

1 Diversity Crisis in UK Geoscience Research Training

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10
11 **Geoscientists have a key role to play in the future challenges of the 21st Century, but our**
12 **subject has not addressed the legacy of the past when it comes to diversity and**
13 **inclusion. How can we break down the barriers that have made Geoscience amongst the**
14 **worst for racial minority representation and make our discipline equitable?**

15
16 The significant social, environmental and economic challenges of the 21st Century, as
17 exemplified by the United Nations Sustainable Development Goals, require the work of
18 Geoscientists¹. We must address increasing exposure to geological hazards presented by rapid
19 population growth, meet demand for rare minerals and renewable energy, and sustainably
20 manage resources as our climate changes.

21
22 The historical roots of Geoscience lie in early colonial principles that land could belong to those
23 willing to use its products, regardless of indigenous territories and practices. The historical
24 production of geoscience knowledge is thus strongly tied to a desire to describe and explain
25 resource, largely for the benefit of the colonising force^{2,3}. This knowledge now has an essential
26 role to play in equitable and sustainable development, but it cannot be successfully applied
27 without diverse representation. We need to work within and across communities and face global
28 problems that impact people from all walks of life. A robust approach to diversity and inclusion
29 needs to begin at home, especially in the very countries that have benefited from the structures
30 and wealth of a colonial past.

31
32 However, Geoscience in the Global North is disproportionately white, a result of both historic
33 systemic racism that impacts academia as a whole^{4,5} and discipline-specific issues that make us
34 less inclusive to many underrepresented groups⁶. To move forward progressively, we must
35 remove the bias and hostile environments that have led to inequity in our subject, listen to

36 diverse voices, attract researchers from a variety of backgrounds, and retain them throughout
37 their careers.

38

39 It is crucial to address retention together with initial access; in the USA, just 6% of Geoscience
40 doctorate degrees are awarded to students from underrepresented minorities*, despite 31% of
41 the population belonging to these groups^{7,8}. Little work has previously been published on
42 diversity in postgraduate Geoscience research (PhD and MRes courses in Geology and
43 Physical Geography) in UK universities, but data from the UK Higher Education Statistics
44 Authority (HESA)⁹ paint a similarly dismal picture. This work aims to highlight issues facing UK
45 Geoscience in a similar way to Bernard & Cooperdock⁷, to give international perspective to
46 these discussions. It is difficult to expand this approach to other countries in the Global North
47 because demographic data are not collected in most European countries¹⁰.

48

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

58

59 **The data**

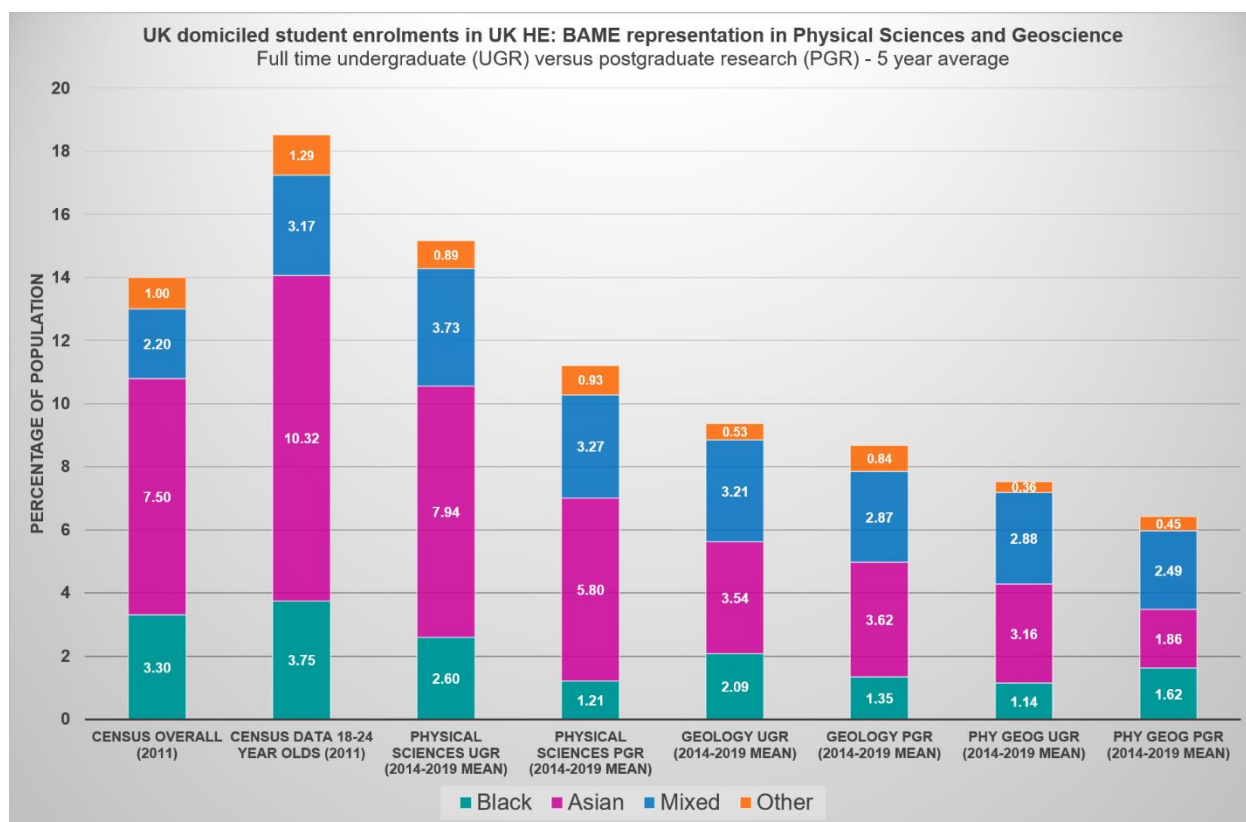
60 In the UK, 18.5% of 18-24 year olds identify as BAME^{11†} (defined as 'Black', 'Asian', 'Mixed' and
61 'Other' in UK Census and HESA ethnicity data). While the absolute number of UK-domiciled
62 students who identify as BAME in UK Higher Education (HE) has grown by >150,000 since
63 2003, there remain pronounced disparities between white and BAME students in their

