



Critical Minerals Webinar Series

Part 1: Introduction and overview

Malte Ebach

TESEP Regional Co-ordinator

Teacher
Earth
Science
Education
Programme Ltd



We wish to acknowledge the Traditional Owners of the land on which we meet today.

We also wish to pay our respects to Elders past, present and future.

Teacher
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- Sydney Mineral Exploration Discussion Group (SMEDG)



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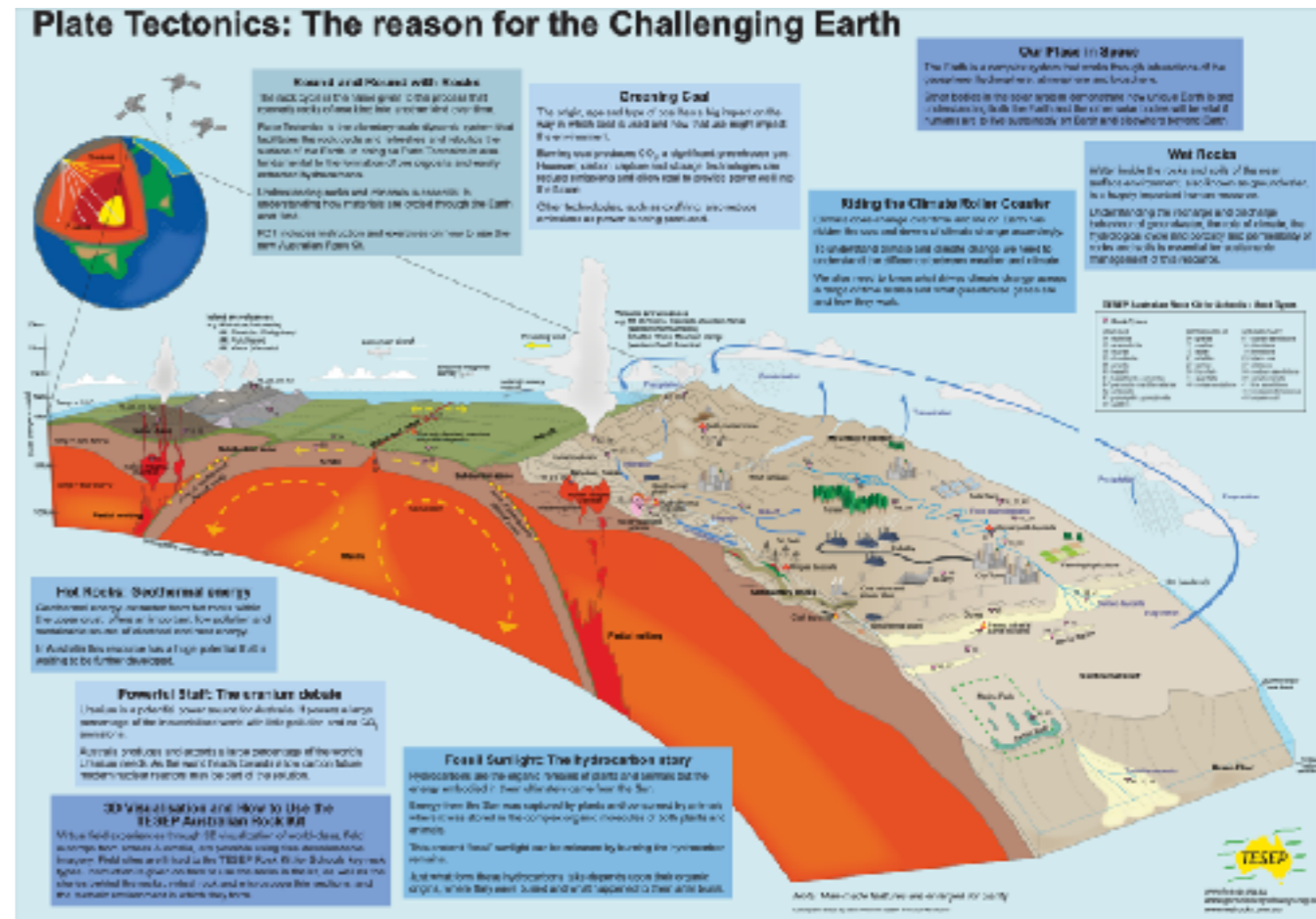
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TESEP Rock Kit and Plate Tectonics Poster



A great to teach where rocks form and the industries that extract and use them.

Get them from haines.com.au or host a [PD at your school!](#)

You can also get them as a [bundle](#)

TESEP Rock and Mineral Check



With each School visit we offer a free rock and mineral check:

- To identify specimens no longer useful for teaching (e.g., pebbles, small specimens etc.)
- To identify any misplaced specimens or valuable specimens (for display only)
- To identify any hazardous material (e.g., asbestos, pitchblende etc.)

TESEP Australian Critical Minerals Kit



2 boxes with 26 minerals:

- Critical minerals
- Metallic minerals
- Rock forming minerals
- Moh's scale of hardness
- Online resources include:
 - Mineral Stories
 - Questions for students
 - 3D renders



Considered hosting a PD at your school?

ABC NEWS

More resourcing, professional development for teachers could help improve NAPLAN results

By national families reporter Fiona Blackwood

Education

9h ago



After 17 years of NAPLAN testing, little has changed when it comes to literacy and numeracy proficiency. (ABC News/Michael Czernik)

In short:

One in three Australian students are not meeting expectations in numeracy and literacy, the latest NAPLAN results show.

Experts say where people live, culture and privilege still shape opportunity in Australia.

What's next?

There are calls for better preparing teachers for the classroom, more resources for schools and smaller class sizes to help improve education outcomes.

