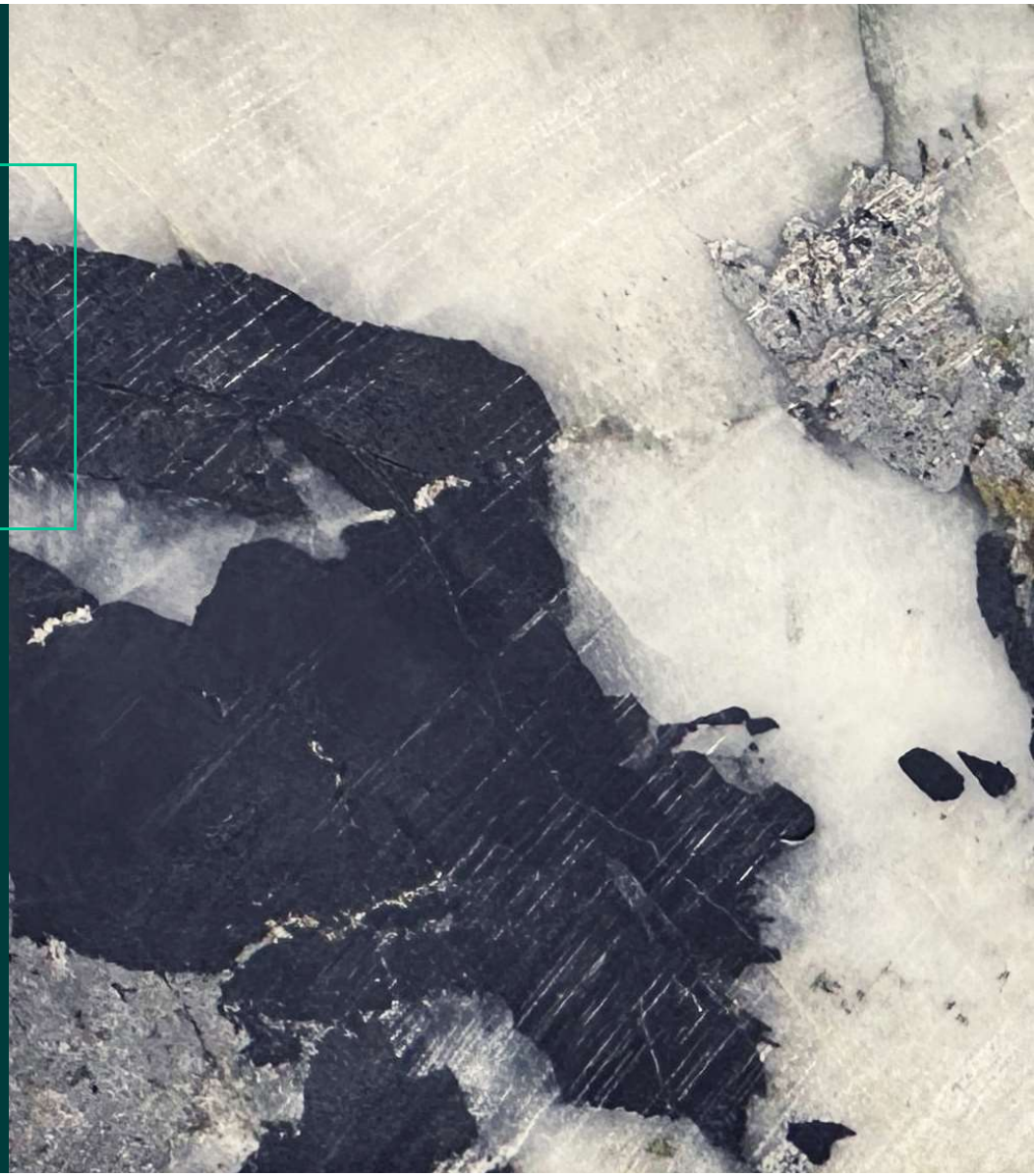
University of Exeter

Critical Minerals

Frances Wall,

Professor of Applied Mineralogy,
Camborne School of Mines, University of Exeter

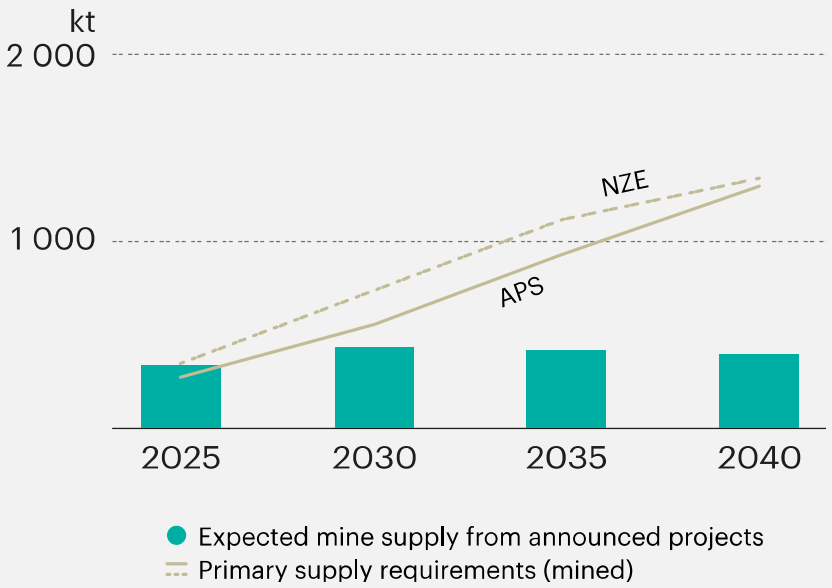
f.wall@exeter.ac.uk

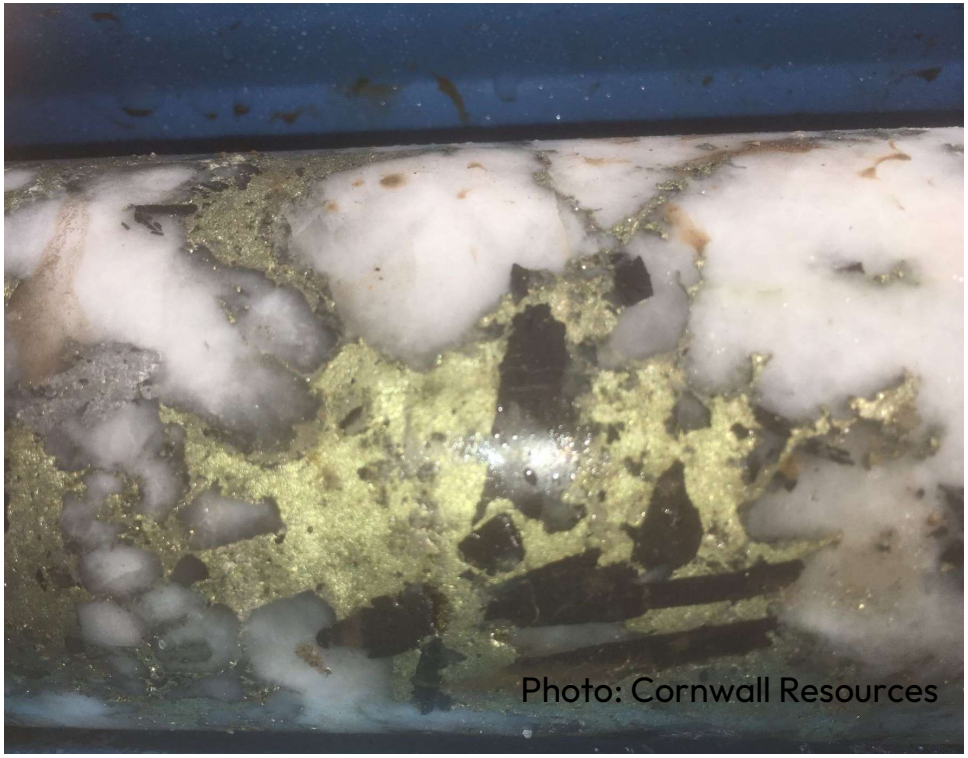


The energy transition is taking us to the age of metals

Critical Minerals Challenge Centre

Mined Lithium Needed

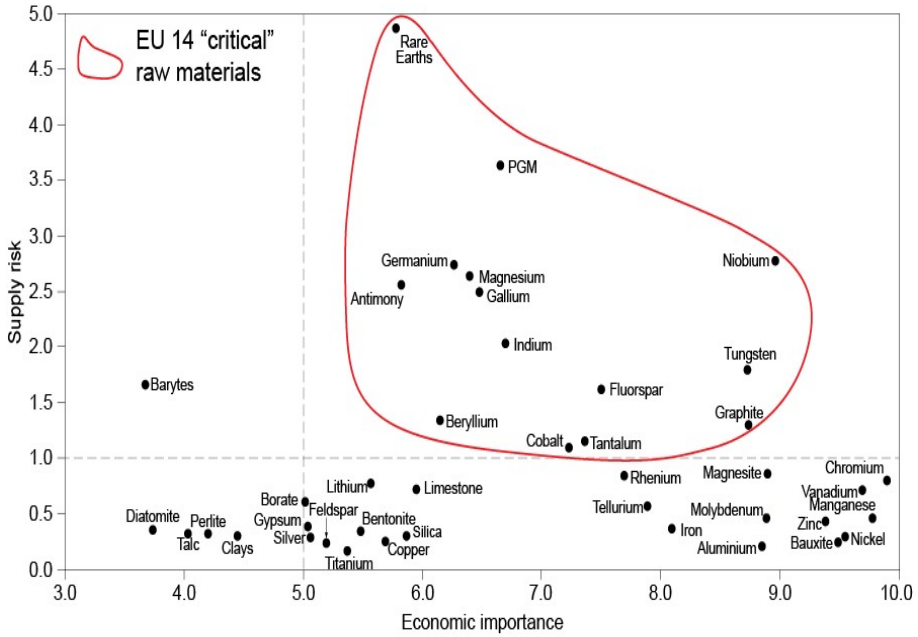




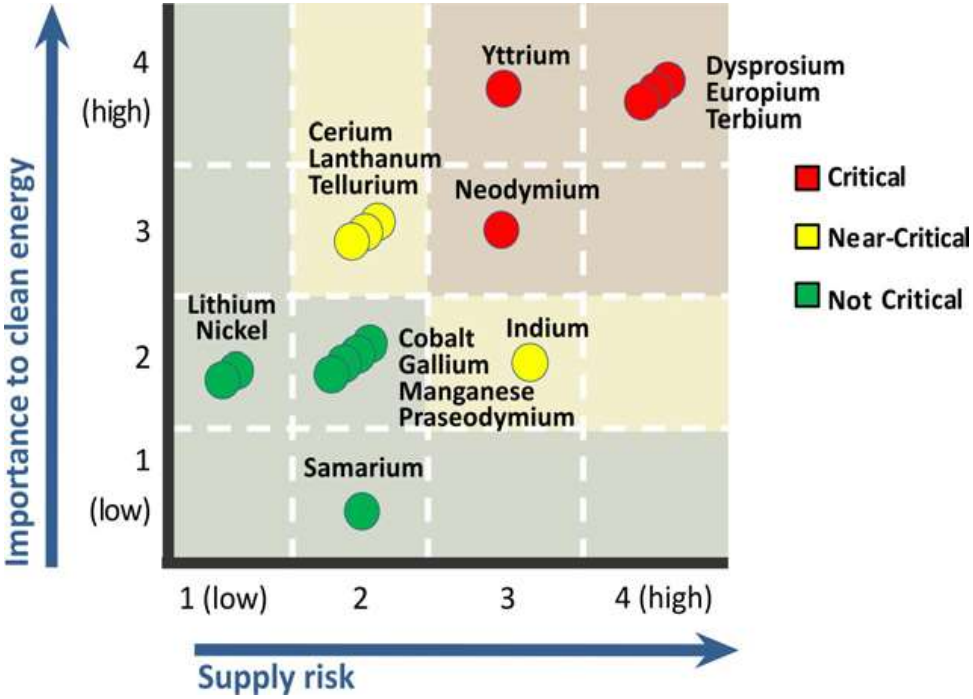
Source:International Energy Agency, 2024

Image: Pixabay

How are critical metals and minerals defined?



European Commission (2010) Critical raw materials for the EU – Report of the Ad-hoc Working Group on defining critical raw materials – European Commission Enterprise and Industry



US Dept Energy report on critical materials, 2011, Figure ES-1. Short-Term (Present–2015) Criticality Matrix

