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Diversity Crisis in UK Geoscience Research Training

Natasha Dowey¹, Jenni Barclay², Ben Fernando³, Sam Giles⁴, Jacqueline Houghton⁵, Christopher Jackson⁶, Anjana Khatwa⁷, Anya Lawrence⁴, Keely Mills⁸, Alicia Newton⁹, Steven L. Rogers¹⁰ and Rebecca Williams¹

¹University of Hull, UK; ²University of East Anglia, UK; ³University of Oxford, UK; ⁴University of Birmingham, UK; ⁵University of Leeds, UK; ⁶Imperial College, UK; ⁷Wessex Museums, UK; ⁸British Geological Survey, UK; ⁹Geological Society of London, UK; ¹⁰Keele University, UK.

*Corresponding Author: N.J.Dowey@hull.ac.uk

Geoscientists have a key role to play in the future challenges of the 21st Century, but our subject has not addressed the legacy of the past when it comes to diversity and inclusion. How can we break down the barriers that have made Geoscience amongst the worst for racial minority representation and make our discipline equitable?

The significant social, environmental and economic challenges of the 21st Century, as exemplified by the United Nations Sustainable Development Goals, require the work of Geoscientists¹. We must address increasing exposure to geological hazards presented by rapid population growth, meet demand for rare minerals and renewable energy, and sustainably manage resources as our climate changes.

The historical roots of Geoscience lie in early colonial principles that land could belong to those willing to use its products, regardless of indigenous territories and practices. The historical production of geoscience knowledge is thus strongly tied to a desire to describe and explain resource, largely for the benefit of the colonising force²-³. This knowledge now has an essential role to play in equitable and sustainable development, but it cannot be successfully applied without diverse representation. We need to work within and across communities and face global problems that impact people from all walks of life. A robust approach to diversity and inclusion needs to begin at home, especially in the very countries that have benefited from the structures and wealth of a colonial past.

However, Geoscience in the Global North is disproportionately white, a result of both historic systemic racism that impacts academia as a whole⁴,⁵ and discipline-specific issues that make us less inclusive to many underrepresented groups⁶. To move forward progressively, we must
remove the bias and hostile environments that have led to inequity in our subject, listen to
diverse voices, attract researchers from a variety of backgrounds, and retain them throughout
their careers.

It is crucial to address retention together with initial access; in the USA, just 6% of Geoscience
doctorate degrees are awarded to students from underrepresented minorities\textsuperscript{1}, despite 31% of
the population belonging to these groups\textsuperscript{7,8}. Little work has previously been published on
diversity in postgraduate Geoscience research (PhD and MRes courses in Geology and
Physical Geography) in UK universities, but data from the UK Higher Education Statistics
Authority (HESA)\textsuperscript{9} paint a similarly dismal picture. This work aims to highlight issues facing UK
Geoscience in a similar way to Bernard & Cooperdock\textsuperscript{7}, to give international perspective to
these discussions. It is difficult to expand this approach to other countries in the Global North
because demographic data are not collected in most European countries\textsuperscript{10}.

To provide context for our discussion, we must reflect on our own backgrounds and
experiences. Of the twelve authors of this paper, four are from racial and ethnic minority
backgrounds. For the majority of us, racism is not part of our lived experience. We approach this
from the perspective of concerned Geoscientists, rather than scholars in equality, diversity and
inclusion (EDI), although a number of us have EDI responsibilities in academic institutions or
charities. Our aim is to highlight the current situation and promote the need for meaningful
action. Geoscientists in both industry and academia should work together to listen to people
from marginalised groups, challenge our biases and transform geoscience culture to be more
inclusive and accountable.