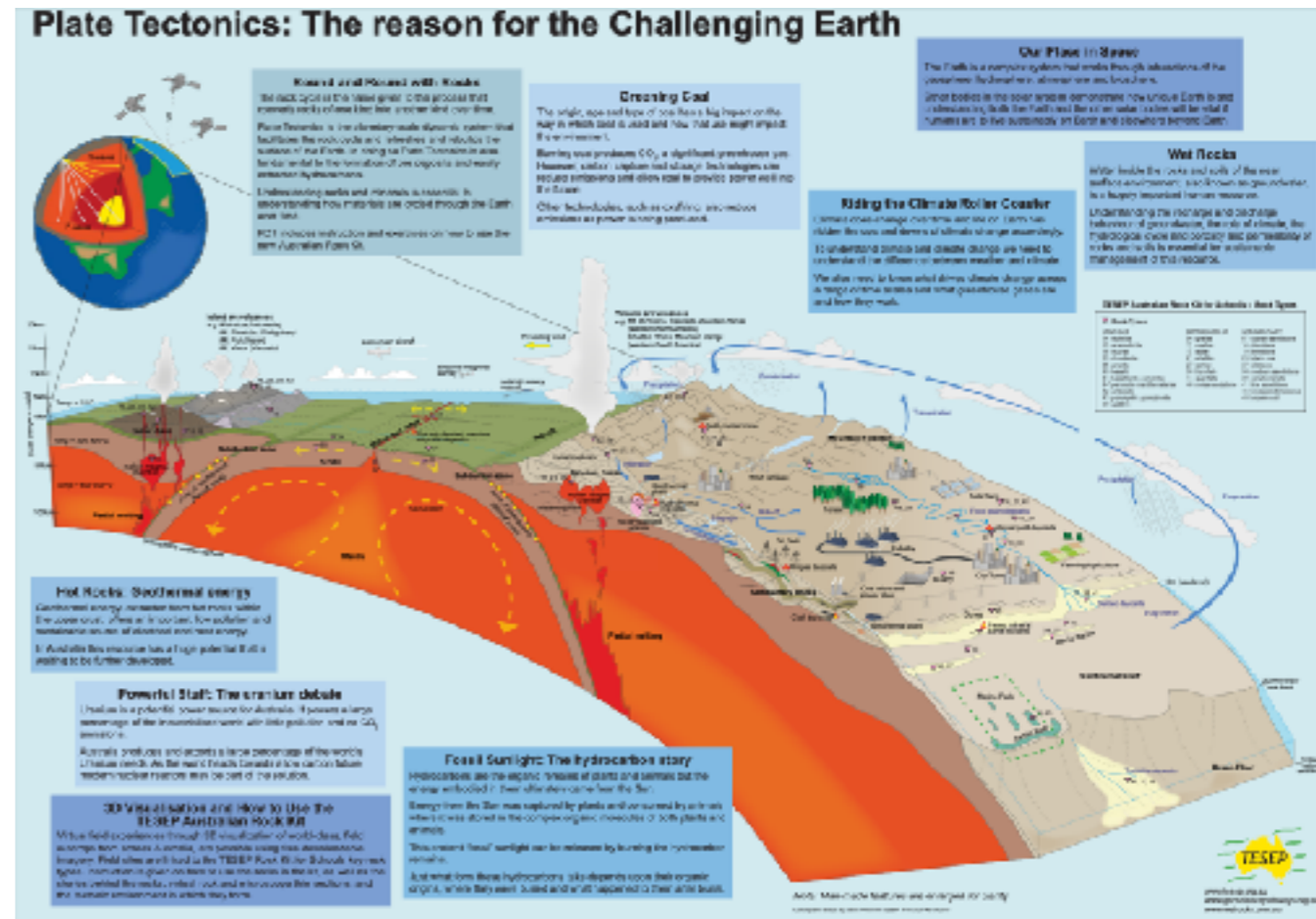
"Professionals right across the system — lawyers, doctors, accountants — are expected to continue to invest in their professional development over their careers, and for teachers it's just the same."

[Book a PD here!](#)

We are a NESAs approved PD provider



TESEP Rock Kit and Plate Tectonics Poster



TESEP Rock and Mineral kits (numbers) will be referred to in each episode





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- access to the slide set for that episode (including any embedded videos and links)
- access to a recording of that episode (YouTube)

After each episode you will also be sent:

- A TESEP Certificate of Attendance (NESA Approved)

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Australian Curriculum v.9 (F-10)

We will be following the Australian Curriculum v.9 (2022):

- Curriculum content for Years 7-10 only
- Focus on the Earth and Space science sub-strand
- Will follow as many other sub-strands as possible



Australian Curriculum v.9 (F-10)

Much of this webinar is dedicated to Year 8, “... continue to develop a view of Earth as a dynamic system, in which change occurs across a range of timescales”.

Rocks and Minerals for the classroom, and Plate Tectonics webinars cover this fully.

This webinar series will follow the following sub-strands:



Australian Curriculum v.9 (F-10)

Years 8 & 9 (Earth and Space Sciences)

- Explaining the uses of different types of rocks with reference to their properties and formation (AC9S8U04) - **Covered in Episode 1**
- Exploring how the mining of ores and minerals impacts on local environments and examining environmental rehabilitation initiative (AC9S8U04) - **Covered in Episodes 4 - 5**
- Analysing how sustainability priorities such as efficiency and limiting environmental impact have led to innovative practices in mining and mine site regeneration (AC9S8H01) - **Covered in Episodes 4 - 5**
- Examining how the development of hybrid and solar, electric and hydrogen-powered vehicles are applications of contemporary science responses to the depletion of fossil fuels and exploring environmental considerations (AC9S8H03) - **Covered in Episodes 2 - 4**
- Investigating how an understanding of materials and concern for the environment have led to the adoption of widespread recycling practices (AC9S8H03) - **Covered in Episode 5**

<https://v9.australiancurriculum.edu.au/>



Australian Curriculum v.9 (F-10)

Years 8 & 9 (Chemical Sciences)

- Examining how the physical and chemical properties of a substance will affect its production or use (AC9S8U07) - **Covered in all Episodes**
- investigating why most elements are not found in their elemental state and processes which are used to obtain the element (AC9S9U06) - **Covered in Episodes 2 - 4**
- predicting how ideas of green chemistry such as minimising the amount of unusable waste products, energy use and using more environmentally friendly chemical processes will affect the environment (AC9S9U06) - **Covered in Episodes 4 - 5**

Year 9 (Physical Sciences)

- Explaining efficiency and recognising that in energy transfer and transformation a variety of processes can occur, so that the amount of usable energy is reduced and the system is not 100% efficient (AC9S9U06) - **Covered in Episodes 3 - 6**
- Comparing the efficiency of electricity generation from coal and other sources such as nuclear, hydroelectricity, gas, solar and wind (AC9S9U06) - **Covered in Episodes 3 - 6**

Year 10 (Biological Sciences)

- Outlining processes involved in natural selection including variation, isolation and selection - **Covered in Episode 1**

<https://v9.australiancurriculum.edu.au/>

Critical Minerals PD overview

This PD has 6 parts:

1. Introduction and overview
2. Critical mineral uses – our high tech lives
3. Critical mineral uses – energy transition
4. Sourcing critical minerals – natural resources
5. Sourcing critical minerals – processing and recycling
6. Australian focus

Question: What is a mineral?