Periodic Table of Criticality!

EU list 2023

USA list 2022

Both

UK list 2024

H																	He
Li	Be											borate	B	C*	N	O	F*	Ne
Na	Mg	magnesite											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
Rb	Sr	Y	Zr	Nb	Mo*	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
Cs	Ba*	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og	

feldspar phosphate rock coking coal

*Ba is barite, F is fluorspar, C is graphite. Mo is not on EU, USA or UK list but is on Canada list

EU

European Commission list of CRMs, 2023 https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en

UK - Critical Minerals Intelligence Centre (2024) https://www.ukcmic.org/downloads/reports/ukcmic-2024-criticality-assessment.pdf

USA

Fortier, S.M., et al. 2018, Draft critical mineral list—Summary of methodology and background information—U.S. Geological Survey technical input document in response to Secretarial Order No. 3359: U.S. Geological Survey Open-File Report 2018–1021, 15 p., https://doi.org/10.3133/ofr20181021. Updated to 2022 list

La	Ce	Pr	Nd	(Pm)	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Frances Wall

Funded by UK Government

Ways to Overcome critical minerals supply security problems

- Reduce - don't use
- Substitute – use something else
- New primary supply – find some more
- Recycle - find some in what you have already
- *Use more efficiently, intensively and for longer*
- *Re-use, refurbish, remanufacture*
- *Link materials science and geoscience much better to choose materials in the first place*

New Circular Economy

Met4Tech.org

NICER PROGRAMME

UK Research and Innovation

Critical raw materials agenda is geopolitical – and much related to China

Critical Minerals Challenge Centre

> “The Middle East has oil, China has rare earth.”

