>Geckoo</td>
<td>1.48 Mt @ 2.5% Cu</td>
<td>37.0</td>
<td>CuFe Ltd</td>
</tr>
<tr>
<td>Goanna</td>
<td>2.92 Mt @ 1.84% Cu, 0.17 g/t Au</td>
<td>53.7</td>
<td>CuFe Ltd</td>
</tr>
<tr>
<td>Orlando</td>
<td>2.2 Mt @ 1.4% Cu, 1.8 g/t Au</td>
<td>30.8</td>
<td>CuFe Ltd</td>
</tr>
<tr>
<td>Redbank</td>
<td>8.4 Mt @ 1.1% Cu</td>
<td>92.4</td>
<td>NT Minerals Ltd</td>
</tr>
<tr>
<td>Browns Oxide</td>
<td>9.4 Mt @ 0.82% Cu, 0.14% Co, 0.14% Ni</td>
<td>77.1</td>
<td>Northern Territories Resources Pty Ltd</td>
</tr>
<tr>
<td>Browns Sulfide</td>
<td>45.1 Mt @ 0.35% Cu, 3.74% Pb, 0.73% Zn, 0.09% Co, 0.07% Ni</td>
<td>157.9</td>
<td>Northern Territories Resources Pty Ltd</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>1,247.9</strong></td>
<td></td>
</tr>
</tbody>
</table>

Case study: Jervois

KGL Resources Ltd | ASX:KGL  
www.kglresources.com.au

KGL Resources Ltd plan to develop an open cut and underground mine to produce copper concentrate at Jervois, 270 km northeast of Alice Springs, and all mining and environmental approvals are in place. The mine will consist of two open cut mines (Reward and Bellbird) that will be developed first, followed by underground mining at four deposits.

The feasibility study is based on a mine with a 11.75 year life, producing 26,700 t per year of copper, 945 koz of silver and 6.5 koz of gold within a concentrate. First production is planned for late 2025, with copper concentrate to be trucked to the Glencore smelter in Mount Isa. The copper mineral resource is likely to continue to grow with further exploration, and strong potential to extend the mine life.

![Diagram](https://example.com/copper-map.png)
Magnesium metal is used as an alloying element to increase aluminium’s rigidity and strength in aerospace and automotive applications, and is used in a range of electronics including mobile phones.

The Territory has significant magnesite deposits located near Batchelor in the Pine Creek Orogen, 75 km south of Darwin. Korab Resources Ltd’s Winchester and Thessally Resources Pty Ltd’s Huandot deposits occur as stratabound bodies within the Celia and Coomalie Dolostones, and are located close to infrastructure and the Darwin Port. Both projects are undergoing scoping or feasibility studies including investigation of downstream processing options to produce caustic calcined magnesia and/or magnesium metal.

### Magnesium mineral resources

<table>
<thead>
<tr>
<th>Deposit</th>
<th>Total JORC mineral resource</th>
<th>Contained Magnesite (Mt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huandot</td>
<td>9.1 Mt @ 44.3% MgO</td>
<td>9.1</td>
<td>Thessally Resources Pty Ltd</td>
</tr>
<tr>
<td>Winchester</td>
<td>16.6 Mt @ 43.2% MgO</td>
<td>16.6</td>
<td>Korab Resources Ltd</td>
</tr>
<tr>
<td>Total</td>
<td>25.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Case study: Winchester**

Korab Resources Ltd | ASX:KOR  
www.korabresources.com

Korab Resources Ltd’s Winchester magnesite deposit is located 75 km south of Darwin port, with the most recent Scoping Study on the project released in 2022. The low cost, open pit project has been planned in three stages to generate the required capital. Stage 1 plans direct shipping ore (DSO) of magnesium carbonate (600 to 1,000 ktpa); Stage 2 DSO and a portion processed offsite to produce caustic calcined magnesia and dead burned magnesia; and Stage 3 includes developing a magnesium metal production plant to produce 50,000 tpa of high purity magnesium metal.