What is a mineral?

Minerals are “naturally occurring, inorganic solids with a definite chemical composition and a regular atomic structure. From this basis come all their physical properties”.

Over 5000 known minerals, most common on Earth are:

- Feldspar (plagioclase, orthoclase)
- Quartz
- Pyroxene (augite)
- Mica (biotite, muscovite)
- Amphibole
- Olivine



Source: Australian Museum, USGS, [2452404.jpg \(1280x1005\) \(weinrichmineralsinc.com\)](#)

What is a mineral?

They are the basic ingredients of rocks



Source: Geologycafe.com [R.328fa7921ba4de44d6c2c3b346d6b70f \(900x650\)](https://www.bing.com/images/search?imgurl=R.328fa7921ba4de44d6c2c3b346d6b70f&imgid=900x650) (bing.com)

Activity: Are these minerals?

Wood?	No, organic. ~50% carbon.	Glass?	No, made from silica plus additives.
Diamond?	Yes, solid carbon.	Concrete?	No, made from aggregate and cement.
Coal?	No, organic.	Iron?	Yes (native iron in meteorites!).
Gold?	Yes.	Steel?	No, alloy of iron with carbon (\pm others).
Quartz?	Yes, SiO_2 .	Plastic?	No, from polymers synthesised from hydrocarbons derived from oil.

Source: [mineral-families-3-728.jpg \(728x546\) \(slidesharecdn.com\)](#)

Minerals, metals and elements

Most of the elements in the periodic table are metals.

- Metals are chemical elements that ‘have a characteristic lustre, are good conductors of heat and electricity, and are opaque, fusible, and generally malleable or ductile’.

Elements can occur:

- Naturally as a mineral – known as ‘native’ form.
- With other elements in a mineral.
- Some elements do not exist in native form.

Source: Neuendorf et al. (2005) in Geoscience Australia: [Critical commodities for a high-tech world](#) | [Geoscience Australia \(ga.gov.au\)](#) [Native Elements and Minerals List \(thoughtco.com\)](#)

Metals

Hydrogen 1 H																Helium 2 He	
Lithium 3 Li	Beryllium 4 Be	Metals										Non-metals					
Sodium 11 Na	Magnesium 12 Mg	Alkali	Alkaline earth	Lanthanides	Transition	Post-Transition	Metalloids	Other non-metals	Halogens	Noble gases	Boron 5 B	Carbon 6 C	Nitrogen 7 N	Oxygen 8 O	Fluorine 9 F	Neon 10 Ne	
Potassium 19 K	Calcium 20 Ca			Actinides							Aluminium 13 Al	Silicon 14 Si	Phosphorus 15 P	Sulfur 16 S	Chlorine 17 Cl	Argon 18 Ar	
Rubidium 37 Rb	Strontium 38 Sr	Scandium 21 Sc	Titanium 22 Ti	Vanadium 23 V	Chromium 24 Cr	Manganese 25 Mn	Iron 26 Fe	Cobalt 27 Co	Nickel 28 Ni	Copper 29 Cu	Zinc 30 Zn	Gallium 31 Ga	Germanium 32 Ge	Arsenic 33 As	Selenium 34 Se	Bromine 35 Br	Krypton 36 Kr
Cesium 55 Cs	Barium 56 Ba	Yttrium 39 Y	Zirconium 40 Zr	Niobium 41 Nb	Molybdenum 42 Mo	Technetium 43 Tc	Ruthenium 44 Ru	Rhodium 45 Rh	Palladium 46 Pd	Silver 47 Ag	Cadmium 48 Cd	Indium 49 In	Tin 50 Sn	Antimony 51 Sb	Tellurium 52 Te	Iodine 53 I	Xenon 54 Xe
Francium 87 Fr	Radium 88 Ra	57-71 *	Hafnium 72 Hf	Tantalum 73 Ta	Tungsten 74 W	Rhenium 75 Re	Osmium 76 Os	Iridium 77 Ir	Platinum 78 Pt	Gold 79 Au	Mercury 80 Hg	Thallium 81 Tl	Lead 82 Pb	Bismuth 83 Bi	Polonium 84 Po	Astatine 85 At	Radon 86 Rn
		89-103 **	Rutherfordium 104 Rf	Dubnium 105 Db	Seaborgium 106 Sg	Bohrium 107 Bh	Hassium 108 Hs	Mtnerium 109 Mt	Darmstadtium 110 Ds	Roentgenium 111 Rg	Copernicium 112 Cn	Ununtrium 113 Uut	Flerovium 114 Fl	Ununpentium 115 Uup	Livermorium 116 Lv	Ununseptium 117 Uus	Ununoctium 118 Uuo

*	Lanthanum 57 La	Cerium 58 Ce	Praseodymium 59 Pr	Niodymium 60 Nd	Promethium 61 Pm	Samarium 62 Sm	Europium 63 Eu	Gadolinium 64 Gd	Terbium 65 Tb	Dysprosium 66 Dy	Holmium 67 Ho	Erbium 68 Er	Thulium 69 Tm	Ytterbium 70 Yb	Lutetium 71 Lu
**	Actinium 89 Ac	Thorium 90 Th	Protactinium 91 Pa	Uranium 92 U	Neptunium 93 Np	Plutonium 94 Pu	Americium 95 Am	Curium 96 Cm	Berkelium 97 Bk	Californium 98 Cf	Einsteinium 99 Es	Fermium 100 Fm	Mendelevium 101 Md	Nobelium 102 No	Lawrencium 103 Lr