Plaque in Baotou near Bayan Obo, Inner Mongolia, China quotes Deng Xiaoping in 1992:

Exploring for rare earths in Malawi

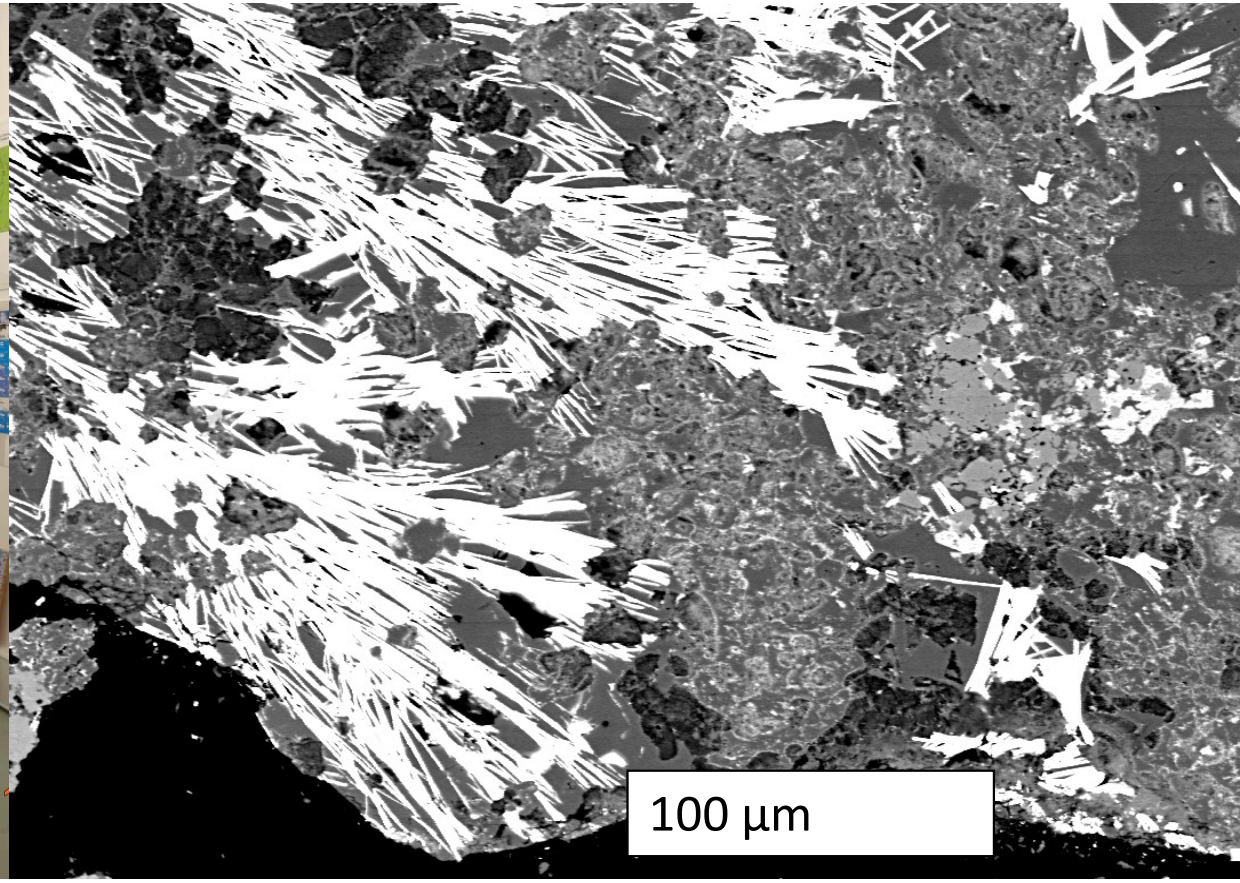
Photo Sam Broom-Fendley


Photo: F Wall

Rare earth ores in carbonatite rocks – Songwe Hill, Malawi

Specialist analytical equipment based on scanning electron microscopes, Camborne School of Mines, University of Exeter, Penryn Campus

