Critical Minerals Association
Environment, Social & Governance (ESG) Workshop Series

ESG Workshop: A Talent Pipeline

April 2022
Kirsty Benham, Critical Minerals Association

Recommendations

The Critical Minerals Association recommends that:

1. Geoscience/ engineering/ metallurgy community represented at the Government industry groups working on green jobs - Green Jobs Taskforce, Cross-Cutting Delivery Group, Trailblazers.
2. Critical minerals and geoscience/ engineering/ metallurgy as part of the programmes Government is organising outlined in the Net Zero Strategy - careers information, teacher training, education programmes.
3. Geoscience/ engineering/ metallurgy education community represented in the development of new green skills for hydrogen, carbon capture usage and storage (CCUS) supply chain roadmap.
4. Include the importance of critical minerals and geoscience/ engineering/ metallurgy in the sustainability and climate change strategy for education.
5. UK Government to support existing geoscience/ engineering/ metallurgy education initiatives through funding opportunities/ integration with Government initiatives in BEIS/ DfE.
6. UK Government to outline the importance of geoscience/ engineering/ metallurgy and critical mineral degree programmes in the Critical Minerals Strategy, and to engage with university leaders to ensure that these courses continue to run, particularly at universities which enable students from lower socio-economic backgrounds to level up.
7. UK Government to help remove financial barriers in university courses for lower socio-economic background students by extending postgraduate loans to cover the full costs of tuition and providing bursaries to support to cover costs of fieldwork and equipment.
8. The UK Critical Minerals strategy, and UK Government, should clearly explain the connection between critical minerals with climate change and outline its commitment to supporting responsible supply chains.
9. The UK should create graduate programmes specialising in critical minerals and commercialising innovations.
10. Geoscience/ engineering/ metallurgy education community represented in DfE discussions on geography/ science curriculum development meetings.
11. UK Government to help provide funding for the Geoscience Summer School to continue training geology teachers.

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With special thanks to Ben Lepley & Lucy Crane, Chairs of the Critical Minerals Association's Perception of Mining working group for chairing and presenting in the ESG workshop on the 18th February 2022, and to all CMA members and friends who have commented on this paper. Please find more information about their important initiatives in the appendix on pages 17-23.

Supporting the Green Industrial Revolution

The Critical Minerals Strategy needs to include a vision on how the UK can increase training and education for all parts of the critical minerals supply chain.

If something hasn't been grown, then it must be mined. To deliver the Net Zero Strategy and Green Industrial Revolution, the UK needs to be a world-leading economy that:

1. Provides a sustainable supply of the raw materials required for manufacturing of green, low-impact technologies and the UK's defence and economic sectors.

2. Reinvigorates the **UK's waning soft power leadership as the global centre of geoscience, engineering, processing, expertise, education, and training.**

3. Nurtures **a new generation with a clear understanding of the connection between products, raw materials, and the mining/mineral extraction industry**, and how they can use this understanding to play a meaningful role in tackling climate change.

The UK cannot deliver the energy transition without significant extraction of critical raw materials – and the UK cannot responsibly produce these raw materials without qualified professionals and scientists, including geoscientists, engineers, and metallurgists. **There has been a dramatic decline in the number of young people entering the mineral extraction and processing industry,** and in the places available for them to study. The UK needs to incorporate critical minerals, geoscience, mineral processing[1] and engineering (including mining, geotechnical, civil, electrical, mechanical, and processing engineering) into sustainability education initiatives and strategies.

The Challenge & Opportunity

If the UK wants to develop expertise, innovation, and new businesses for critical minerals supply chains, it needs to build a talent pipeline of people skilled in geosciences, engineering (including mining, geotechnical, civil, electrical, mechanical, processing engineering) and metallurgy.

The UK was once world renowned for training people to work in mineral extraction operations across the world. This brought enormous soft power, as UK geoscientists/ metallurgists/ engineers went to work abroad, and international students would bring their influential UK university experience back home. As the saying goes: 'A mine is a hole anywhere in the world with a Cornishman at the bottom of it!'.

[1] *The circular economy is also an important component of the supply chain, and we refer to processing as the minerals midstream processing* and *recycling processing*.

Unfortunately, the number of mining related university courses in the UK is in decline, and without these skillsets, the UK will lack the ability to identify new geological potential, develop a mine, process minerals, and build recycling and midstream plants, without importing talent from elsewhere. Geoscientists and engineers are already on the UK's shortage occupation list.

The UK is still home to several universities and institutions, world-renowned for geoscience, engineering, processing, and mining. Many of these are outside of London, in levelling up areas such as the South West. The UK has the facilities, the drive, the passion, and ability to teach; but the decline in geoscience/engineering/metallurgy education in recent years means that students are sadly lacking.

There is a lack of exposure to geoscience, engineering and metallurgy in schools, and few teachers have these geoscience or industry backgrounds. There was only one UK university training geoscience teachers, Keele Summer School, but this officially stopped in 2020 due to a lack of funding. Most people do not know about mineral exploration or that geoscience/engineering/metallurgy related career options exist. This means fewer young people are studying geoscience/engineering/metallurgy at university. In five years' time, the A-level students today will be tomorrow's teachers, which is why increasing education around these disciplines needs to happen now.

Interest in geoscience and the production of raw materials has waned in the UK at the wrong time. Whilst there is a trend towards environmental sciences, there is a decline in interest in earth sciences despite the importance of understanding earth processes for climate change solutions. The energy transition and decarbonising economies will be mineral-intensive and requires a quantum shift in supply of several key raw materials required for manufacturing of green, low-impact technologies. But due to an increasing disconnect between people, products, and raw materials, in addition to negative connotations around the extractive industry, fewer young people are entering education in these areas. As a result, there is a widening knowledge gap in the production and supply of critical raw minerals.

At a time when Green Jobs and Levelling Up are key Government priorities, the inability of the UK to create a pipeline of skilled individuals in critical mineral related disciplines would be a wasted opportunity. Other countries are supporting their schools and universities to produce the geologists, metallurgists, engineers that their industries need. This includes the Australian National Exploration Undercover School ('NExUS'; NExUS | University of Adelaide), which is supported by Government, industry, and academia. To create talent, you also need graduate programs that attract the best and the brightest worldwide to work together with industry. The UK creates these graduate programmes with other industries but not with mineral extraction like in Australia and Canada**.**

The UK therefore needs to invest in training for individuals on how to find, extract and process raw materials. If there is a lack of investment in this training in the UK and its trading allies, this knowledge gap will be filled by those countries who are developing their talent. The UK will lose its soft power and its competitive advantage when it comes to skills.

The UK should remember the value of these skillsets as it seeks to extract more critical minerals, and support greater understanding of geoscience related disciplines, career opportunities and the connection between critical mineral extraction and 'Green Jobs.'

Recommendations

The UK Government has already made important commitments around **Green Jobs and Levelling Up.** Geoscience and critical mineral related education and training could easily be included as part of these existing commitments. **The need for critical minerals, as well as carbon capture/ hydrogen/ geothermal/ nuclear storage, to tackle climate change, mean these are key Green Jobs for the UK.**

Our recommendations highlight how the UK Government can integrate critical minerals/ geoscience/ metallurgy into its Green Jobs taskforce, sustainability education programmes, teacher training, career information.