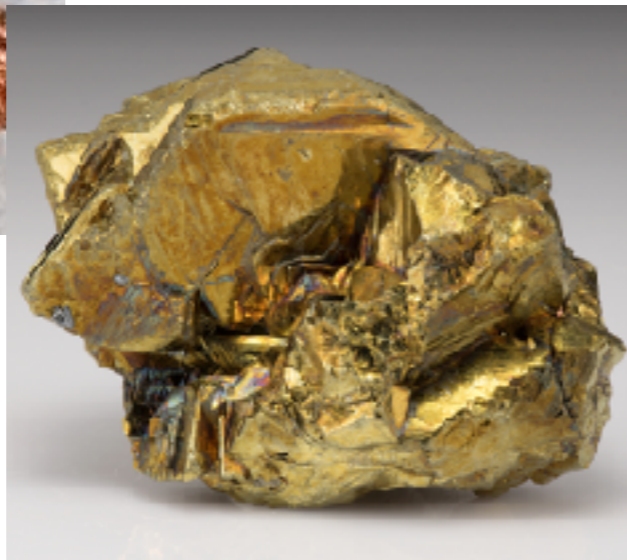
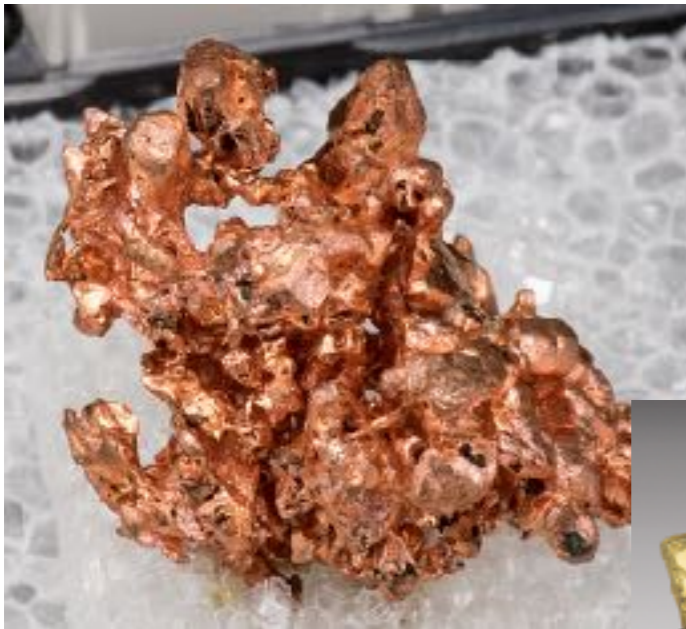
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Source: Geoscience Australia: [Critical commodities for a high-tech world | Geoscience Australia \(ga.gov.au\)](https://www.ga.gov.au)

Minerals, metals and elements

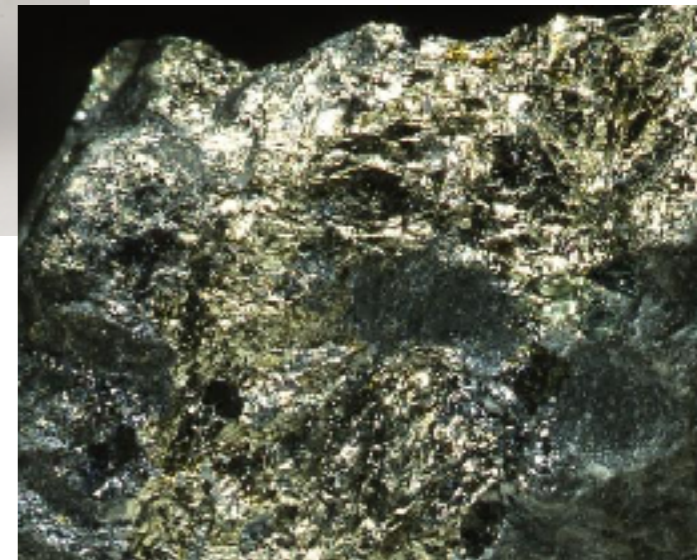
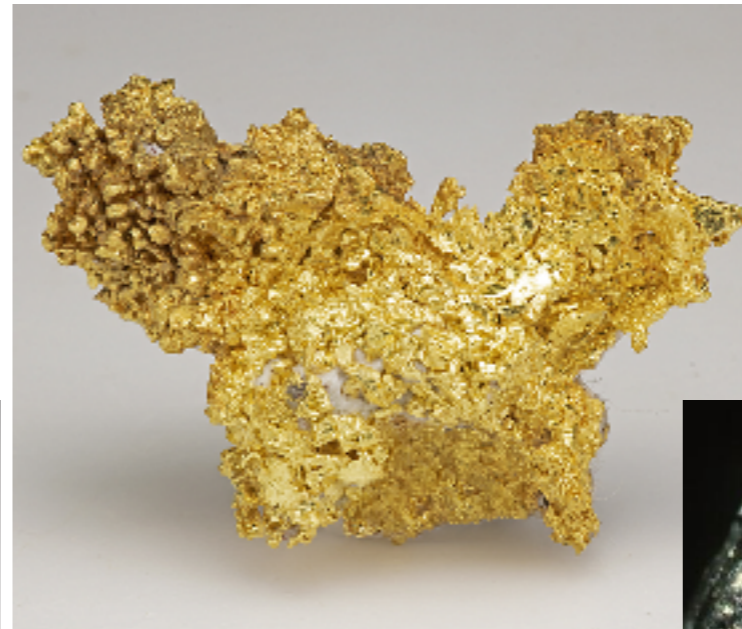
Copper

- Native copper (Cu)
- Chalcopyrite (CuFeS_2)^{TESEP Min. Kit No. 82}



Gold

- Native gold (Au)
- Calaverite (AuTe_2)



Source: [3331663.jpg \(1280x909\) \(weinrichmineralsinc.com\)](#) [2431005.jpg \(1280x966\) \(weinrichmineralsinc.com\)](#) [1095769.jpg \(1123x1024\) \(weinrichmineralsinc.com\)](#) [calaverite.jpg \(704x396\) \(museum.wa.gov.au\)](#)

What are the Rare Earth Elements (REE)?

The Lanthanides plus Scandium and Yttrium

Not actually that rare in the Earth's crust

- The scarcest REE (Lu) is the 60th most abundant element
- But not common to find in volumes that are economic to mine.

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57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu																																
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr																																

Source: Geoscience Australia

Why are minerals, metals and elements important?

Their properties enable them to be used for different purposes ...