* defined as American Indian or Alaska Native, Black or African American, and Hispanic or Latino groups

† 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 identities⁵⁶. 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.

64 continuation into postgraduate research⁹. These disparities vary between disciplines, and
 65 between ethnic groups within the BAME identifier.

66
 67 In the 2018/19 academic year, the proportion of UK-domiciled BAME students enrolled in UK
 68 HE overall was 24.8% at undergraduate level⁹, dropping to 18.1% in postgraduate research.
 69 The Physical Sciences[‡] had 16.8% BAME student undergraduate enrolment in 2018/19 (the
 70 third lowest of the nine Science, Engineering, and Technology subject groups assessed). This
 71 number drops to just 12.1% at research postgraduate level⁹.



72
 73 *Representation of BAME (Black, Asian, Mixed and Other ethnic minorities) in Physical Sciences and*
 74 *Geosciences from Higher Education Statistics Agency data⁹, alongside ethnicity data from the*
 75 *2011 UK Government Census¹¹. HESA data are based on full-time “all undergraduate” (UGR) and full-time*
 76 *“postgraduate research” (PGR) categories and are a five-year mean average of data from 2014/15 to 2018/19.*
 77

78 Geology and Physical Geography were amongst the bottom three Physical Sciences subjects
 79 for BAME representation in 2018/19. BAME enrolment in undergraduate Geology was just
 80 10.1%, and in postgraduate Geology research 10.4%. This slight increase reverses when a

[‡] Physical Sciences includes Chemistry, Materials Science, Astronomy, Physics, Geology and Physical Geography

81 five-year average is used. Physical Geography was the worst of all Physical Sciences, with
82 8.5% BAME representation on undergraduate courses dropping to just 5.2% in postgraduate
83 research⁹ (see Figure for five year averages).

84
85 The proportion of Black students (i.e. the 'B' of BAME) in postgraduate Geology research has
86 been consistently lower than the proportion taking up undergraduate study since 2015. On
87 average, over the past 5 years, just 1.4% of postgraduate Geology research students were
88 Black (10 Black students in 2018/19)⁹, compared to 3.8% of the UK 18-24 population¹¹.

89
90 Note that although we present quantitative data here, we acknowledge that voices and insights
91 are vital in this debate¹². Our analysis in this article is not only informed by the data, but also by
92 the valuable experiential knowledge of our colleagues and peers. We also synthesise salient
93 information from wider analyses and initiatives that can inform action specific to the
94 geosciences.

95

96 **Factors involved in BAME inequity in research training across UK HE**

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

100

101 Rates of BAME students entering undergraduate study in the UK have grown considerably in
102 recent years¹³. However, BAME students applying to high tariff universities (e.g. the Russell
103 Group) are less likely to be offered places than white students with comparable A-level
104 qualifications¹⁴. For example, BAME applicants to Mathematical, Physical and Life Sciences
105 subjects at Oxford are 5.8% less likely to receive an offer than their white counterparts, a
106 discrepancy which persists even after accounting for prior attainment and course choice¹⁵. In
107 2018/19, Black students made up just 3.9% of students at 'high-tariff' universities, compared to
108 12.2% at low-tariff universities⁹.