Green Jobs - *"employment in an activity that directly contributes to, or indirectly supports, the achievement of the UK's net zero emissions target and other environmental goals, such as nature restoration and mitigation against climate risks."* – *BEIS Net Zero Strategy 2021*

The Critical Minerals Association recommends that:

1. Geoscience/engineering/metallurgy community is represented at the Government industry groups working on green jobs - **Green Jobs Taskforce, Cross-Cutting Delivery Group, Trailblazers.**

2. Critical minerals and geoscience/ engineering/ metallurgy to be part of the programmes Government is organising outlined in the Net Zero Strategy - **careers information, teacher training, education programmes.**

3. Geoscience/ engineering/ metallurgy education community is represented in the development of new green skills for **hydrogen, carbon capture usage and storage (CCUS) supply chain roadmap.**

4. Include the importance of critical minerals and geoscience/ engineering/ metallurgy in the **sustainability and climate change strategy for education.**

5. UK Government to **support existing** geoscience/engineering/metallurgy **education initiatives** through funding opportunities/ integration with Government initiatives in BEIS/ DfE.

6. UK Government to outline the importance of geoscience/ engineering/ metallurgy and critical mineral **degree programmes in the Critical Minerals Strategy**, and to engage with **university leaders** to ensure that these courses continue to run, particularly at universities which enable students from lower socio-economic backgrounds to level up.

7. UK Government to **help remove financial barriers in university courses** for lower socio-economic background students by extending postgraduate loans to cover the full costs of tuition and providing bursaries to support to cover costs of fieldwork and equipment.

8. The UK Critical Minerals strategy, and UK Government, to **clearly explain the connection between critical minerals with climate change** and outline its commitment to supporting responsible supply chains.

9. The UK to create graduate programmes specialising in critical minerals and commercialising innovations.

10. Geoscience/ engineering/ metallurgy education community represented in DfE discussions on geography/ science curriculum development meetings.

11. UK Government to help provide funding for the Geoscience Summer School to continue training geology teachers.

Areas to Address

To develop a talent pipeline for critical minerals, the UK Government needs to address the following areas whilst taking into consideration social mobility:

- Schools
- Careers Advice
- Universities
- Public Awareness

Schools

Few schools offer Geology GCSE or A-level/ Scottish Highers. Only 500 students across England and Wales took GCSE last year and the year before. 1,268 students took A-level Geology in 2019 as it is not viewed as a 'core/ fundamental' subject choice. A-level geology students declined from 2,240 in 2015 to 1,268 in 2019[2]. Geology is no longer even included in government statistics[3] on the different subjects taught in secondary schools.

Encouraging greater uptake of geology would be helpful. The Critical Minerals Association would firstly advocate for the existing curriculum in primary/ secondary schools to incorporate earth science/ critical minerals topics related to the energy transition, in subjects like geography/ chemistry and interdisciplinary materials. Geoscience incorporates the disciplines of geology, geophysics, geochemistry, engineering, and

2 Enrolment in crisis: A UK-wide strategy for exciting, engaging and retaining students in the geosciences A joint report from The Geological Society of London and University Geoscience UK https://www.geolsoc.org.uk/~/media/shared/documents/education%20and%20careers/UGUK/resources/enrolment%20strategy.pdf?la=en

3 https://explore-education-statistics.service.gov.uk/data-tables/fast-track/cfc13a9e-d1c8-44bc-8f60-cc1da7125f44

resource geology and many of its concepts (e.g., plate tectonics, the rock cycle, geomorphology, and climate) are covered in other subjects such as Geography and Chemistry.[4]

Getting children excited about geoscience/ engineering/ metallurgy when they are at primary school is an important first step. Everyone should understand that everything is made from something and must come from somewhere. Secondary schools have the breadth of the population as the audience. All students study geography until the age of 14, and this offers the potential for building geoscience/ critical minerals in. If individuals are not learning about geoscience at an early age, they will not have awareness about the science or to become specialists.

Teachers will teach about important new topics such as critical minerals and skills in the green industrial revolution if:

1. There are properly trained to teach these topics.
2. There are suitable resources available.
3. They must teach it because it is on the curriculum and exam questions are frequently set on the topics.

Engaging students at GSCE level prior to starting A-levels would be an opportunity to broaden the horizons of students and raise awareness of the opportunities in the critical industry, away from conventional careers.

There are several impressive initiatives that are working with limited resources to bring geoscience/ engineering/ metallurgy into schools. Further details are provided in the appendix. UK Government can support these efforts by **facilitating engagement and collaboration between DfE and these initiatives**, or through funding opportunities. Discussions on geography/ science curriculum development in BEIS should include representatives from the geoscience/ engineering/ metallurgy education community.

The Critical Minerals Association heard from an organiser of geology teacher training through a Geoscience Summer School, where generally between 7-10 teachers were trained to teach geology before the pandemic. Last year, the Earth Science Teachers' Association (ESTA) took over the administration of the Geoscience Summer School but without funding it is unsure how they might train anyone in the future. When Scotland stopped training geology teachers, they very soon dropped geology from their curriculum at Highers - a reflection of what could happen in the rest of the UK. **UK Government could help provide funding for the Geoscience Summer School to continue training geology teachers.**

4 Enrolment in crisis: A UK-wide strategy for exciting, engaging and retaining students in the geosciences A joint report from The Geological Society of London and University Geoscience UK https://www.geolsoc.org.uk/~/media/shared/documents/education%20and%20careers/UGUK/resources/enrolment%20strategy.pdf?la=en

UK Government should also include geoscience/ critical minerals in its **Green Jobs work around teacher training and sustainability education programmes**, as this would have a significant impact.

Careers Awareness

Young people are increasingly concerned about the environment and interested in careers related to fighting climate change. However, young people are not aware about geoscience/ engineering/ metallurgy, their role in the energy transition, or the career pathways that lead to well paid jobs.

Career pathways related to geoscience/ engineering/ metallurgy and critical minerals do not exist on careers websites and so most students will only stumble upon them by chance. This lack of information decreases the likelihood of people from lower socio-economic and diverse backgrounds from discovering these career pathways. Parents also need to be aware of the career opportunities available.

The mineral extraction sector has potential for employment at home and overseas. There is a small but thriving mineral processing community in the South West of England. Students from the world-renowned Camborne School of Mines (CSM), University of Exeter have spent time in the South West after graduating with consultancies, manufacturers, and operations. A high proportion of graduates will spend some or their entire careers working abroad. Not only is this an exciting career pathway for adventurous young people, but it is also important that there are UK trained professionals with an appreciation of health and safety along with environmental, social and governance (ESG) working internationally.

There are several important initiatives which are bringing the geoscience/ engineering/ metallurgy and critical minerals community together to raise awareness of career pathways, and these would benefit from being joined up with schools' careers services. UK Government should work with these existing initiatives to include geoscience/ engineering/ metallurgy and critical minerals in its **Green Jobs work around careers information,** as this would have a significant impact. Showcasing geoscience/ engineering/ metallurgy and critical minerals career pathways as part of Green Jobs options would help young people to understand all the ways that they can contribute to the climate crisis.