Copper (pipes, heating, wiring)

- Soft but tough
- Malleable and ductile
- Conducts heat and electricity

Titanium ('modern metal, pigment in paint, sunscreen)

- Lightweight, strong, rust-resistant, non-toxic, high melting point
- White and bright
- Reflects UV light

Lithium (batteries, ceramics, glass)

- Reactive – easy to get current flowing, so used as charge carrier
- Lightweight
- Tough but soft

Neodymium (magnets, car batteries, specialised glass, lasers, tanning)

- Powerful magnetic potential, less material needed so able to miniaturise electronic devices
- Transmits UV rays, but not heating infrared rays

Source: [Critical Minerals and their uses | Geoscience Australia \(ga.gov.au\)](https://www.ga.gov.au/education/classroom-resources/minerals-energy/australian-mineral-facts/) <https://www.ga.gov.au/education/classroom-resources/minerals-energy/australian-mineral-facts/>

Activity: what metals come from these minerals?



Wolframite?



Tungsten



Rutile?



Titanium



Bauxite^{TESEP Min. kit No. 51}
(gibbsite)?



Aluminium



Spodumene^{TESEP Min. Kit No. 52?}



Lithium

Source: <https://www.weinrichmineralsinc.com/>

Question: Which minerals do you think are critical minerals?



What are critical minerals?

Lots of definitions ...this is from Geoscience Australia:

“Critical minerals are both economically important and have a high risk of supply disruption”.

“Four main issues:

1. Scarcity.
2. Diversity and suitability of supply.
3. Production only as a by-product of other commodities.
4. Level of concentration from production or processing”.

Source: Geoscience Australia: [Critical commodities for a high-tech world | Geoscience Australia \(ga.gov.au\)](https://www.ga.gov.au/critical-commodities-for-a-high-tech-world)

What are critical minerals?

Here's another from the European Commission (EU) ...

Their 2010 report on Critical raw materials for the EU stated:

- “a raw material is labelled critical when the risks of supply shortage and their impacts on the economy are higher than for most of the other raw materials”.

Source: Geoscience Australia: [Critical commodities for a high-tech world](#) | [Geoscience Australia \(ga.gov.au\)](#)

What are critical minerals?

In plain language ...

- A critical mineral is a mineral that a jurisdiction is worried about the supply of, as their economy will be impacted if the supply is not ensured.

The list differs for each national / state / territory government globally, depending on:

- Supply risk:
 - Local mineral endowment or reliance on import (geopolitical issues)
- Economic importance
 - Mining, manufacturing and consumption.

Lots of jargon ...

Critical v strategic, tech v high-tech

- Critical is (broadly) consistently defined
- Strategic refers to a plan to source these materials
- Tech and high-tech mostly marketing terms ... lots of minerals are needed for 'low' technology and everyday uses too.

Raw materials v commodities

- Raw materials can be used to make or create something
- Commodities are raw materials or primary products that can be bought or sold

Source: Geoscience Australia: [Critical commodities for a high-tech world](#) | [Geoscience Australia \(ga.gov.au\)](#)

Globally in terms of 'criticality'

High

1	Rare Earth Elements
2	Gallium
3	Indium
4	Tungsten
5	Platinum Group Elements
6	Cobalt
7	Niobium
8	Magnesium
9	Molybdenum
10	Antimony
11	Lithium
12	Vanadium
13	Nickel
14	Tantalum
15	Tellurium
16	Chromium
17	Manganese

Moderate

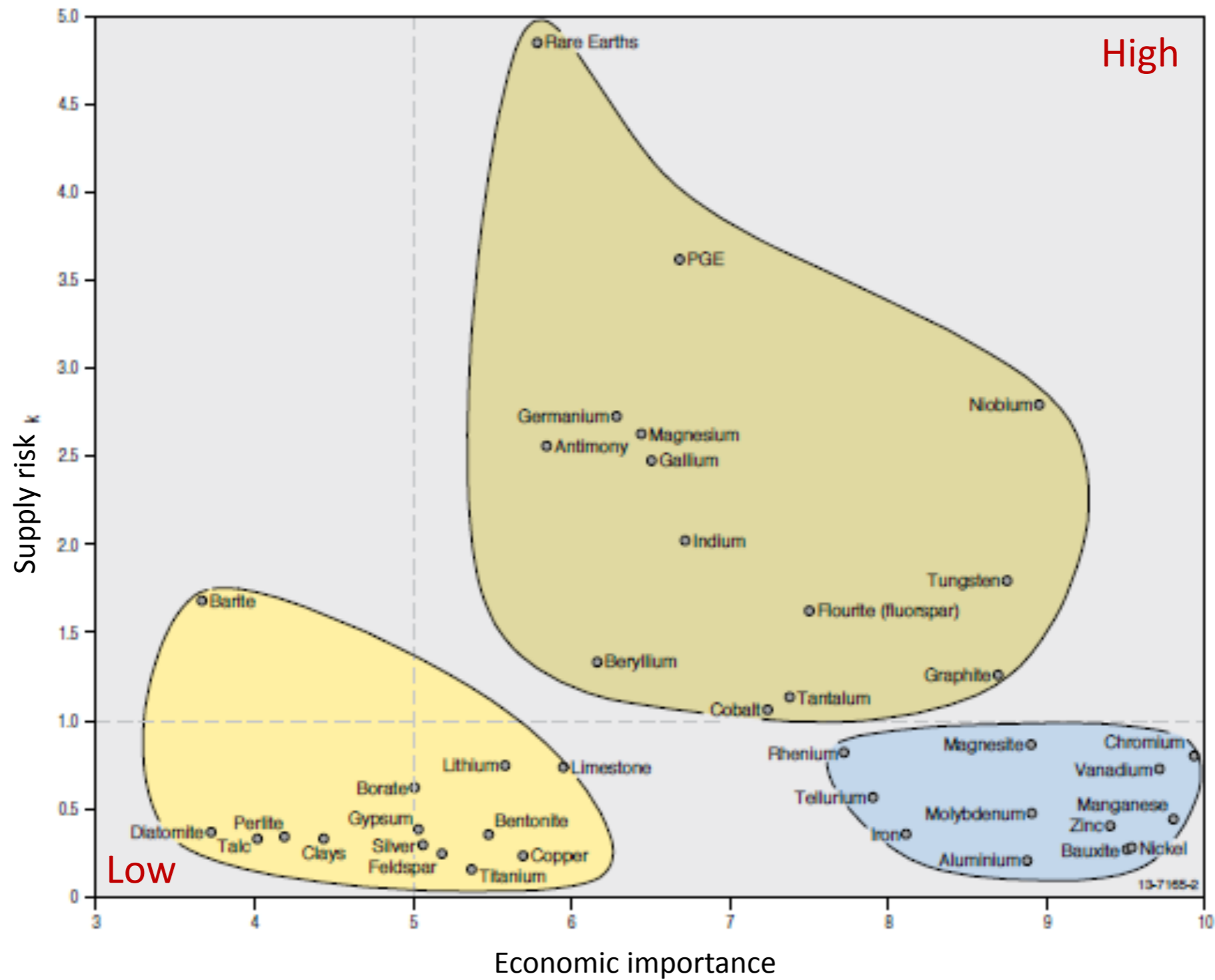
18	Selenium
19	Titanium
20	Strontium
21	Graphite
22	Tin
23	Germanium
24	Beryllium
25	Zirconium
26	Bismuth
27	Fluorine
28	Zinc

