



**The pivotal interventions to get ‘more-through-the-door’ into geosciences (& mining/engineering) skills training, for a resilient UK Critical Minerals sector, are largely in secondary education.**

Dr Kathryn Moore (Senior Lecturer in Critical and Green Technology Metals) and Professor Pat Foster (Head of Camborne School of Mines); Department of Earth and Environmental Sciences, University of Exeter, Penryn Campus, Treliever Road, Penryn, Cornwall TR10 9FE, UK

We have more than 60 years combined experience in geoscience and mining practice, education and research. Based in the only dedicated mining school in a UK university, we work with industrial partners and communities and other educational institutions. In this brief, we consider the Critical Minerals talent gap and the stated ambition in the 2022-2024 UK Critical Minerals Strategy to ‘*define a critical minerals skills blueprint, recognising the full breadth [and scale] of skills needed*’. We summarise a research and review manuscript that was submitted (30 April 2025) to Geoscience Education, a special issue of the journal *Earth Science, Systems and Society*.

#### KEY FACTS

**Policy area:** Critical Minerals, Education, Natural Capital, Circular Economy,

**Research question:** How can we unlock mindsets and skills development for the low carbon transition, specifically the critical minerals–energy nexus and the circular economy?

**Methods:** A pathways approach, examining the role of higher-level institution as the intermediary between school leavers and industrial stakeholders

**Research stage:** Completed and submitted for review, unpublished

#### Executive Summary

The Institute of Materials, Minerals and Mining reported<sup>i</sup> on the serious and growing skills gap as a significant risk facing the entire Critical Minerals (CMs) value chain, focussing on the types of skills that are needed by industry. The report highlighted that modernising perceptions will be key to attracting talent and sustaining the industry. However, outreach programmes have been operating consistently while entrants into relevant study programmes have been decreasing. There is now increasing competition between industrial stakeholders to recruit from a diminishing pool of available talent. Outreach programmes, unless dramatically scaled up and out, will fail to attract entrants in the sufficient numbers to mitigate competition between industrial sectors. Here, we develop a ‘more-through-the-door’ approach applied to geoscience student recruitment, as a pathway into critical minerals careers. We focus on the pivotal interventions needed in core secondary level curricula that can change mindsets widely, attract new entrants into technical careers and support the UK knowledge economy for nature-regenerative industrial futures.

#### Policy recommendations

1. Create synergy between CM strategy, industrial strategy and **educational strategy** to address the talent gap.

The current model of academic–industry collaboration centres around knowledge-sharing, upskilling, and graduate recruitment. There is industrial competition<sup>i</sup> for a limited number of skilled graduates. Universities act as an intermediary between secondary level teaching and industry. More consistent and strategic interventions at secondary education level are needed nationally, before learners are filtered into academic and industrial silos. Specifically, key messaging needs to be delivered early through national curricula<sup>ii</sup>, about the role of natural primary and secondary resources in supporting modern society.

2. **Scale up outreach programmes** but recognise that this is a partial solution.



Outreach programmes increase interest levels for only a small number of individuals as evidenced by a continuing decline (43% from 2014 to 2020<sup>iii</sup>) in University geoscience (and other discipline) enrolments. They would need to be significantly widened and consistently scaled up to have any impact on addressing the CMs talent gap, using an educational platform with a cascade training programme.

3. **Separate critical minerals requirements from fossil fuel requirements**, in energy resource teaching specifications.

Secondary-level geology and geography curricula include core topics that are fundamental to CM careers but make no specific reference to CMs. Metal mining is taught alongside fossil fuel extraction as part of 'energy' provision (e.g. Eduqas and AQA exam boards). The association of mining with fossil fuels is reflected in campaigning against all extractive, including CM, careers<sup>iv</sup>. The need to engage with modern industrial challenges would be better conveyed if curriculum: featured a CMs-focussed case study; emphasised that copper, where included, is a strategic metal for low carbon energy provision; explicitly delineated CM-based energy and hydrocarbon-based energy. The curricula are already over-stretched, so accommodation of CM case studies and messaging will require wider changes.

4. **Increase awareness of geology** and what it is.

Geology provides many of the transferable skills that support energy transitions and critical minerals supply. Uptake of Geology GCSE and A level is often influenced by local educational availability, family awareness and sense of place, and locally active relationships between schools and industries or higher education centres. In order to improve messaging and attract talent, there needs to be a coherent educational message about what constitutes geology<sup>v vi</sup> at Key Stage 3 (across geography and science disciplines), and how it addresses modern sustainability challenges. This should encourage geology uptake at Key Stage 4 (rarely available) and Key Stage 5 (sometimes available).