Universities

Universities are vital for upskilling geoscientists, metallurgists, engineers, and researchers, who can teach the next generation. Universities must ensure that their courses are attractive to students and that they have sufficient numbers to run programmes. As geology decreases in schools and fewer young people are aware of career pathways in geoscience/ engineering/ metallurgy and critical minerals. There has been a decline in applicants to these degrees. According to the Geological Society/ University Geoscience UK (UGUK), the number of students studying geology at university

has declined each year since 2014, a decrease of 43%.[5] In 2020, Camborne School of Mines, University of Exeter paused the UK's last BEng Mining Engineering programme.

If interest in geosciences continues to decline due to lack of awareness, more universities will be tempted or forced to close similar programmes. Universities such as Hull, Brighton, Portsmouth have dropped geology courses. This further concentrates geosciences in red brick, expensive, exclusive universities, which makes it harder to encourage upward social mobility in these fields.

Many students at post-92 universities live at home/have caring responsibilities and cannot move away to undertake higher education. Some students from lower socio-economic backgrounds cannot afford to leave their family home, and if fewer Universities are offering geoscience/ engineering/ metallurgy degrees, these become more exclusive and there is less opportunity for upward social mobility. It is crucial that the UK Government supports broad access and participation in these courses by ensuring that a wide range of universities continue teaching these programmes.

For mineral processing, the Critical Minerals Association have heard from professors at Camborne School of Mines that it has been difficult to recruit for a number of years, and they have attracted small numbers over the four years they have been running the current Master's programme. Of those who enrolled on the programme, only 5 were UK based and all of them had some previous exposure of the industry. The biggest issue is a lack of awareness amongst potential students of the specialisms such as mineral processing and potential in this industry. This coupled with negative exposure to the mining industry has hurt recruitment of students.

There is an international trend (in Western countries at least) of decreasing numbers studying mining/mineral processing degrees. This is as true in countries with large mining industries (Australia, USA, Canada) as it is in the UK. However, some Asian nations are seeing a significant increase.

Master's degrees are typically an industry requirement for an entry level job in mining. However, the costs of Master's programmes has increased whilst the maximum loan at postgraduate level has remained the same. For example, in 2022/23, the maximum post-graduate student loan is £11,836, and Camborne School of Mines's MSc Mining Geology programme fee is £13,500, the Imperial College London's MSc Metals and Energy Finance programme fee is £24,950. Whilst there are some scholarships available (mostly for international rather than UK students), this can be a hindrance to people from lower socio-economic backgrounds.

Field trips are essential for most geoscience degrees, and this can be difficult for students who may be worried about additional field costs and are unable to take much time off

5 Enrolment in crisis: A UK-wide strategy for exciting, engaging and retaining students in the geosciences A joint report from The Geological Society of London and University Geoscience UK https://www.geolsoc.org.uk/~/media/shared/documents/education%20and%20careers/UGUK/resources/enrolment%20strategy.pdf?la=en

their jobs for travelling. Field trip requirements shouldn't be a barrier to young people from lower income backgrounds to enter the field.

The Critical Minerals Association's paper – 'A Blueprint for Responsible Sourcing of Critical Minerals' made the following recommendations for the UK Government to help remove financial barriers to support upward social mobility in the industry:

1. Provide bursaries to fully cover the costs of all fieldwork and equipment.
2. Extend postgraduate loans to cover the full amount of tuition fees (due to expenses associated with practical fieldwork, tuition fees can vary, up to twice the maximum available amount of a postgraduate loan).
3. Introduce a postgraduate maintenance loan to cover the costs of living for the duration of the course.
4. Provide easily accessible research grants to promote domestic and international innovation.

These would enable the courses to be more accessible to lower socio-economic background students.

Many University leaders and managers do not understand how important geoscience/ engineering/ metallurgy and critical minerals are, and their role in the energy transition. Universities follow the market, and many see a decrease in geology at secondary school as inevitably resulting in a decrease in uptake at university. University staff in these disciplines are working hard to highlight the importance of their programmes to leaders, but with lack of awareness and fewer students, decisions such as the one to pause the Camborne School of Mines BEng Mining Engineering Programme have been steadfastly resolute by University of Exeter leaders.

UK Government can lead the way by highlighting the importance of geoscience/ minerals engineering/ processing/ critical minerals education and training for Green Jobs and the energy transition to society and University leaders. **University decisionmakers are more likely to listen to UK Government than their own staff**, given the importance of Government policy for the nation's strategic direction. UK Government should explain the importance of these disciplines for critical mineral supply chains in their critical mineral strategy to university leaders, outline that these are skillsets that need to be developed for national energy transition ambitions and offer to help struggling Universities to keep running these courses.

Graduate students and their projects are specialised. To create talent, you need graduate programs that attract the best and the brightest worldwide to work hand in hand with industry. Innovation comes out of companies and graduate programs. The UK has an amazing program, Centre for Process Innovation (CPI) that works with industry and universities to commercialise technology. This drives innovation and attracts people to the UK. The UK creates these graduate programmes with other industries but not with mineral extraction like Australia and Canada**. The UK should create graduate programmes specialising in critical minerals and commercialising innovations.**

Universities should be the pinnacles of education and enlightenment; however, many provide the platform for passionate students to promote and lobby for climate change action, without the Universities providing students with any in-depth academic exposure to the nuances and challenges of the energy transition. Most students who take part in climate change action and environment societies are from different academic backgrounds, which means they are not receiving any further education on the climate change issues they care about.

For example, King's College London's Fossil Free movement successfully lobbied after years of student action and a hunger strike, for the university to divest from fossil fuels. Whilst this is an important campaign, the university could have provided a course to all students interested in climate change, bringing in investment professionals and academics, for students to debate and discuss the 'what next?' As the energy transition moves away from polluting sources of energy, what will be fuelling homes in the interim? Does divestment from Rio Tinto solve the problem when everything we use in everyday life relies on metals and mining? The solutions to climate change are not always black and white. **Universities could do more to instigate college wide education on the intricacies of the energy transition, and UK Government could encourage this to take place.**

Government Role in Public Awareness

The IPCC Climate Change 2021 report outlines pathways to limit global warming to 1.5°C, but this is predicated on the assumption of mature wind and solar technologies. A single 3MW wind turbine requires 2,000 kg of rare earth elements! Without a steady supply of critical minerals for renewable energies, mitigating climate change will not be possible. Most people are not aware of this.

The UK's Critical Minerals strategy needs to explicitly make the connection between critical minerals, geoscience/ engineering/ metallurgy, and the fight against climate change. The UK Government can play an essential role in helping people to understand the science, technology, and materials that are needed for the energy transition. By representing the best interests of the UK population, Government is a neutral body which can communicate these messages in a way that is independent from stakeholder groups and their individual interests**. The UK Critical Minerals strategy, and UK Government should clearly explain the connection between critical minerals with climate change** and outline its commitment to supporting responsible supply chains.