Low

29	Mercury
30	Thorium
31	Arsenic
32	Lead
33	Barium
34	Silver
35	Cadmium
36	Copper
37	Aluminium
38	Rhenium
39	Gold
40	Uranium
41	Diamond
42	Iron

Source: Geoscience Australia

Criticality in the European Union ...



In the USA (with import reliance)

 Beryllium	11%	Alloying agent in aerospace, defense industries	Tellurium	95%	Solar cells, thermoelectric devices
Aluminum	13%	Power lines, construction, electronics	 Vanadium	96%	Alloying agent for iron, steel
Zirconium	25%	High-temperature ceramics production	Arsenic	100%	Semi-conductors, lumber preservatives, pesticides
Palladium	40%	Catalytic converters	Cerium	100%	Catalytic converters, ceramics, glass, metallurgy
 Germanium	50%	Fiber optics, night vision applications	Cesium	100%	Research, development
Lithium	50%	EV rechargeable batteries	Dysprosium	100%	Data storage devices, lasers
Magnesium	50%	Car seats, luggage, laptops	Erbium	100%	Fiber optics, optical amplifiers, lasers
 Nickel	50%	Stainless steel, rechargeable batteries	 Europium	100%	Phosphors, nuclear control rods
 Tungsten	50%	Wear-resistant metals	Fluorspar	100%	Manufacture of aluminum, cement, steel, gasoline
Barite	75%	Hydrocarbon production	Gadolinium	100%	Medical imaging, steelmaking
 Chromium	75%	Stainless steel	Gallium	100%	Integrated circuits, LEDs
 Tin	75%	Coatings, alloys for steel	Graphite	100%	Lubricants, batteries
 Cobalt	76%	Rechargeable batteries, superalloys	Holmium	100%	Permanent magnets, nuclear control rods
 Platinum	79%	Catalytic converters	Indium	100%	Liquid crystal display screens
 Antimony	81%	Lead-acid batteries, flame retardants	Lanthanum	100%	Catalysts, ceramics, glass, polishing compounds
 Zinc	83%	Metallurgy to produce galvanized steel	Lutetium	100%	Scintillators for medical imaging, cancer therapies
Titanium	88%	White pigment or metal alloys	 Manganese	100%	Steelmaking, batteries
Bismuth	94%	Medical, atomic research	Neodymium	100%	Rubber catalysts, medical, industrial lasers

Source: [The 50 Minerals Critical to US Security - Read-Roses](#)

Australia has identified 31 critical minerals

Critical Mineral	U.S. list ⁵	EU list ⁶	Japan list ⁷	Australia's Geological Potential ⁸	Australia's Economic Demonstrated Resource ⁹	Australia's Production	Global Production	Market Value (Global) (US\$m) ¹⁰
1 Antimony	✓	✓	✓	Moderate	138 kt	5.5 kt	150 kt	\$185.2
2 Beryllium	✓	✓		Moderate	-	-	230 t	\$918.6 ¹¹
3 Bismuth	✓	✓		Moderate	-	-	14 kt	\$69.2
4 Chromium	✓		✓	High	-	-	31 000 kt	\$4,705.3
5 Cobalt	✓	✓	✓	High	1221 kt	5 kt	110 kt	\$541.8
6 Gallium	✓	✓	✓	High	-	-	495 t	\$918.6 ¹¹
7 Germanium	✓	✓	✓	High	-	-	134 t	\$918.6 ¹¹
8 Graphite	✓	✓	✓	Moderate	7140 kt	0	1200 kt	\$1,076.1
9 Hafnium	✓	✓		High	756 kt	-	-	\$918.6 ¹¹
10 Helium	✓	✓		Moderate	-	4 hm ³	160 hm ³	\$591.0
11 Indium	✓	✓	✓	High	-	-	0.72 kt	\$918.6 ¹¹
12 Lithium	✓		✓	High	2803 kt	14.4 kt	43 kt	\$1,430.6
13 Magnesium	✓	✓	✓	Moderate	-	0	1100 kt	\$716.4
14 Manganese	✓		✓	High	231 000 kt	3200 kt	16 000 kt	\$5,443.7
15 Niobium	✓		✓	High	216 kt	-	64 kt	\$1,709.5 ¹²
16 Platinum-group elements	✓	✓	✓	High	24.9 t	2.6 t	200 kt	\$19,316.6
17 Rare-earth elements	✓	✓	✓	High	3270 kt	14 kt	130 kt	\$415.4 ¹³
18 Rhenium	✓		✓	Moderate	-	-	52 kt	\$918.6 ¹¹
19 Scandium	✓	✓		High	-	-	-	13
20 Tantalum	✓	✓	✓	High	55.4 kt	-	1.3 kt	\$1,552.9
21 Titanium	✓		✓	High	Ilmenite: 276 500 kt Rutile: 32 900 kt	Ilmenite: 1400 kt Rutile: 300 kt	Ilmenite: 6700 kt Rutile: 750 kt	\$1,609.9
22 Tungsten	✓	✓	✓	Moderate	386 kt	0.11 kt	95 kt	\$164.0
23 Vanadium	✓	✓	✓	Moderate	3965 kt	0	80 kt	\$1,709.5 ¹²
24 Zirconium	✓		✓	High	52 662 kt	600 kt	1600 kt	\$1,003.4

Since June 2023 ...

- 25. Silicon
- 26. High purity alumina

Since February 2024 ...

- 27. Nickel
- 28. Fluorine
- 29. Selenium
- 30. Molybdenum
- 31. Arsenic

Source: [Australia's Critical Minerals Strategy 2019 \(industry.gov.au\)](https://www.industry.gov.au/publications/australias-critical-minerals-strategy-2019)

Australia has identified 26 critical minerals:
note copper isn't one nationally ...