The data

In the UK, 18.5% of 18-24 year olds identify as BAME\textsuperscript{11,12} (defined as ‘Black’, ‘Asian’, ‘Mixed’ and
‘Other’ in UK Census and HESA ethnicity data). While the absolute number of UK-domiciled
students who identify as BAME in UK Higher Education (HE) has grown by >150,000 since

\textsuperscript{1} defined as American Indian or Alaska Native, Black or African American, and Hispanic or Latino groups

\textsuperscript{12} We use the term ‘BAME’ in this piece for consistency with HESA public data and terminology. However, we
recognise the problems with using this identifier as it artificially homogenises many different backgrounds and identities\textsuperscript{5,6}. It also obscures discrimination that is overwhelmingly felt by one race or ethnicity. In some places we refer to data from a distinct group within UK Census and HESA data (e.g. Black) to highlight particularly wide disparities. Experiences even within this category will not be homogenous, but we are constrained by the available data.
2003, there remain pronounced disparities between white and BAME students in their continuation into postgraduate research. These disparities vary between disciplines, and between ethnic groups within the BAME identifier.

In the 2018/19 academic year, the proportion of UK-domiciled BAME students enrolled in UK HE overall was 24.8% at undergraduate level, dropping to 18.1% in postgraduate research. The Physical Sciences had 16.8% BAME student undergraduate enrolment in 2018/19 (the third lowest of the nine Science, Engineering, and Technology subject groups assessed). This number drops to just 12.1% at research postgraduate level.

Representation of BAME (Black, Asian, Mixed and Other ethnic minorities) in Physical Sciences and Geosciences from Higher Education Statistics Agency data, alongside ethnicity data from the 2011 UK Government Census. HESA data are based on full-time “all undergraduate” (UGR) and full-time “postgraduate research” (PGR) categories and are a five-year mean average of data from 2014/15 to 2018/19.

Geology and Physical Geography were amongst the bottom three Physical Sciences subjects for BAME representation in 2018/19. BAME enrolment in undergraduate Geology was just

‡ Physical Sciences includes Chemistry, Materials Science, Astronomy, Physics, Geology and Physical Geography
10.1%, and in postgraduate Geology research 10.4%. This slight increase reverses when a
five-year average is used. Physical Geography was the worst of all Physical Sciences, with
8.5% BAME representation on undergraduate courses dropping to just 5.2% in postgraduate
research\(^9\) (see Figure for five year averages).

The proportion of Black students (i.e. the ‘B’ of BAME) in postgraduate Geology research has
been consistently lower than the proportion taking up undergraduate study since 2015. On
average, over the past 5 years, just 1.4% of postgraduate Geology research students were
Black (10 Black students in 2018/19)\(^9\), compared to 3.8% of the UK 18-24 population\(^11\).

Note that although we present quantitative data here, we acknowledge that voices and insights
are vital in this debate\(^12\). Our analysis in this article is not only informed by the data, but also by
the valuable experiential knowledge of our colleagues and peers. We also synthesise salient
information from wider analyses and initiatives that can inform action specific to the
geosciences.

Factors involved in BAME inequity in research training across UK HE

Location of study, awarding gaps, unconscious and structural bias, and an application system
that fails to account for these biases, all contribute to the drop in BAME representation between
undergraduate study and postgraduate research.

Rates of BAME students entering undergraduate study in the UK have grown considerably in
recent years\(^13\). However, BAME students applying to high tariff universities (e.g. the Russell
Group) are less likely to be offered places than white students with comparable A-level
qualifications\(^14\). For example, BAME applicants to Mathematical, Physical and Life Sciences
subjects at Oxford are 5.8% less likely to receive an offer than their white counterparts, a
discrepancy which persists even after accounting for prior attainment and course choice\(^15\). In
2018/19, Black students made up just 3.9% of students at ‘high-tariff’ universities, compared to
12.2% at low-tariff universities\(^9\).

Once at university, the well-documented awarding (also known as attainment) gap means that
BAME students are less likely to gain a first or 2:1 degree classification than their white peers\(^16\).
They are also particularly vulnerable to exiting their undergraduate degree before completion\(^17\).