Conclusion

The UK cannot deliver Net Zero or the Energy Transition without critical minerals. It cannot source critical minerals without geoscientists, engineers, and metallurgists. If the UK continues in its current direction, geoscience and critical mineral education will likely continue to decline. The UK's voice in this crucial matter will diminish on a global stage. Mineral extraction will become more elitist, with graduates only coming from the highest tariff universities. All of this will make us less effective at building equitable partnerships on a global stage.

The UK Government has a role in engaging with university leaders and ensuring that these geoscience/ engineering/ metallurgy and critical mineral related courses continue to run across the country, and that they are accessible to students from all backgrounds. The UK Critical Minerals strategy, and UK Government should also clearly explain the connection between critical minerals with climate change and outline its commitment to supporting responsible supply chains to raise awareness in society.

The UK Government already has many important commitments around Green Jobs, sustainability education, careers advice, teacher training, and hydrogen/ CCUS. The Critical Minerals Association urges the UK Government to recognise geoscience/ engineering/ metallurgy as part of its 'Green Jobs' agenda, and to commit to develop a talent pipeline for these supply chains in its Critical Minerals Strategy by inviting these disciplines to participate in its programmes.

There are many excellent initiatives that volunteers are undertaking to raise awareness of geoscience and critical minerals for the energy transition. But these are often under-funded, run by volunteers, and localised in reach. It is crucial for a national, joined-up approach to have the biggest impact, supported by government funding bodies. The Critical Minerals Association would like to see engagement between these many volunteer-led initiatives and Government departments, to support Green Jobs, levelling up, upward social mobility, increased diversity, and a talent pipeline for critical mineral supply chains.

Appendix

Appendix 1: Social Mobility

The Social Mobility Foundation outlined the importance of 'Green Jobs' benefiting a wide group of young people, supporting levelling up aims and not just supporting the already advantaged. Those from poorer backgrounds are still twice as likely to end up in working class jobs than those from more privileged backgrounds. If green jobs do not focus on upskilling from working-class backgrounds and educating young people on routes into these jobs, the transition to net zero could further this inequality.

Current challenges to entering sustainability careers for students from low-income backgrounds:

a. **Young people from low-income backgrounds are not aware of the opportunities available to them.** The Social Mobility Foundation works with very enthusiastic students interested in Biology and Chemistry who would thrive in Geoscience/ Critical Minerals careers if they knew about the opportunities. Students need people who work in these industries to support as mentors, and offer advice such as the need to have a Master's degree or attend networking events.
b. **Relatively few entry-level jobs into the sector(s)**. This is likely to underline the role of social networks, to provide knowledge and information about entry routes and perhaps to provide opportunities for work experience. This could benefit people with friends and family working in the sector or in corporate life, who can provide support and advice. Networks may also be important as many jobs are not advertised.
c. **Entry is not linear,** and may require periods of short-term work, freelance contracts, or unpaid work experience, which could benefit people from more affluent backgrounds with more financial support. Months of unpaid work is not viable for lower income background students.
d. **Relevance of higher-level degree**: 'Jobs for a sustainable future' as defined here may be especially available to people with a relevant higher-level degree, which may be prohibitive for people who are not aware of this requirement, or who cannot afford to take it up. Master's degrees are typical pre-requisites for entry level jobs in the mining sector, and as previously outlined, these can be prohibitively expensive.

The Critical Minerals Association undertook a snap survey of alumni in mining in February 2022. The survey was shared with the association's networks and had a good spread of 117 respondents, graduating from 1952 to 2021. Of the 100 British respondents, only 4 were from non-white backgrounds demonstrating there is still work needed to increase the ethnic diversity of UK mining.

Of the 29 respondents who had graduated between 2010-2021:

- 14/29 were the first in their family to go to university
- 13/29 were from working class backgrounds
- 25/29 had Masters' qualifications or higher
- 25/29 said networking and informal networks were the best way to find employment
- 24/29 said a lack of job opportunities in the UK impacted their career. This compares starkly to 17/22 graduates from the 1950-1980s who didn't have this issue

Whilst this is just a snapshot, it demonstrates how the mining sector provides an opportunity for individuals from working class backgrounds to enter highly paid professions. However, the requirement of Master's qualifications, and networking/ informal networks to find employment can be barriers to upward social mobility unless the UK Government ensures that industry/ universities are aware of them and make moves to be more inclusive.

The Critical Minerals Association can also support joined up working with industry to help create the green jobs and apprenticeships that take into consideration providing opportunities for individuals from diverse and lower socio-economic backgrounds.

"Mining for a green future completely changed my perspective on the importance of mining. We are so used to mining being demonised in the climate change campaign that we forget how necessary it is. The session also made me want to look into Geology."

- Student Feedback following Critical Minerals Association presentations (Ben Lepley, SRK Consulting & Phoebe Whattoff, Minviro) to the Social Mobility Foundation

Appendix 2: Initiatives

The Critical Minerals Association recommends that UK Government supports existing geoscience/ engineering/ metallurgy education initiatives through funding opportunities/ integration with Government initiatives in BEIS/ DfE and includes relevant stakeholders in its Green Jobs Taskforce to include geoscience/engineering/metallurgy and critical minerals participation.

Below are a number of important initiatives in this space, and the Geological Society/ University Geoscience UK also produced a joint report, *Enrolment in crisis: A UK-wide strategy for exciting, engaging and retaining students in the geosciences*, following a 2020 conference highlighting how various stakeholders can work together.

Companies can also get involved and are often doing their part in providing easy access to work experience and placements to various age groups, or doing community outreach programmes (e.g., CMA members are funding field trips and doing school visits/ presentations to engage kids with the industry).

Schools, Outreach and Careers Awareness

Briefcase of Mineral Applications

The Briefcase of Mineral Applications is an EIT RawMaterials funded project for wider society learning and seeks to bring minerals and mining closer to society. It offers an innovative approach to teaching the importance of minerals and mining – how various minerals are mined and used in our daily life as well as how the potential social and environmental impacts of mining can be mitigated. The Briefcase teaching tools include:

- thematic Briefcases containing minerals and ores, objects produced with the minerals, games and activities and a pedagogic guide for workshops
- online Briefcase games
- AR Book of Daily Use Minerals
- 3D Briefcase to explore inside mines
- other resources

The multi-disciplinary and hands-on educational tools are designed for different age groups (6 – 9, 10 – 14, and 15 – 18 years old) and promote STEM subjects and related careers. The UK partner, Coventry University, brings humanity aspects to the Briefcase project and developed Tin Briefcase Workshop and the Briefcase Online Game for Kids.

Geoscience for the Future

Geoscience for the Future is an outreach initiative that showcases awesome geoscience stories and connects geoscientists with schools, to promote the vital role of geoscience careers in a more sustainable future. Led by Dr. Natasha Dowey (Sheffield Hallam University), Dr. Hazel Beaumont (University of West of England), Dr. Jen Roberts (University of Strathclyde).