**Under feasibility**  
CAPEX  
Stage 1: A$2.5M  
Stage 3: A$410M  
JORC resources  
16.6 Mt @ 43.2% MgO  
15 year mine life  
Offtake agreement available  
Exploring downstream opportunities

**Magnesium in the Territory:**
- Significant near-surface magnesite resources located close to infrastructure.
- Potential for near-term mining with downstream processing opportunities.
The demand for phosphate for fertilisers will continue as global food production needs to increase. Rapid growth of lithium-iron-phosphate (LFP) batteries for the electric vehicle and energy storage industries provides an additional market for phosphate products.

The Territory has Australia’s largest undeveloped rock phosphate deposits in the Georgina Basin, including Verdant Minerals Ltd’s Ammaroo deposit and Avenira Ltd’s Wonarah deposit. These deposits comprise high-tonnage, near-surface sedimentary phosphorite. Both companies are looking at the feasibility of producing phosphoric acid, and Verdant are proposing downstream processing to produce mono-ammonium phosphate (MAP) and di-ammonium phosphate (DAP) fertilisers. Potential exists for further phosphate discoveries in the vast Georgina and Wiso basins.

Arafura Rare Earths Ltd’s rare earth deposit, Nolans, also contains a sizable phosphate resource, with planned production of 144,000 tpa of fertilizer-grade (54%) phosphoric acid from the proposed rare earth extraction plant.

### Phosphate mineral resources

<table>
<thead>
<tr>
<th>Name</th>
<th>Total JORC mineral resource</th>
<th>Contained P₂O₅ (Mt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammaroo</td>
<td>1,141 Mt @ 14% P₂O₅</td>
<td>159.7</td>
<td>Verdant Minerals Ltd</td>
</tr>
<tr>
<td>Nolans</td>
<td>56 Mt @ 2.6% REO, 11% P₂O₅</td>
<td>6.2</td>
<td>Arafura Rare Earths Ltd</td>
</tr>
<tr>
<td>Wonarah</td>
<td>842 Mt @ 18.1% P₂O₅</td>
<td>149.1</td>
<td>Avenira Ltd</td>
</tr>
<tr>
<td>Highland Plains</td>
<td>53 Mt @ 16% P₂O₅</td>
<td>8.5</td>
<td>Gibb River Diamonds Ltd</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>323.5</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Case study: Wonarah

Avenira Ltd | ASX:AEV
www.avenira.com

Avenira Ltd is planning development of the Wonarah phosphate project, located 245 km east of Tennant Creek near the Barkly Highway. Avenira is proposing that feedstock from Wonarah will enable three product streams:
- direct shipping ore (DSO) phosphate to supply fertiliser markets,
- thermal grade phosphoric acid and
- lithium-iron-phosphate (LFP) cathode active material.

The initial DSO operation will focus on export of high-grade (>30% P₂O₅) phosphate ore through Darwin Port. A Scoping Study on production of LFP is underway, following an Memorandum of Understanding between Taiwanese battery manufacturer Aleees, Avenira and the Northern Territory Government on a potential LFP battery cathode manufacturing plant in Darwin.

### Downstream plans for phosphate in the Territory:
- Australia’s largest undeveloped phosphate deposits.
- Plans for downstream processing to products including phosphoric acid, ammonium fertilisers and LFP battery cathode.
There is growing global demand for permanent NdFeB magnets used in wind turbines, audio and electronics, electric vehicles and emerging fusion energy technology.

The Territory’s most significant rare earth deposit, Arafura Rare Earths Ltd’s Nolans project, is located in the Aileron Province north of Alice Springs, and promises to be Australia’s first integrated mining and rare earth separation project. The deposit is hosted within fluorapatite veins containing allanite and monazite, and is rich in the magnet-feed rare earths neodymium and praseodymium (NdPr).

The Territory has high exploration potential for a range of rare earth mineralisation styles. This includes rare earth elements within xenotime and monazite in heavy mineral sands in central Australia and the Tiwi Islands, carbonatite-related rare earth elements in Central Australia, discoveries of clay-hosted rare earth elements in the northern half of the Territory and vein-hosted xenotime (heavy rare earth elements) in the Tanami Region.