Leading Routes, a UK initiative to prepare and support the next generation of Black students,
report that although a range of factors have been proposed to explain this attainment gap, an "unexplained gap" still exists. It is likely that unconscious bias and inequitable frameworks (structural, organisational and cultural) within higher education systematically disadvantage Black and minority ethnic students. A lack of BAME representation at faculty level likely contributes to this hostile and isolating environment and has been linked to BAME students not continuing to PhD level. Across the UK 10.8% of professors are BAME; just 0.7% (140 out of 21,000) are Black.

Aspects of the PhD application process that negatively affect marginalised and underrepresented students, such as emphasis on prior attainment, preference for graduates from research-intensive, high-tariff universities, and fixed notions of academic excellence, have recently been raised in an open letter to UK Research and Innovation (UKRI), the UK national funding agency. Although these factors affect students from a broad range of minority groups, many of them are particularly relevant to BAME applicants. The letter outlines nine short-term actions to be taken, including the publication of candidate demographic data at application, interview, offer and acceptance stages, which would provide a clearer picture of postgraduate recruitment diversity. UKRI have recently published a diversity report that reveals just 9% of UKRI studentships were awarded to ethnic minorities (the Office for National Statistics uses the term ‘ethnic minority’ rather than BAME) in 2018/2019; a dismal statistic considering that 19.4% of 18-34 year olds (the demographic to which the majority of studentships were awarded) are BAME. For the Natural Environment Research Council (NERC), the national funder of Geoscience and Physical Geography, these numbers are even lower, with just 6% of studentships going to ethnic minorities. However, in 19% of cases ethnicity was “unknown” or “not disclosed”, highlighting the need for improved reporting and transparency.

Factors involved in BAME inequity in UK Geoscience

Geoscience programmes have additional, subject-specific structural and cultural barriers to diversity and BAME accessibility.

The early pipeline

In a recent unpublished Geological Society of London survey of undergraduate Geology students, 60% of respondents mentioned a lifelong interest in the natural environment. Rural environments may be less accessible to children who grow up in urban settings (which are more ethnically diverse than rural settings; over 98% of Black African, Pakistani and Bangladeshi
people live in urban locations in the UK\(^{(24)}\) or to children from low-income households, who in the UK are disproportionately more likely to be Pakistani, Bangladeshi, Chinese or Black than white\(^{(25)}\). A 2019 report by the UK Department for Environment, Food and Rural Affairs concerning access of BAME communities to protected landscapes\(^{(26)}\) found that 18% of children living in the most deprived areas never visit the countryside at all, and that Black and Asian families are the least likely group to visit the countryside.

A scarcity of celebrated diverse role models, and the stereotype of a Geoscientist as a white man\(^{(27)}\), are perception issues that may be particularly discouraging to those from minority ethnic backgrounds. Such stereotypes can be reinforced by the promotional materials used by University departments and funding bodies alike, which typically feature generic images of white, adventurous, able-bodied students in rugged environments.

Fundamental lack of acknowledgement that Geoscience is deeply rooted in, and built on, colonialism, white power, violence, exploitation and slavery pervades relationships in the present and is a barrier to forging equitable partnerships (by creating a power imbalance)\(^{(6)}\). This is an issue recently highlighted in other Physical Sciences\(^{(28,29)}\), and one that impacts perceptions of our discipline.

Furthermore, a career pathway in Geoscience, particularly in postgraduate Geoscience research, may not be seen to offer the financial security of other professions such as Law or Medicine by some minority or low-income communities\(^{(30)}\).

**Retention into postgraduate research and beyond**

In addition to the academia-wide issues outlined by *Leading Routes*\(^{(18)}\) and summarised above, once in Geoscience hostile environments can deter BAME students from continuing in postgraduate research. Fieldwork requirements create barriers to racial and ethnic minorities, for reasons including cultural sensitivity (e.g. co-ed residential trips), cost, inclusivity and racial harassment\(^{(31,32)}\). The ‘alcohol culture’ in many Geoscience departments and at conferences\(^{(33)}\) presents barriers to inclusivity for students who do not drink, who are more likely to be from BAME backgrounds\(^{(30)}\).