Time for Geography

Time for Geography is the UK's unique and dedicated video platform for geography and geoscience education, developed in collaboration with a community of world-leading academic, educational and industry partner organisations, serving an audience of several million school students across the UK and over 200 countries, in over 30 major languages. Following over half a decade of intensive collaboration, *Time for Geography* provides an exclusive and valuable ad-space for partner organisations to embed further study and careers promotional messages in school classrooms. With the full support of the teaching community, this is delivered via an unparalleled, open-access archive of award-winning, expert-led, classroom videos. This synergy of world-class content and robust, long-term partnerships delivers sustainable audience and platform growth year-on-year. *Time for Geography* provides an unrivalled, tech-driven geoscience recruitment and outreach network for higher education, and a direct channel for industry and government to nurture the environmental and net zero talent pipeline

Social Mobility and Diversity

Black In Geoscience

Black in Geoscience is a grassroots network that aims to acknowledge, amplify, and support the work of Black earth and planetary scientists from around the world. Co-led in the UK by Dr. Munira Raji (University of Hull) and Dr. Craig Poku (University of Leeds). Involves annual social media events.

Equator Research Project

Equator Research Project is a Natural Environment Research Council-funded initiative to improve racial diversity in postgraduate Geography, Earth and Environmental research, by removing barriers to access and improving inclusion and accessibility. Involves a mentoring network bringing together students, postgraduates, and industry leaders; a research training school aimed at improving networks, careers perceptions, and training opportunities; and a working group to advocate for more equitable application practises amongst Doctoral Training Partnerships. Led by Dr Natasha Dowey of Sheffield Hallam University, in collaboration with Prof Chris Jackson (University of Manchester), Dr. Sam Giles (University of Birmingham), and Dr. Rebecca Williams (University of Hull), along with a steering committee of professional bodies and grassroots organisations.

Girls into Geoscience

Girls into Geoscience is an award-winning outreach initiative based at the University of Plymouth co-led by Dr Jodie Fisher. Involves annual careers events aimed at promoting geoscience careers to women and girls.

Industrial Bursary Scheme - Engineering Geology & Geotechnics at University of Portsmouth

The Industrial Bursary Scheme at Portsmouth has been running since 2009 and is a collaboration between the University and industry with the aim to attract young people from diverse backgrounds into the field of geoscience and in particular engineering geology. There are currently 14 industrial partners who sponsor a student through their degree with funding of £1,750 per year plus paid placements at the end of the 1st year (8 weeks) and a year placement at the end of the 2nd year. To date ninety (90) students have benefited from this scheme.

Women in Mining – Scholarships

Women In Mining UK ("WIM UK") promotes the employment, retention, and progress of women in the mining industry and actively promotes the mining sector as a career choice for women and girls.

As part of WIM UK's initiatives to encourage more women and girls to enter the mining industry, it has a long-standing annual University Scholarship scheme open to female students. The scheme aims to support and encourage women to seek a career in the mining industry, particularly since many careers available (even entry level) in the sector require a Master's degrees as a minimum.

WIM UK award two scholarships at value of £6,000 to Master's degree courses (MSc) at the Cambourne School of Mines ("CSM") and Imperial Collage London ("ICL"). The scholarships are available on the following courses:

- Mining Engineering (CSM)
- Mining Geology (CSM)
- Exploration Geology (CSM)
- Geotechnical Engineering (CSM)
- Mining Environmental Management (CSM)
- Metals and Energy Finance (ICL)

WIM UK also runs an annual summer internship programme with its industry partners. These include:

- Altus Strategies
- World Gold Council
- Anglo American
- Golden Star Resources
- Centamin
- Glencore

The scheme aims to expose students and graduates to the career opportunities that are available in the sector, whilst actively promoting and encouraging gender diversity within the mining sector.

The scheme has been running since 2019 and has provided 12 female student and graduates with valuable industry experience that is often required to apply for entry level positions. Through the internship scheme four of the women have successfully secured permanent positions.

Professional Bodies, National Organisations and Charities

The Geological Society of London

The UK's national society/professional body for geoscience, providing support to c.11,600 members in the UK and overseas. Geology Career Pathways (geolsoc.org.uk).

University Geoscience UK (UGUK)

A national organisation that represents all Earth Science departments across the UK. In 2019, UGUK in conjunction with the Geological Society of London published a joint strategy to address the enrolment crisis in Geoscience at Universities across the UK. UGUK is focussed on tackling this problem on four fronts:

- Spearheading the development of a Geoscience Degree Apprenticeship – Trailblazer group established representing the Geoscience sectors
- EDI in geoscience – initiative to make Geoscience courses more inclusive and reducing barriers. Workshop program ongoing which are free to Universities in the UK.
- Development of STEM teaching materials at GCSE and A Level which: will help non-geoscience teachers deliver the geoscience content in the curriculum and highlight and signpost "this is Geoscience/ Geology/ Earth Science" to the students.

ESTA (Earth Science Teachers Association)

ESTA is a national network of teachers, educators and partners working to support and improve the teaching of Earth Sciences at all levels in the UK. Providing training and resources to geoscience teachers.

Geology for Global Development

Geology for Global Development (GfGD) exists to build a sustainable future for all by improving understanding of, access to, and capacity to use the geoscience required to achieve the UN Sustainable Development Goals (SDGs).

For the last decade GfGD have been at the forefront of efforts to strengthen geoscience education through integrating sustainability concepts into undergraduate and postgraduate learning experiences. This strand of work includes (i) a network of university chapters (soon to adapt into a 'global student network'), (ii) delivery of seven UK-based conferences, dozens of guest lectures, and additional international workshops for geoscience students (e.g., in Tanzania in 2014, in South Africa in 2016), and (iii) publication of a learning resource for higher education (with support from UNESCO) and

an edited book on 'Geosciences and the SDGs'. GfGD also designed research, delivered with UK and international partners, to understand how geoscience education can be strengthened to support the sustainable development ambitions of Kenya, and are keen to expand and replicate this analysis in other contexts.

Geoscience Education Academy

Run through the Geological Society and ESTA – this is the body that provides geoscience training to geography/science teachers.

The Geoscience Education Academy[6] (GEA) offers UK secondary school teachers a great opportunity to understand how to teach the geoscience part of the curriculum if it is not their principal subject, as well as existing Earth science teachers who may need a refresher and some new material.

The GEA provides curriculum led training and support for science and geography teachers across the UK. Held at the Geological Society, Burlington House, London. With training given by experienced teachers/examiners, the GEA is a fully accredited CPD training course. A complete pack of teaching resources is available to all attendees.

Industry

Cornish Metals

The Camborne/ Pool/ Redruth area is deprived, and schools struggle with obtaining funding for school trips. Cornish Metals has fully funded field trips for 8 schools in this area. Funding includes transport and admission to various locations (e.g., Geevor Tin Mine) that provide an opportunity for the pupils to engage with their industrial heritage and consider the reasons why the extractive industry in the UK is in its current state. They also do school visits and presentations about careers in the geosciences/mining and highlight the importance of training a (much needed) skilled and enthusiastic domestic work force for this industry.

Cornish Metals have arranged for three secondary school pupils to do work experience with them. They are supporting two master's students and a PhD student with access to data/ core/ samples for their project. With Camborne School of Mines nearby, providing worthwhile projects and giving students access to real-world data is a good way of giving the next generation of employees with the relevant skills.