**Rare earth oxide (REO) mineral resources**

<table>
<thead>
<tr>
<th>Name</th>
<th>Total JORC mineral resource</th>
<th>Contained REO (kt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nolans</td>
<td>56 Mt @ 2.6% REO, 11% P₂O₅</td>
<td>1456.0</td>
<td>Arafura Rare Earths Ltd</td>
</tr>
<tr>
<td>Charley Creek</td>
<td>805 Mt @ 0.029% TREO</td>
<td>233.45</td>
<td>Enova Mining Ltd</td>
</tr>
<tr>
<td></td>
<td>including 0.04% Monazite, 0.01% Xenotime 0.05% Zr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1,689</td>
<td></td>
</tr>
</tbody>
</table>

**Case study: Nolans**

Arafura Rare Earths Ltd | ASX:ARU  
www.arultd.com

Arafura Rare Earths Ltd’s Nolans project is globally significant with the potential to meet up to 5% of the world’s global supply of NdPr.

The company has all approvals in place for mining through to onsite separation of rare earths to produce 4,440 tonnes per annum (tpa) of NdPr oxide and 470 tpa of a mixed middle-heavy rare earth (SEG/HRE) oxide (REO). They also plan to produce 144,000 tpa of fertilizer-grade phosphoric acid (54% P₂O₅).

**Proposed rare earth production in the Territory:**

- First rare earth production in the Territory is scheduled for 2025-26.
- Australia’s first integrated mining and rare earth separation operation planned at Nolans.
The demand for vanadium is expected to rise as the technology for long lifespan and durable vanadium redox flow batteries improves.

Tivan Ltd’s Mount Peake deposit in the northern Aileron Province near Barrow Creek contains the Territory’s largest high grade vanadium resource, associated with vanadium-rich magnetite in near-surface mafic intrusion. Exploration potential exists throughout the Aileron Province for further mafic-hosted vanadium magnetite occurrences.

Vanadium also occurs in sandstone-hosted uranium deposits in Central Australia. Energy Metal Ltd’s Bigrlyi deposit is a shallow sandstone hosted uranium-vanadium deposit that occurs on the edge of the Ngalia Basin. Laterite-hosted vanadium mineralisation has been recorded in the Carpentaria Basin.

### Vanadium mineral resources

<table>
<thead>
<tr>
<th>Name</th>
<th>Total JORC mineral resource</th>
<th>Contained $V_2O_5$ (kt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mount Peake</td>
<td>160.4 Mt @ 0.28% $V_2O_5$, 5.3% TiO$_2$, 23% Fe</td>
<td>449.1</td>
<td>Tivan Ltd</td>
</tr>
<tr>
<td>Bigrlyi</td>
<td>7.5 Mt @ 0.13% U$_3$O$_8$, 0.12% $V_2O_5$</td>
<td>9.0</td>
<td>Energy Metals Ltd</td>
</tr>
<tr>
<td>Total</td>
<td>458.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Case study: Mount Peake

Tivan Limited | ASX:TVN
www.tivan.com.au

Tivan Ltd’s Mount Peake project is an advanced mining project planning mining and downstream processing to produce 6000 tpa of high-purity vanadium pentoxide along with titanium pigment and ferric oxide products using TIVAN® technology.

Tivan Ltd is progressing plans for a Vanadium Redox Flow Battery business including potential production of vanadium electrolyte.

**Potential vanadium production in the Territory:**

- Large near surface vanadium resource at Mount Peake with planned downstream processing.
- Potential for future vanadium production as a by-product of mining of sandstone-hosted uranium.
Tungsten and molybdenum are both primarily alloying metals used in aerospace, steel hardening, cutting and drilling.

The Territory’s most significant tungsten and molybdenum resource is at Thor Energy PLC’s Molyhil tungsten and molybdenum deposit hosted in the Aileron Province northeast of Alice Springs. Further tungsten occurrences are present in the Hatches Creek and Wauchope tungsten fields in the Davenport Province that produced most historic production of wolframite and scheelite. While historic occurrences across the Aileron province and Pine Creek Orogen highlight further exploration opportunities.