Hydrogen 1 H																	Helium 2 He
Lithium 3 Li	Barium 4 Ba	Metals										Non-metals					Neon 10 Ne
Sodium 11 Na	Magnesium 12 Mg	Alkali	Alkaline earth	Lanthanides	Transition	Post-Transition	Metalloids	Other non-metals	Halogens	Noble gases	Boron 5 B	Carbon 6 C	Nitrogen 7 N	Oxygen 8 O	Fluorine 9 F	Argon 18 Ar	
Potassium 19 K	Calcium 20 Ca											Aluminium 13 Al	Silicon 14 Si	Phosphorus 15 P	Sulfur 16 S	Chlorine 17 Cl	Krypton 36 Kr
Rubidium 37 Rb	Strontium 38 Sr	Scandium 21 Sc	Titanium 22 Ti	Vanadium 23 V	Chromium 24 Cr	Manganese 25 Mn	Iron 26 Fe	Cobalt 27 Co	Nickel 28 Ni	Copper 29 Cu	Zinc 30 Zn	Gallium 31 Ga	Germanium 32 Ge	Arsenic 33 As	Selenium 34 Se	Bromine 35 Br	Xenon 54 Xe
Cesium 55 Cs	Barium 56 Ba	Yttrium 39 Y	Zirconium 40 Zr	Niobium 41 Nb	Molybdenum 42 Mo	Technetium 43 Tc	Ruthenium 44 Ru	Rhodium 45 Rh	Palladium 46 Pd	Silver 47 Ag	Cadmium 48 Cd	Indium 49 In	Tin 50 Sn	Antimony 51 Sb	Tellurium 52 Te	Iodine 53 I	Radon 86 Rn
Francium 87 Fr	Radium 88 Ra	57-71 *	Hafnium 72 Hf	Tantalum 73 Ta	Tungsten 74 W	Rhenium 75 Re	Osmium 76 Os	Iridium 77 Ir	Platinum 78 Pt	Gold 79 Au	Mercury 80 Hg	Thallium 81 Tl	Lead 82 Pb	Bismuth 83 Bi	Polonium 84 Po	Astatine 85 At	
		89-103 **	Rutherfordium 104 Rf	Dubnium 105 Db	Seaborgium 106 Sg	Bohrium 107 Bh	Hassium 108 Hs	Mtnerium 109 Mt	Darmstadtium 110 Ds	Roentgenium 111 Rg	Copernicium 112 Cn	Ununium 113 Uut	Flerovium 114 Fl	Ununpentium 115 Uup	Livermorium 116 Lv	Ununseptium 117 Uus	Ununoctium 118 Uuo

*	Lanthanum 57 La	Cerium 58 Ce	Praseodymium 59 Pr	Neodymium 60 Nd	Promethium 61 Pm	Samarium 62 Sm	Europium 63 Eu	Gadolinium 64 Gd	Terbium 65 Tb	Dysprosium 66 Dy	Holmium 67 Ho	Erbium 68 Er	Thulium 69 Tm	Ytterbium 70 Yb	Lutetium 71 Lu
**	Actinium 89 Ac	Thorium 90 Th	Protactinium 91 Pa	Uranium 92 U	Neptunium 93 Np	Plutonium 94 Pu	Americium 95 Am	Curium 96 Cm	Berkelium 97 Bk	Californium 98 Cf	Einsteinium 99 Es	Fermium 100 Fm	Mendelevium 101 Md	Nobelium 102 No	Lawrencium 103 Lr

13-7165-7

Source: Geoscience Australia: [Critical commodities for a high-tech world | Geoscience Australia \(ga.gov.au\)](https://www.ga.gov.au)

... but it is critical in NSW

NSW critical minerals and tech metals

Co	Ni	Cu
In	Sn	Ag
Sb	Zn	

Technologies

Renewable energy

This infographic illustrates the link between critical minerals and renewable energy. It features a list of metals (Co, Ni, Cu, In, Sn, Ag, Sb, Zn) and icons for a battery, solar panels, and wind turbines. A lightbulb with a plant growing inside it is labeled 'Renewable energy'.

NSW critical minerals and tech metals

REE	Sn	Cu
W	Ti	
Sc		

Technologies

Advanced manufacturing and technology enabled primary industries

This infographic shows the application of critical minerals in advanced manufacturing and primary industries. It lists metals (REE, Sn, Cu, W, Ti, Sc) and includes icons for a robotic arm, a car, a wind turbine, a laptop, and a drone. The text 'Advanced manufacturing and technology enabled primary industries' is prominently displayed.

NSW critical minerals and tech metals

Co	Ni	Cu
Al	W	Li
REE		

Technologies

Recycling and waste management

This infographic focuses on recycling and waste management. It lists metals (Co, Ni, Cu, Al, W, Li, REE) and features icons for a recycling symbol, a battery, and solar panels. The text 'Recycling and waste management' is clearly visible.

NSW critical minerals and tech metals

REE	Al	Sc
W	Ti	

Technologies

Defence and aerospace

This infographic highlights the role of critical minerals in defence and aerospace. It lists metals (REE, Al, Sc, W, Ti) and includes icons for a satellite, a rocket, and an aircraft. The text 'Defence and aerospace' is prominently displayed.

Source: [Critical minerals and high-tech metals strategy \(nsw.gov.au\)](https://www.nsw.gov.au/critical-minerals-and-high-tech-metals-strategy)

... but it is critical in NSW. Why?

NEWS

Mining giant Glencore seeks taxpayer bailout for Mount Isa copper smelter

By Emily Dobson and Meghan Dansie

ABC North West Old

Mining and Metals Industry

Tue 8 Apr



The Mount Isa Mines complex has been operating for over 100 years. (Supplied: Glencore Australia)

There are only two Australian copper smelters: Mount Isa in Queensland and Olympic Dam in SA

What about 'traditional' minerals?

Still important and in use though:

- Currently less worry about supply
 - e.g. the known iron ore resources in Australia will last for 175 years at current production rates.
- Transition from their use
 - e.g. lead soldering is being phased out due to health concerns – replaced by tin or zinc

Many are on GA's 'low criticality list'.