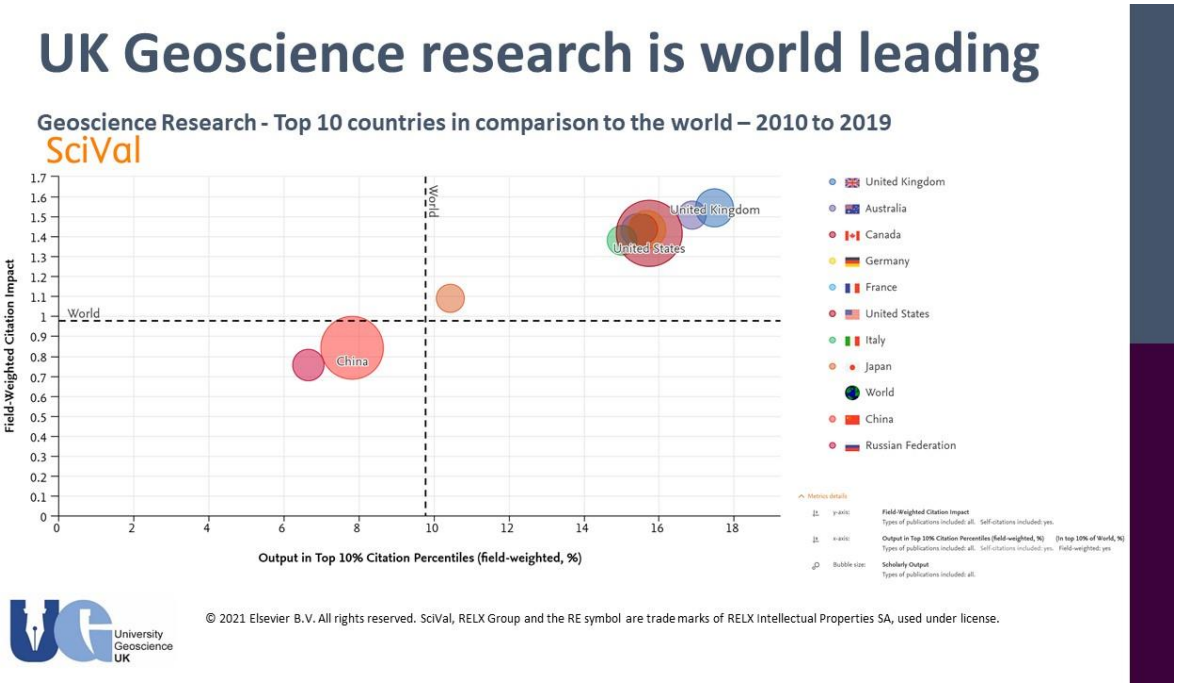
Less Common Metals

Less Common Metals is working with local schools to deliver fully funded Mine to Magnet workshops. They have engaged 120 children so far across four primary schools and aim to educate them about the whole supply chain through six hands on activities. They are doing this with the help of Xplore Science Museum. The workshops are 45 minutes long

[6] https://www.geolsoc.org.uk/gea

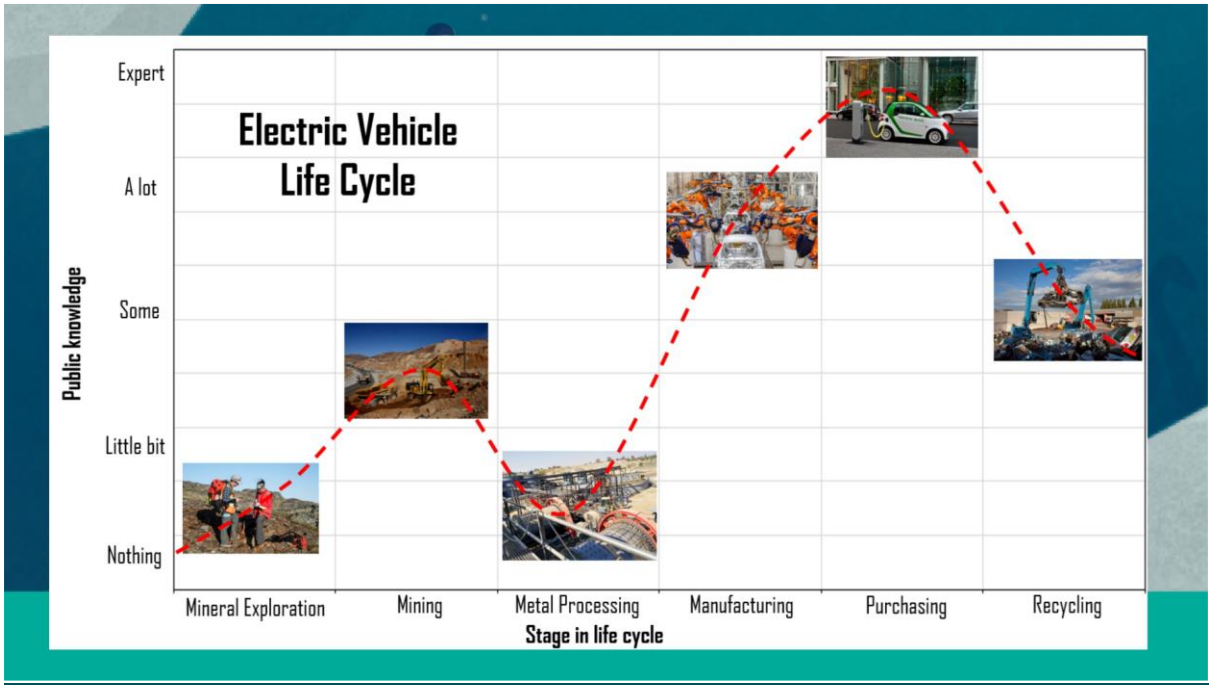
and are designed to fit into the National Curriculum. So far this has been extremely well received from students and teachers alike. LCM are also part of the Young Chamber initiative which is an arm from the West Cheshire and North Wales Chamber of Commerce. This focuses on giving young adults the best chance to secure a role within the workplace and LCM use this as an avenue to raise awareness about the rare earth industry. This is done by career talks, mock interviews, CV writing and mentor support.