5. Mediate the **need for secondary geoscience educators** within the limited talent pool.

The reach of secondary geoscience education is falling (from 4,000 A level geology students in the early 1980s, to 935 in 2023)<sup>iii vii viii</sup>. There is strong synergy between A Level recruitment and University recruitment so that A level geology teaching is a key entry point into CM-related careers. An increase in support and dedicated teaching by specialist geoscientists at A Level is required but it will add to the industrial competition for graduate employees. Tackling this would require active recruitment and a mid- to long-term vision for cascade training of non-specialists.

6. **Increase diversity** in order to satisfy a diverse range of skills.

A diverse range of skilled roles are required to ensure CM supply and company performance<sup>ix</sup>, but diversity is low across higher UK geoscience education and CM industries. Trials have taken place at the secondary and tertiary level to enhance knowledge of and access to opportunities for diverse groups, but initiatives lack longevity of support and scale. Equal access to nature-based learning, messaging about modern geosciences, and communication of the diverse roles and opportunities that are available, need to be implemented at pre-University levels. This requires longer-term actions and financial support on a national scale, coupled to educational strategy.

7. Positive actions to **maintain and extend outdoor education opportunities**

Awareness of geoscience and nature-based industrial careers is biased towards school leavers with access to outdoor education and leisure<sup>ii</sup>, which can reinforce the low diversity of entrants into relevant study programmes. Equal access to nature-based learning requires positive actions for some students, particularly those in urban environments and those with limited transport opportunities, with commensurate financial support.

8. **Extend the narrative** beyond the geosciences.

The challenges inherent in raw materials production require the engagement of a new cross-disciplinary generation of practitioners. Getting the CM narrative and messaging right across secondary-level disciplines (science, humanities and arts) could foster engagement, and thereby responsible production for



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positive socio-environmental outcomes. We need a good mechanism to learn from the pilot studies for innovative outreach (linking to point 2) that consider how to mainstream geoscience CM messaging beyond industrial and academic silos, and to translate that learning into widespread action.

### Further information:

The potential for ‘business-as-usual’, ‘innovative’ and ‘visionary’ actions to address the talent gap was examined<sup>ii</sup> and described using the criteria below, with an emphasis on interventions at the secondary education level.

Aspect	Pathway 1 Business-As-Usual	Pathway 2 Sustainable innovation	Pathway 3 Regenerative Futures
Communication challenges	Potential growing disenchantment of those already lacking trust	Outreach subject to a lack of uptake and scaling	Rooted in educational mindsets & dialogue
Ethical stance on training and skills development	A neocolonial international geoscience and 'sustainability' knowledge economy	Cocreated and 'regenerative' solutions, depending on jurisdictions	Fair, just and equal 'regenerative disruption', attuned to micropolitical context
Diversity in participating identities	Interactive outreach programmes in place of greater intervention	Accreditation and fostering of diversity to match the changing skills landscape	Equal access to nature - based learning about working landscapes.
More-through-the-door into industry	Awareness of skills-needs informing competition within a limited talent pool	Education strategy following innovation, but not at the required rate of change	Attract diverse new entrants into geo- and materials science disciplines by mainstream dialogues
Teaching interventions	Conventional resource geology teaching limited to rare geology provision	CM reorientation of existing educational curricula with cascade training	Wider rollout of dedicated geoscience teaching, coupled to cross-discipline messaging*

\*A complimentary measure here is to embed up-to-date CM and energy transition reemployment opportunities into the GCSE Geography Curriculum

## Contact details

We would be pleased to provide further information to inform this inquiry. Please do not hesitate to contact Kathryn Moore [k.moore@exeter.ac.uk] and Pat Foster [p.j.foster@exeter.ac.uk].

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<sup>i</sup> <https://www.iom3.org/resource/the-talent-gap-critical-skills-for-critical-materials.html>

ii Moore et al, 2025. *More Through the Door: Regenerative Disruption in Education, to secure skills for a just transition to Critical Minerals Production*. Submitted (30 April 2025) to ES3: Geoscience Education

iii <https://geoscientist.online/sections/unearthed/global-geoscience-enrolment>

iv <https://peopleandplanet.org/news/2024-12-04/10-universities-ban-fossil-fuel-industry-recruitment-as-aberystwyth-ends-careers-relationships-with-oil-gas-and-mining-companies>

<sup>v</sup> <https://doi.org/10.3389/esss.2024.10116>

vi <https://doi.org/10.3389/esss.2024.10078>

viii <https://www.geolsoc.org.uk/~media/shared/documents/geoscientist/2019/September%202019/Feature%20SEPTEMBER2019.pdf>

viii <https://www.geolsoc.org.uk/~media/shared/documents/education%20and%20careers/UGUK/resources/enrolment%20strategy.pdf?la=en>

ix <https://www.mckinsey.com/industries/metals-and-mining/our-insights/increasing-diversity-in-mining-three-years-on>