### Tungsten and molybdenum mineral resources

<table>
<thead>
<tr>
<th>Name</th>
<th>Total JORC mineral resource</th>
<th>Contained $WO_3$ (kt)</th>
<th>Contained Mo (kt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molyhil</td>
<td>4.39 Mt @ 0.27% $WO_3$, 0.10% Mo</td>
<td>11.8</td>
<td>4.4</td>
<td>Thor Energy PLC</td>
</tr>
<tr>
<td>Samarkand</td>
<td>0.245 Mt @ 0.19% $WO_3$</td>
<td>0.47</td>
<td></td>
<td>Thor Energy PLC</td>
</tr>
<tr>
<td>White Violet</td>
<td>0.495 Mt @ 0.22% $WO_3$</td>
<td>1.1</td>
<td></td>
<td>Thor Energy PLC</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>13.4</strong></td>
<td><strong>4.4</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Case study: Molyhil**

Thor Energy PLC | ASX: THR  
www.thorenergyplc.com

Thor Energy PLC’s Molyhil deposit is hosted in a scheelite-molybdenite-magnetite skarn located 220 km northeast of Alice Springs near the Plenty Highway, with estimated resources containing 11,800 tonnes of tungsten and 4,000 tonnes of molybdenum.

A Feasibility Study in 2018 was based on a 7 year open pit mine, followed by potential underground mining of deeper extensions of the deposit. Further development studies are being undertaken by Investigator Resources Ltd as part of an earn-in to the project from Thor Energy. Additional tungsten resources at the nearby Samarkand and White Violet prospects may also extend the current mine life.

- The largest known tungsten and molybdenum resources occur in skarns in the Aileron Province.
- Tungsten-rich veins and greisens occur in the Davenport Province and Pine Creek Orogen, associated with tin, copper and/or molybdenum.
Growth in electric vehicles and renewable energy are fueling demand for nickel and other battery metals.

The Territory is prospective but underexplored for nickel. The only defined resources are in the polymetallic Browns resource in the Pine Creek Orogen, and a small resource at Resolution Minerals Ltd’s Stanton Co-Cu-Ni prospect.

There is considerable potential for nickel sulphide deposits in the Aileron and Irindina provinces. While the region remains effectively unexplored for nickel, a number of prospects have been identified with numerous generations of mafic and ultramafic intrusions considered fertile for nickel mineralisation. Feeders to the widespread flood basalts of the Kalkarindji Province are also a prospective exploration target.

**Nickel mineral resources**

<table>
<thead>
<tr>
<th>Name</th>
<th>Total JORC mineral resource</th>
<th>Contained Ni (kt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Browns Oxide</td>
<td>9.4 Mt @ 0.82% Cu, 0.14% Co, 0.14% Ni</td>
<td>13.2</td>
<td>Northern Territories Resources Pty Ltd</td>
</tr>
<tr>
<td>Browns Sulfide</td>
<td>45.1 Mt @ 0.35% Cu, 3.74% Pb, 0.73% Zn, 0.09% Co, 0.07% Ni</td>
<td>31.6</td>
<td>Northern Territories Resources Pty Ltd</td>
</tr>
<tr>
<td>Stanton</td>
<td>0.94 Mt @ 0.13% Co, 0.12% Cu, 0.061% Ni</td>
<td>0.6</td>
<td>Resolution Minerals Ltd</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>45.4</strong></td>
<td></td>
</tr>
</tbody>
</table>

Zircon is a refractory material and a principal component of metallic zirconium used for nuclear, space, aeronautic and medical applications. There is also growing demand for the zircon chemicals, particularly in catalytic converters for automotive and industrial exhaust systems to reduce emissions.

The Territory is a past producer of zircon from mineral sands deposits on the Tiwi Islands where mining took place between 2006 and 2013.

Enova Mining Ltd’s Charley Creek deposit in Central Australia is a large alluvial resource containing monazite, xenotime and an estimated 403 kt of contained zircon. Further resources of mineral sands including zircon have been defined in the southwest of Bathurst Island on the Tiwi Islands.