Appendix 3: UK Geoscience Research is World Leading

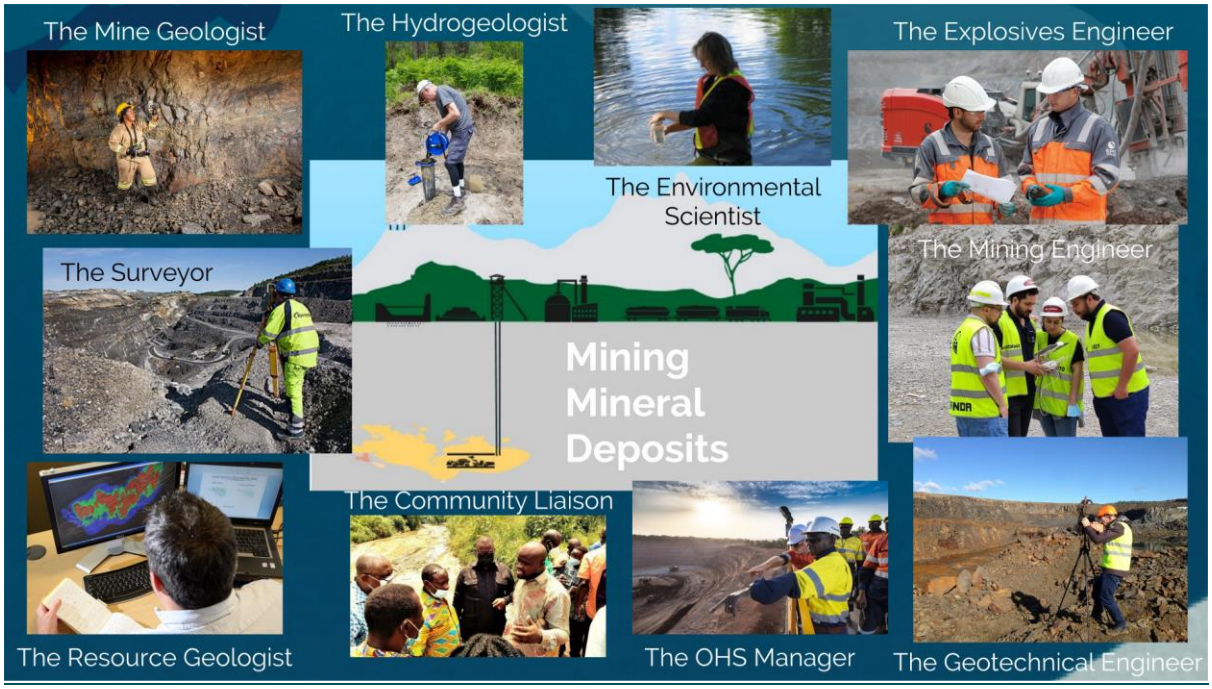


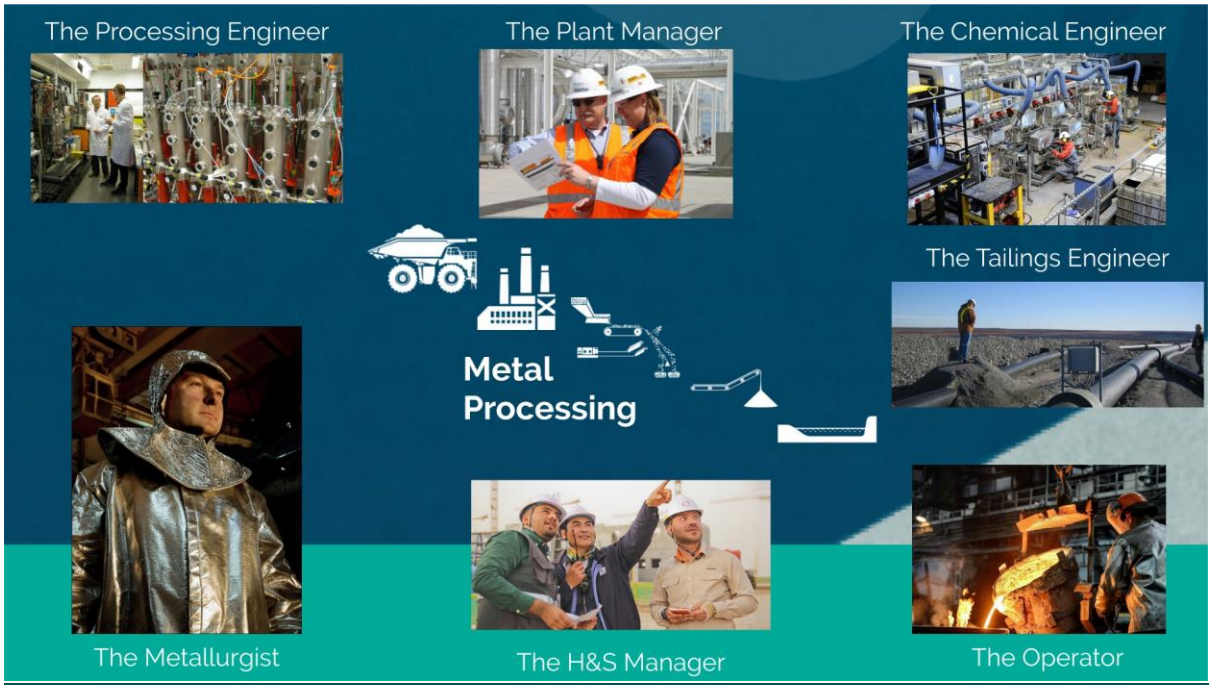
Slide provided by Dr Nick Koor, Reader in Geological Engineering, University of Portsmouth.

Appendix 4: Careers in Critical Minerals[7]