Having role-models who students can identify with is important to foster a sense of belonging in the scientific community\(^{(34)}\). Representation and presence of role models is a significant issue in
Geoscience. In 2018/2019, ‘Earth, Marine and Environmental Sciences’ in UK HE had the second lowest proportion of BAME staff of all Science, Engineering and Technology disciplines; of the 2,390 staff working in this subject area just 90 (3.9%) were BAME. In Universities with largely monoethnic staff populations, BAME academics may experience feelings of isolation, exclusion and ‘not belonging’ within their academic environment. This is especially problematic for staff who are the only BAME individual in their Geoscience departments, who are forced to go to other institutions or utilise social media channels to obtain similar support and networking opportunities. Such ‘institutional whiteness’ can result in the few BAME staff present being relied upon to be representative of all BAME issues, and burdened with advancing equality of opportunity for minority individuals within the institution.

Although these factors are all found in Geoscience, some overlap with those encountered in other Physical Sciences. If we can work towards acknowledging and resolving these issues in the Geosciences, and increase the diversity of our particularly white discipline, we can develop strategies transferable to other UK HE subjects.

In discussing these issues, it is important to note that such concerns are intersectional; BAME students may experience overlapping barriers depending on their gender, sexuality, disability, class, or nationality, particularly in the field. It is important to identify the multiple individual, cultural, and structural dimensions that shape the way a person is marginalised and forced to navigate the discipline of Geoscience. Building a culture more inclusive to BAME students will be advantageous to all and can help broaden participation to a range of minority groups.

What can we do about it?

A number of suggestions have been made in recent years to improve BAME diversity in Geoscience. We refer to many of these below, with additional thoughts from a UK perspective. Our goal is to encourage academic departments to take actions to improve both retention and initial access of BAME students.

Broadening participation at all levels
Perceptions and awareness

Modernising our curriculums, and acknowledging the colonial and exclusional foundations of our institutions, is a key step to addressing hostile environments. By exploring links between Geoscience and colonialism, and embedding sustainable development into our curriculum, we
can improve the subject’s attractiveness to those accessing it from underrepresented backgrounds. Recruitment should ensure that it appeals to those without prior experience of rural environments, through reassurance that such skills need not be ‘known’ prior to application, and by including more urban Geoscience in our teaching. We can promote a more modern view of careers in Geoscience by giving more air-time to how varied techniques, from laboratory analysis to numerical modelling, are used to solve global real-world problems.

**Representation**

Actions to improve representation include using the opportunity online networks (such as Twitter) provide to invite diverse international Geoscience researchers to deliver departmental seminars, highlighting a wider array of role models for students. We can actively support grass-roots initiatives to amplify BAME voices (such as the recent Black In Geoscience Week), and invest resources in racially diverse promotional materials and ambassador outreach schemes - without disproportionately placing the burden of such work on BAME members of our community. Recognising and rewarding students and staff who become involved in outreach and engagement will improve experiences while enhancing representation.

There are no data available for BAME diversity at postdoctoral level for the Geosciences, or granular data for representation at faculty. We need to better understand the trends that influence representation at the highest levels of our discipline. It is clear, and has been recognised, that we must increase the diversity of our faculty staff. This will involve addressing a host of systemic issues (see Barriers to Progression below).

**Removing barriers to entry**

The funding of immersive summer schools dedicated to students from underrepresented minorities and low-income backgrounds is a proven method of increasing accessibility to science degrees. Working collaboratively together with schools/colleges and other universities can make such initiatives more viable and increase their reach.