Backscattered electron image of synchysite-(Ce) in ferroan dolomite



Done **well** mining can:

- Produce the metals and minerals we need
- Provide well paid jobs for local people and an international workforce
- Produce benefits for the national and local economy
- Enhance the local community to improve quality of life, with education and better facilities
- Act as a catalyst for other industries
- Drive sustainable development

Done badly mining can:

- Create environmental pollution
- Drain money out of the country
- Use up valuable water supplies
- Use up valuable energy supplies
- Displace local people
- Kill people
- Finance wars
- Create poverty

- ‘The resource curse’

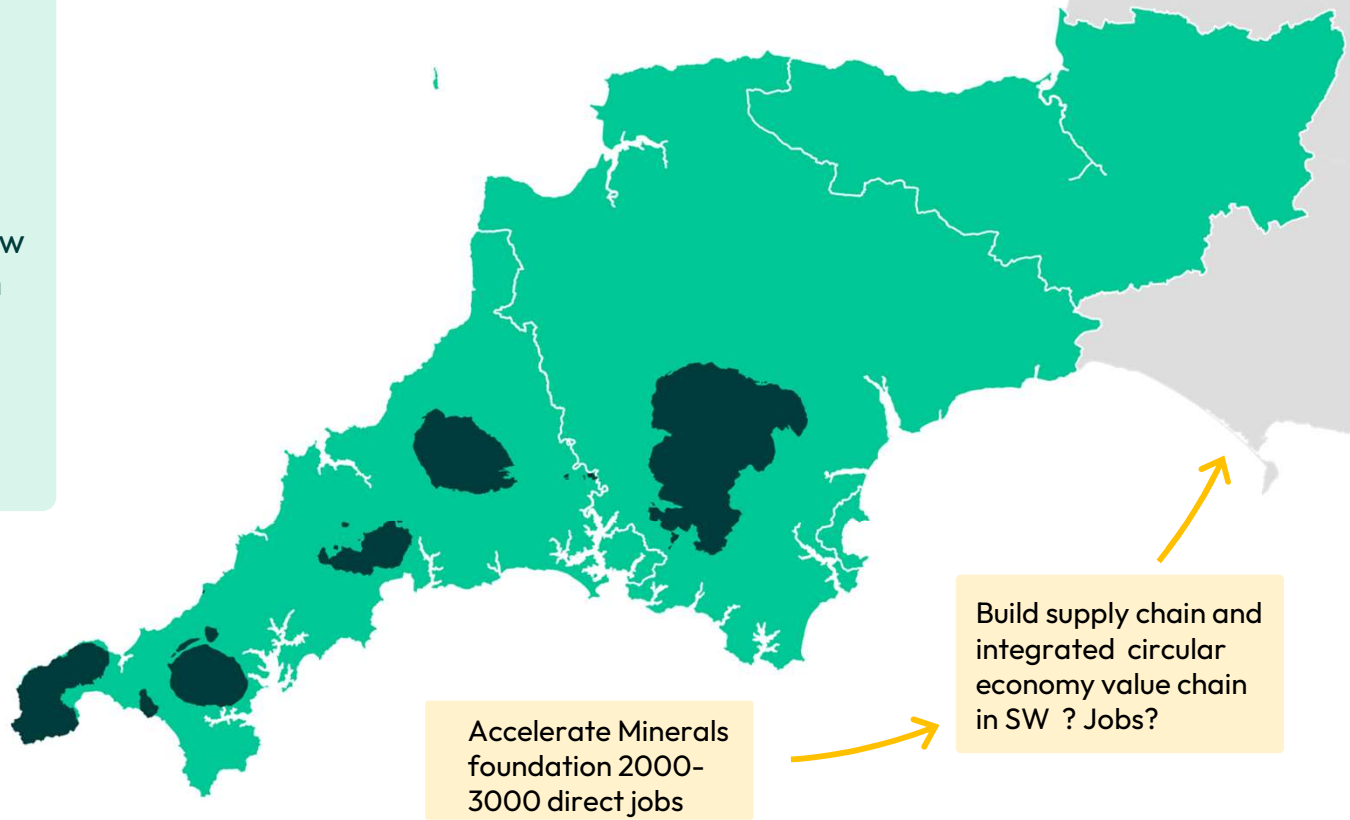
Auty, R. (1993) Sustaining Development in Mineral Economies:The Resource Curse Thesis. Routledge, London..