**Zirconium mineral resources**

<table>
<thead>
<tr>
<th>Name</th>
<th>Total JORC mineral resource</th>
<th>Contained Zircon (kt)</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charley Creek</td>
<td>805 Mt @ 0.029% REO and 0.05% Zircon</td>
<td>403</td>
<td>Enova Mining Ltd</td>
</tr>
</tbody>
</table>
Emerging critical minerals in the Territory

The Territory has substantial potential to grow its critical minerals inventory. In addition to the Territory’s current list of 15 critical minerals, there are 13 additional critical minerals listed in the following pages for which the Territory has known occurrences and demonstrated geological potential. The Territory has seen limited exploration to date for many of these commodities. It is expected that in the coming decade, economically demonstrated resources will be defined for some of these commodities, at which time they will move into the Territory’s critical minerals list.
Emerging critical minerals in the Territory

Antimony
Antimony occurs as a potential by-product in a number of gold deposits in the Northern Territory. The University of Queensland and NTGS are currently testing the potential for antimony associated with gold tailings in the Pine Creek region.

Bismuth
The Tennant Creek mineral field contains significant gold-bismuth-copper mineralisation with bismuth occurring within a number of projects under feasibility including Castile Resources Ltd’s, Rover 1 copper-gold deposit, southwest of Tennant Creek. Recent high grade bismuth (and gold) discoveries include Emmerson Resources Ltd’s historic Golden Forty deposit.

Gallium and germanium
Gallium and germanium are known to occur as a by-product in zinc deposits, with potential to occur associated with zinc in the McArthur Basin.

Graphite
The Pine Creek Orogen, Aileron Province and Tanami Region all have known potential to contain graphite. Tivan Ltd intersected broad intervals of >5% graphite in drilling at their Mount Peake project in the Aileron Province in 2014.

Kingsland Minerals Ltd are commencing exploration of the Lelyn graphite project near Pine Creek that has historic assays of up to 17.4% total graphitic carbon in a 20 km strike length of graphitic schist.

Helium
High concentration of naturally occurring helium have been recorded from petroleum wells in the Amadeus Basin, with concentration of up to 9% helium intersected in sub-salt plays in the south of the Basin. Peak Helium Pty Ltd is targeting helium in the southern Amadeus Basin, partly through joint ventures with Central Petroleum Ltd and Santos Ltd. Australia’s only helium extraction plant, BOC Darwin Helium Operations based in Darwin, already processes gas derived from the offshore Bayu-Undan field, and may be able to support further helium development in the Territory.

High Purity Alumina
Enova Mining Ltd are investigating the production of high purity alumina from saprolite and clays as a by-product of processing at the Charley Creek rare earths project.
Sn 50

Nb 41

The Territory has a history of tin mining in the Pine Creek Orogen and northern Aileron Province. The Mount Wells project in the Pine Creek Orogen includes an inferred mineral resource of 3,000 t of contained tin, with exploration further potential.

Niobium

Lithium-bearing pegmatites in the Northern Territory locally also have high values of niobium, with the potential for economically significant deposits to occur. High grade niobium (with rare earths) has also been discovered in mineralised carbonatites in the Aileron Province in adjacent regions of Western Australia, with potential extending into western regions of the NT.

Pt 78

Platinum Group Elements (PGE)

The Coronation Hill deposit (now inaccessible) contains 5.7 t palladium and 1.7 t platinum. Other PGE-gold occurrences occur in the Pine Creek area. PGEs have also been intersected in drilling of mafic intrusions in the Aileron Province in Central Australia.

Sc 21

Scandium

Enova Mining Ltd have announced that they are scoping production of scandium oxide from saprolite and clays as part of the Charley Creek rare earths project. No scandium resource has been announced to date.

Si 14

Silicon

Territory Sands Pty Ltd are actively exploring for high-purity silica sand in the Sturt Plateau region, adjacent to the railway between Katherine and Tennant Creek.

Ta 73

Tantalum

The Territory has a history of tantalum (and tin) mining throughout the outcropping pegmatite fields of the Pine Creek Orogen and northern Aileron Province. Significant exploration potential exist in these regions and undercover, while production is possible in association with lithium from pegmatite fields in the Bynoe region.

Sn 50

Tin

The Territory has a history of tin mining in the Pine Creek Orogen and northern Aileron Province. The Mount Wells project in the Pine Creek Orogen includes an inferred mineral resource of 3,000 t of contained tin, with exploration further potential.