The fieldwork conducted both as part of summer schools and in our Geoscience degrees can be adapted to be more inclusive. For example, fully subsidised equipment and trip costs would remove barriers to students from low-income backgrounds. Some field locations may require risk assessments that acknowledge heightened risk for BAME staff and students. We must hold our professional bodies, such as the Geological Society of London in the UK, accountable.
for change; we can push for accreditation reform that improves inclusivity (e.g. reducing the
number of mandatory days in the field), and encourages the facilitation of best practise
knowledge exchange and reflection (e.g. when it comes to risk assessments and field codes of
conduct).

Early pipeline

By working further back along the pipeline, we can help those from BAME communities foster a
love for nature and an appreciation for the outdoors. Natural heritage organisations need to
work closely with community leaders to welcome and nurture positive experiences for BAME
children and young people in green spaces, and universities can play a part in this through
outreach activities. Black2Nature camps run by youth campaigner and environmentalist Mya-
Rose Craig have opened pathways that have enabled young people from deprived areas in
Bristol to learn about birding, conservation and wildlife. Such is the impact of this work that Mya-
Rose Craig was the youngest person in the UK to be awarded an Honorary Doctorate from
Bristol University for her achievements.47

Retaining diverse geoscience researchers

Remove barriers to progression

Once in college or university, the provision of research experiences with universities, provided
together with mentoring and financial support, has been shown to benefit retention into graduate
schemes and full-time employment.45 The work of such initiatives should be closely monitored
and evaluated throughout to understand impacts, as in the HEFCE-funded ‘Discover Postgrad”
project that aims to improve progression to taught postgraduate courses for BAME students.48

Ring-fenced opportunities, either paid internships created through cultivating links with industry
or fellowships specifically targeted at BAME students (such as two new studentships in the
White Rose Doctoral Training Partnership and Esri UK’s new scholarship to support Black and
mixed Black heritage students in Geography and Geoscience), are clear pathways to
increased chances of progression for underrepresented groups. Institutions can also implement
BAME staff development opportunities to mitigate occupational underrepresentation and
facilitate career progression; the StellarHE programme aims to equip BAME academics with
the skills and confidence needed to progress to senior leadership roles in the HE sector.

§ Higher Education Funding Council for England
We can ensure that the application processes for postgraduate and faculty opportunities are as transparent as possible to ensure improved diversity in successful applicants\(^49\), by pressuring funding organisations and institutions to be transparent in their recruitment processes. In the UK, we can encourage Centres for Doctoral Training (CDTs) and Doctoral Training Partnerships (DTPs) to share best practice for broadening participation, starting by ensuring that interview panels fundamentally understand these barriers.

**Effective initiatives and action research**

To ensure our efforts are effective and long-lived, we need to put forward progressive funding bids for evidence-driven action research that works to address data gaps, advocates for real change, and develops effective strategies to broaden participation. We can be more multidisciplinary, and work with other subjects and bodies facing similar challenges, sharing transferable solutions across the HE sector. Historically, white women have been the main beneficiaries of equalities policymaking\(^52\); universities and professional bodies must ensure that equalities initiatives effectively target people from minority ethnic groups.

**Address hostile environments**

Initiatives do not end at recruitment: it is vital to ensure that equal effort is invested into fostering inclusive environments and providing ongoing support. Allocating more resources to training in equity and inclusion, and creating more ‘champions’ of diversity to support the interests of minority groups and encourage reflection within Geoscience departments\(^53\), would be a significant step forward in creating this supportive environment.

Crucially, we need to acknowledge the hostile environments that deter BAME students from both applying to, and continuing with, our discipline. A recent petition for an anti-racism plan for the Geosciences has reached over 25,000 signatures at the time of writing\(^54\); these problems are real and felt by many in the discipline. We must address personal and structural biases\(^55\), and go beyond this to be actively anti-racist.

The less diverse a field is, the more prevalent implicit biases become\(^8\). We must act now, and have those difficult conversations, to create a modern Geoscience research culture that reflects the diverse nature of the planet we study.
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