SW Critical Minerals Opportunity

Critical Minerals Challenge Centre

Vision

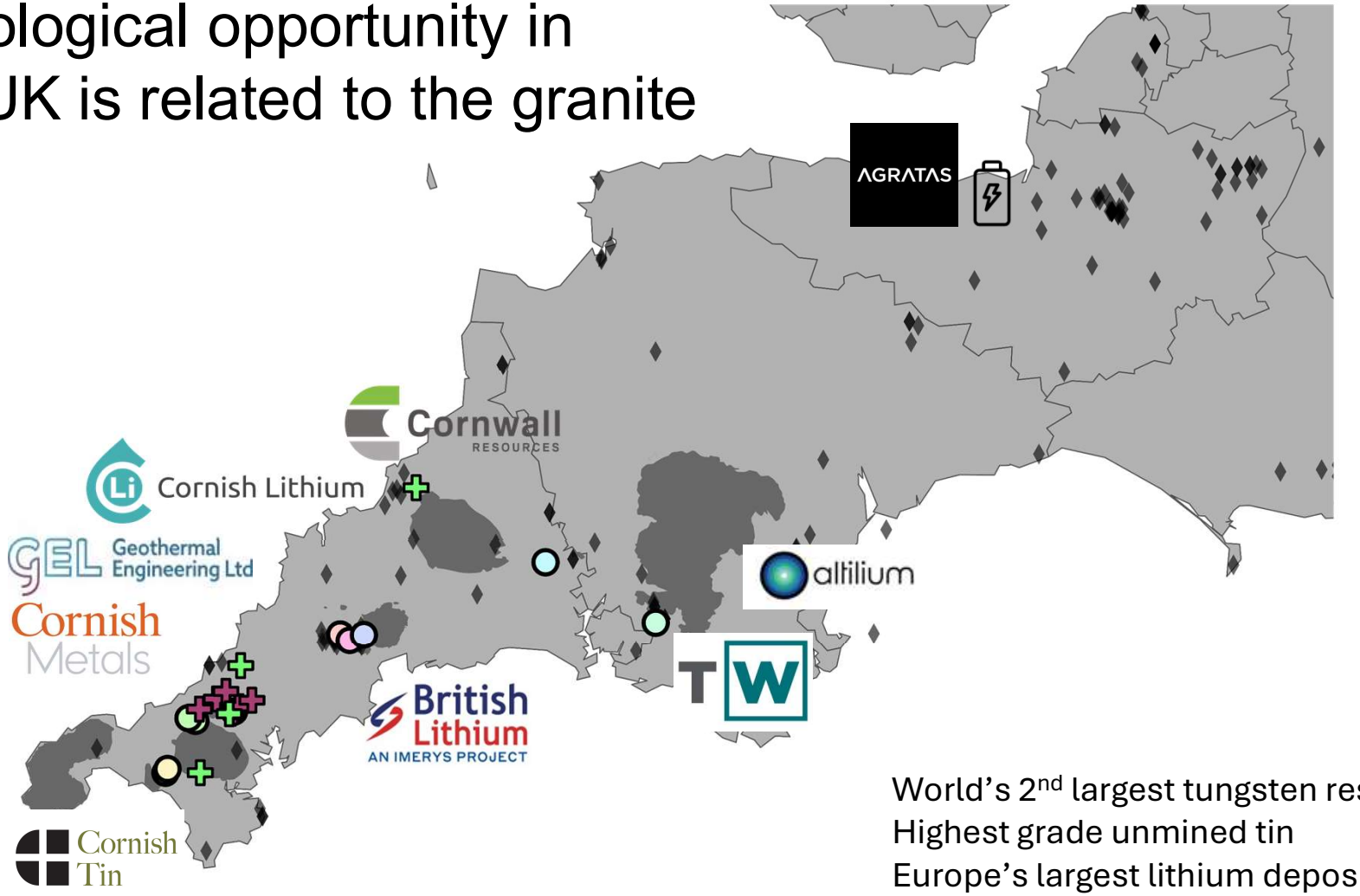
- Develop new critical minerals mines in SW England
- Opportunity for establishing new value chains, e.g. for tin, lithium in UK
- Lead good practice globally



Accelerate Minerals foundation 2000-3000 direct jobs

Build supply chain and integrated circular economy value chain in SW ? Jobs?