Low

29	Mercury
30	Thorium
31	Arsenic
32	Lead
33	Barium
34	Silver
35	Cadmium
36	Copper
37	Aluminium
38	Rhenium
39	Gold
40	Uranium
41	Diamond
42	Iron

What about future critical minerals?

Australia's strategic materials are:

- Aluminium (Al) not alumina (Al_2O_3)
- Copper
- Phosphorous
- Tin
- Zinc

Note: Fluorine was on the strategic materials list in 2023.

Question: What are some industries using critical minerals?



What are some industries using critical minerals?

TOP INDUSTRIES THAT RELY ON CRITICAL MINERALS

- 1 Telecommunications and electronics
- 2 Energy
- 3 Defence
- 4 Aerospace
- 5 Transportation

2

CRITICAL MINERALS ARE EVERYWHERE



Lithium is used to create batteries.



Helium is used in MRIs.



Uranium is used in radiation therapy.



Potash is used in fertilizer.



Indium is used to make LCD screens.

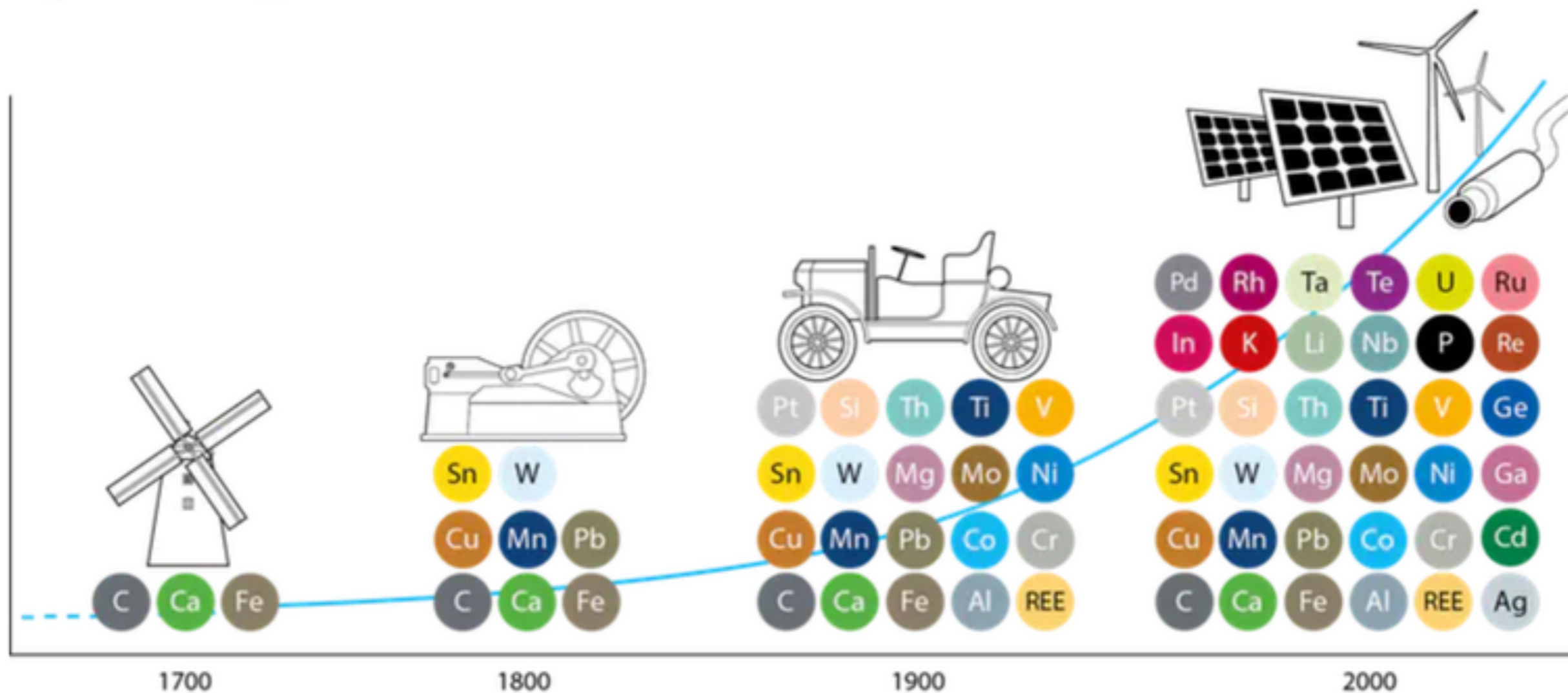


Strontium is used in fireworks.

3

Minerals through the ages of energy

Ages of Energy



Elements widely used in Energy Pathways

Source: [AgesOfEnergy-Elements-widely-used-in-energy-pathways.png \(754x421\) \(ug.edu.au\)](https://www.ug.edu.au/~tesep/ages-of-energy-elements-widely-used-in-energy-pathways.png)

What about ... ?

Year 10 (Biological Sciences)

- Outlining processes involved in natural selection including variation, isolation and selection

nature

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NEWS | 22 July 2024

Mystery oxygen source discovered on the sea floor – bewildering scientists

A chemical reaction could be producing oxygen by splitting water molecules, but its source of energy remains unknown.

By [Davide Castelvocchi](#)

[Twitter](#) [Facebook](#) [Email](#)



A polymetallic nodules (above) are formed by metals precipitating out of sea water, or formed from diagenetic redox reactions in sediments, or via hydrothermal circulation around mid-oceanic sea vents. The nodules grow slowly over millions of years and can range in size from small nuggets to football sized boulders.

Dark Oxygen ... a new origin of life?

Year 10 (Biological Sciences)

- Outlining processes involved in natural selection including variation, isolation and selection

Takeaways:

- Polymetallic nodules are found deep on the ocean floor (~5km), around the world, far from sunlight
- The nodules are made of copper, iron and critical minerals: manganese, nickel and cobalt
- These nodules act as “batteries” by splitting water into oxygen and hydrogen
- The only known source of oxygen in the absence of sunlight and photosynthesis, called Dark Oxygen
- The discovery “... requires us to rethink how the evolution of complex life on the planet might have originated”
- Nodules are at risk from deep sea mining because they contain critical minerals
- Published in Nature Geoscience
- Great description in The Conversation (March 2025)

Summary

Critical minerals are those where supply is low or threatened, and they are important economically.

List varies across jurisdictions.

They are sometime referred to as critical or high-tech metals.

They are critical for high-tech applications and the transition to renewable energy (plus more ...).