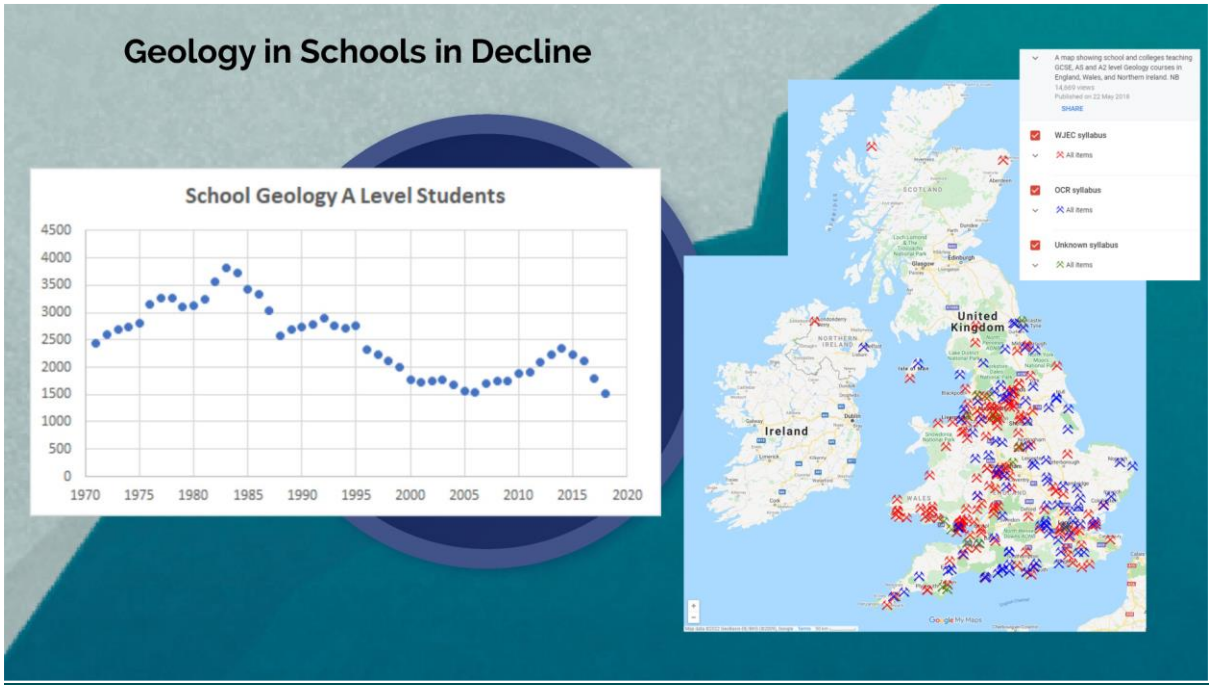


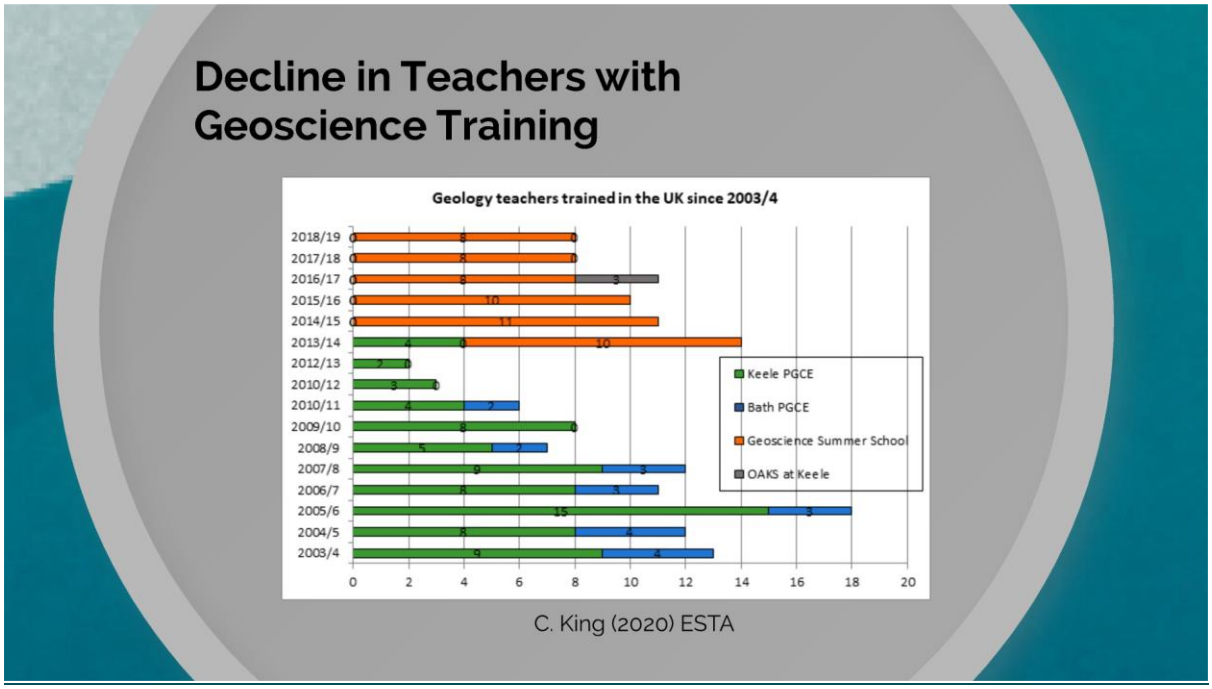
[7] *Presentation slides by Ben Lepley, ESG Consultant, SRK Consulting & CMA Co-Chair Perception of Mining.*


The Mine Geologist
The Hydrogeologist
The Explosives Engineer
The Environmental Scientist
The Surveyor
The Mining Engineer
Mining Mineral Deposits
The Community Liaison
The Resource Geologist
The OHS Manager
The Geotechnical Engineer

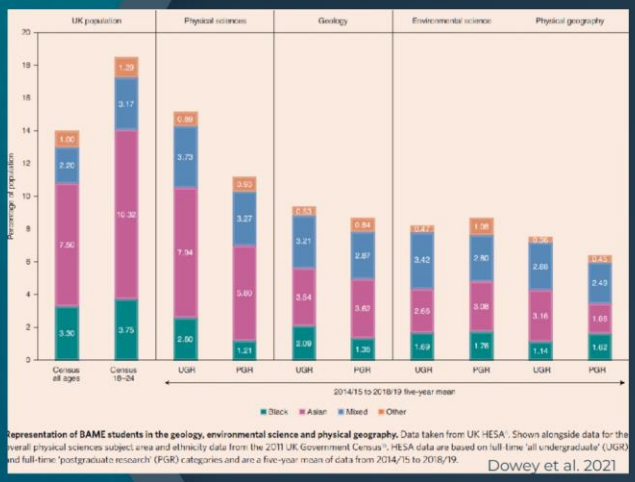

The Processing Engineer
The Plant Manager
The Chemical Engineer
The Tailings Engineer
Metal Processing
The Metallurgist
The H&S Manager
The Operator

Appendix 5: Decline in Geoscience





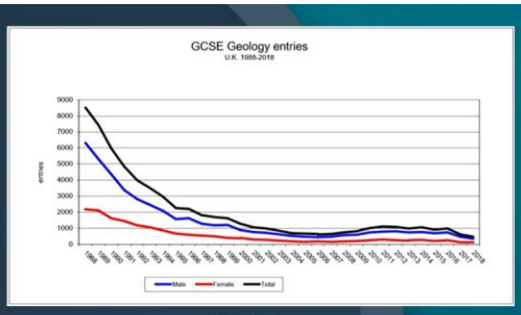
Inequality



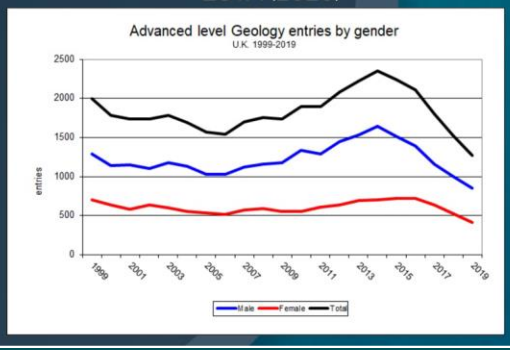
Representation of BAME students in the geology, environmental science and physical geography. Data taken from UK HESA[1]. Shown alongside data for the overall physical sciences subject area and ethnicity data from the 2011 UK Government Census[2]. HESA data are based on full-time 'all undergraduate' (UGR) and full-time 'postgraduate research' (PGR) categories and are a five-year mean of data from 2014/15 to 2018/19.

Dowey et al. 2021

Dowey et al (2021)



ESTA (2020)



Immigration Rules Appendix K: shortage occupation list

Shortage Occupation List.

GOV.UK

2113	Physical scientists – only the following jobs in the construction-related ground engineering industry: engineering geologist hydrogeologist geophysicist	England, Scotland, Wales, Northern Ireland	80% of going rate: £29,200(£14.40 per hour)
2113	Physical scientists – only the following jobs in the oil and gas industry: geophysicist geoscientist geologist geochemist technical services manager in the decommissioning and waste areas of the nuclear industry senior resource geologist and staff geologist in the mining sector	England, Scotland, Wales, Northern Ireland	80% of going rate: £29,200(£14.40 per hour)
2127	Production and process engineers – all jobs	England, Scotland, Wales, Northern Ireland	80% of going rate: £26,480(£13.06 per hour)
2129	Engineering professionals not elsewhere classified – all jobs	England, Scotland, Wales, Northern Ireland	80% of going rate: £26,160(£12.90 per hour)