The geological opportunity in In SW UK is related to the granite



World's 2nd largest tungsten reserve
Highest grade unmined tin
Europe's largest lithium deposit
World class china clay

Map plotted by Will Parker

Cornwall CE and UNRMS case study

Local Skills and Expertise: Sustainability, Circular Economy, Responsible Mining and Exploration, Mineral Processing, Environment, Social and Governance (ESG), Nature Regeneration, Renewable Energy, Blue and Green Economy

UNESCO World Heritage Site: Cornwall and West Devon Mining Landscape

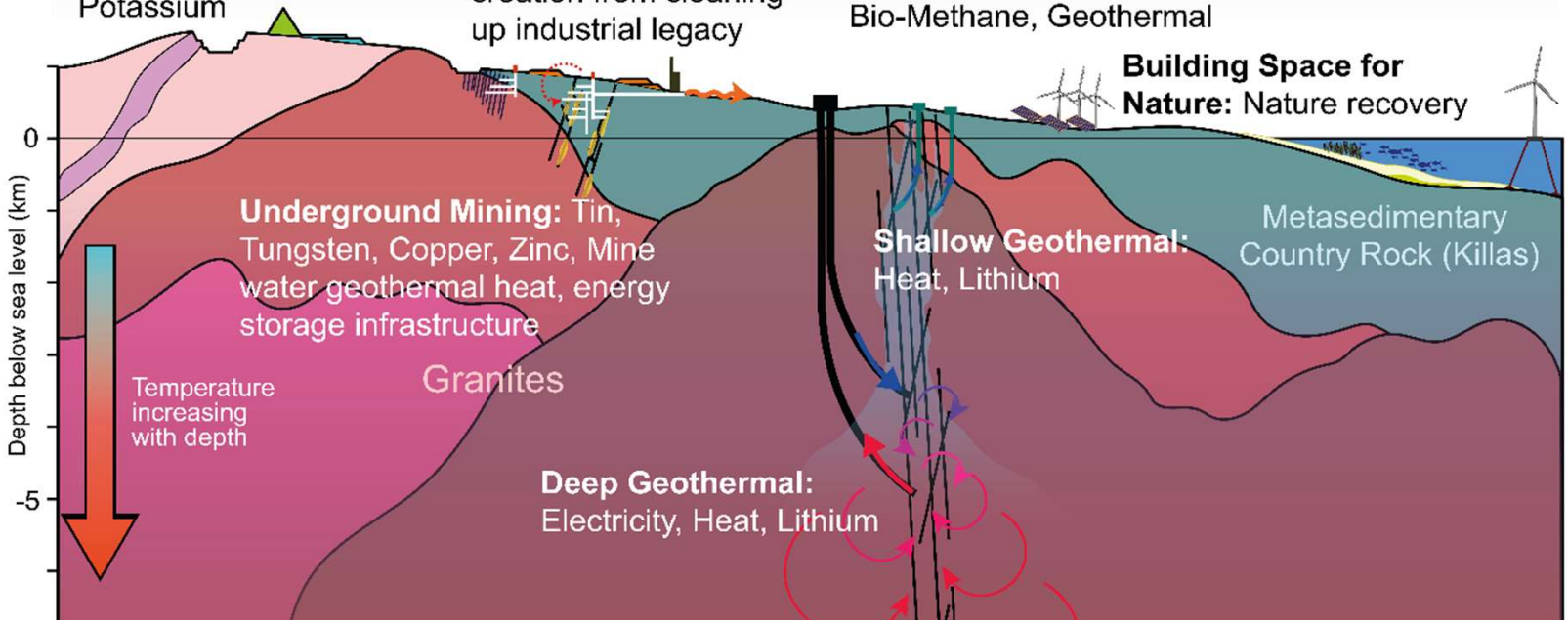
Surface Quarrying: Kaolin, Lithium, Tungsten, Rubidium, Caesium, Potassium

Agri/Aqua-Culture: Sustainable agriculture, aquaculture, and water resourcing practices

Remediation: Value-creation from cleaning up industrial legacy

Exceptional Natural Spaces: 250 km Heritage Coast, 167 SSSI, 12 Special Conservation Areas, 498 County Wildlife Sites, 9 Marine Conservation Areas, 20% UK's designated bathing beaches

Renewables & Clean Energy: Floating Offshore Wind, Onshore Wind, Solar Photovoltaics, Bio-Methane, Geothermal



https://met4tech.org/wp-content/uploads/2023/02/UNFC_SWEngland_Policy_Brief_May2022.pdf

https://cioslep.com/case-study/cornwall-and-ios-tech-metal-opportunity/
E. Marquis

UK Research and Innovation

Figure II Schematic cross-section of South West England illustrating the variety of geological, natural, heritage, cultural and expertise assets in the region related to its geological history, in particular the occurrence of the Cornubian Granite Batholith.

First case study of United Nations Resource Management System applied to Cornwall

Presented at UNECE, Geneva, April 2024

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UNRMS = 12 principles covering Environment, Social and Governance and circular economy

ZAMBIA

Foreign, Commonwealth & Development Office

Department for Business & Trade

UK Research and Innovation

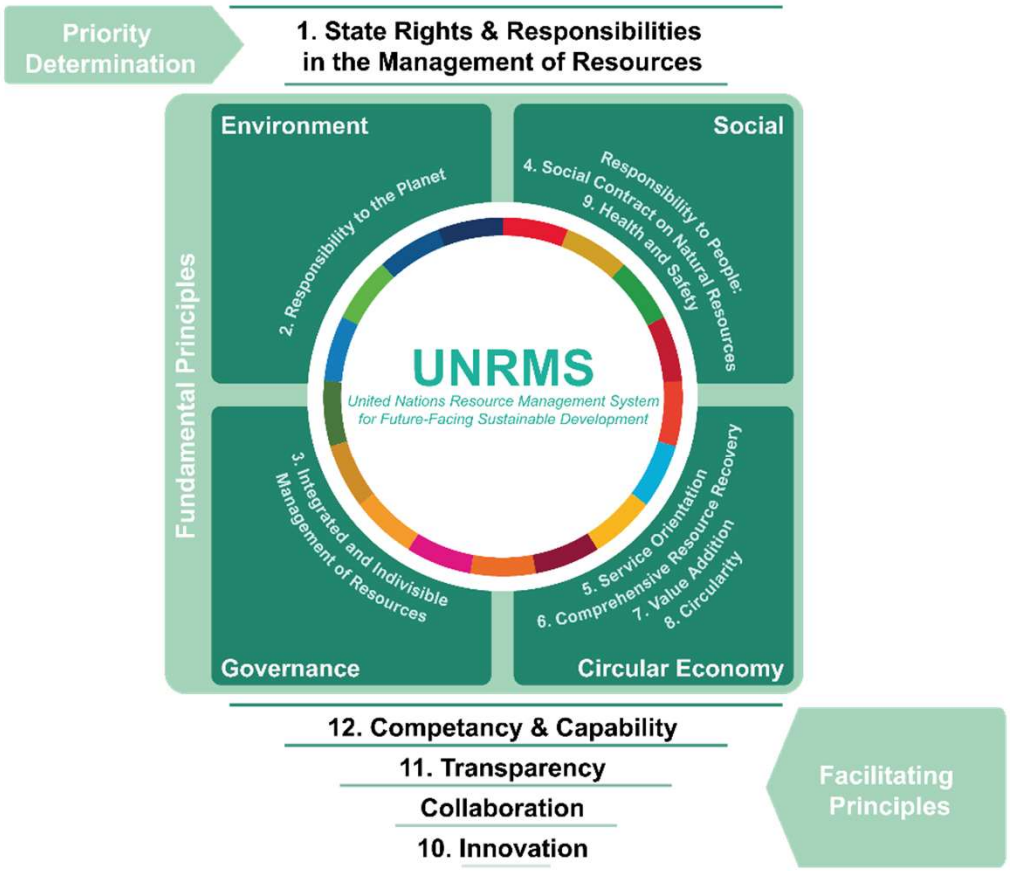
Met4Tech

Cornwall case study → UK's global example United Nations Resource Management System

12 Principles (and 54 underlying requirements)

1.What is UNRMS? https://youtu.be/4BryhgEwDa8

2. Introduction to the Cornwall case study using UNRMS: https://youtu.be/lR6SvZdNFs0



UNRMS adapted for Cornwall Case Study

Marquis et al, 2024, Optimizing Resource Management for Critical Raw Materials: A Case Study of the Application of the United Nations Resource Management System with Cornwall Regional Government, United Kingdom, UNECE

ROGRAMME

UK Research and Innovation

UNRMS informs future research – Critical Minerals Challenge Centre team and partners ready for transdisciplinary research

Critical Minerals Challenge Centre

TWP1
Analytical & geo-metallurgy protocols
Industry lead: Petrolab

TWP2
Value from Mine Waste
Industry lead: Cornwall Resources

TWP3
Exploration and Extraction Technologies
Industry lead: Geolorn

TWP4
Smaller projects with cluster, workshops, building new projects

15 academics

2.5 management

commercialisation, policy, comms., coordination

Innovation fellows all in different disciplines for transdisciplinary team

Researcher co-lead

AI/Software

Regional Government

National Government

31 partners

Companies

NGOs

Social Sciences: Levelling up livelihoods

Technical research including mine waste as new deposits

What Success looks like

- Positive profile of projects attracts new green sector investment
- New UK products worldwide e.g. ecology services

Critical Minerals Accelerating the Green Economy Centre

- Well on the way to 3000 good, new jobs
- Strong Contribution to UK Industry strategic advantage

Photo: Cornish Metals