109

110 Once at university, the well-documented awarding (also known as attainment) gap means that
111 BAME students are less likely to gain a first or 2:1 degree classification than their white peers¹⁶.
112 They are also particularly vulnerable to exiting their undergraduate degree before completion¹⁷.
113 *Leading Routes*, a UK initiative to prepare and support the next generation of Black students,
114 report that although a range of factors have been proposed to explain this attainment gap, an

115 “unexplained gap” still exists. It is likely that unconscious bias and inequitable frameworks
116 (structural, organisational and cultural) within higher education systematically disadvantage
117 Black and minority ethnic students¹⁸. A lack of BAME representation at faculty level likely
118 contributes to this hostile and isolating environment and has been linked to BAME students not
119 continuing to PhD level¹⁹. Across the UK 10.8% of professors are BAME; just 0.7% (140 out of
120 21,000) are Black^{20,21}.

121
122 Aspects of the PhD application process that negatively affect marginalised and
123 underrepresented students, such as emphasis on prior attainment, preference for graduates
124 from research-intensive, high-tariff universities, and fixed notions of academic excellence, have
125 recently been raised in an open letter to UK Research and Innovation (UKRI), the UK national
126 funding agency²². Although these factors affect students from a broad range of minority groups,
127 many of them are particularly relevant to BAME applicants. The letter outlines nine short-term
128 actions to be taken, including the publication of candidate demographic data at application,
129 interview, offer and acceptance stages, which would provide a clearer picture of postgraduate
130 recruitment diversity. UKRI have recently published a diversity report²³ that reveals just 9% of
131 UKRI studentships were awarded to ethnic minorities (the Office for National Statistics uses the
132 term ‘ethnic minority’ rather than BAME) in 2018/2019; a dismal statistic considering that 19.4%
133 of 18-34 year olds (the demographic to which the majority of studentships were awarded) are
134 BAME¹¹. For the Natural Environment Research Council (NERC), the national funder of
135 Geoscience and Physical Geography, these numbers are even lower, with just 6% of
136 studentships going to ethnic minorities²³. However, in 19% of cases ethnicity was “unknown” or
137 “not disclosed”, highlighting the need for improved reporting and transparency.

138

139 **Factors involved in BAME inequity in UK Geoscience**

140 Geoscience programmes have additional, subject-specific structural and cultural barriers to
141 diversity⁶ and BAME accessibility.

142

143 ***The early pipeline***

144 In a recent unpublished Geological Society of London survey of undergraduate Geology
145 students, 60% of respondents mentioned a lifelong interest in the natural environment. Rural
146 environments may be less accessible to children who grow up in urban settings (which are more
147 ethnically diverse than rural settings; over 98% of Black African, Pakistani and Bangladeshi
148 people live in urban locations in the UK²⁴) or to children from low-income households, who in the

149 UK are disproportionately more likely to be Pakistani, Bangladeshi, Chinese or Black than
150 white²⁵. A 2019 report by the UK Department for Environment, Food and Rural Affairs
151 concerning access of BAME communities to protected landscapes²⁶ found that 18% of children
152 living in the most deprived areas never visit the countryside at all, and that Black and Asian
153 families are the least likely group to visit the countryside.

154

155 A scarcity of celebrated diverse role models, and the stereotype of a Geoscientist as a white
156 man²⁷, are perception issues that may be particularly discouraging to those from minority ethnic
157 backgrounds. Such stereotypes can be reinforced by the promotional materials used by
158 University departments and funding bodies alike, which typically feature generic images of
159 white, adventurous, able-bodied students in rugged environments.

160

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

166

167 Furthermore, a career pathway in Geoscience, particularly in postgraduate Geoscience
168 research, may not be seen to offer the financial security of other professions such as Law or
169 Medicine by some minority or low-income communities³⁰.

170

171 ***Retention into postgraduate research and beyond***

172 In addition to the academia-wide issues outlined by *Leading Routes*¹⁸ and summarised above,
173 once in Geoscience hostile environments can deter BAME students from continuing in
174 postgraduate research. Fieldwork requirements create barriers to racial and ethnic minorities,
175 for reasons including cultural sensitivity (e.g. co-ed residential trips), cost, inclusivity and racial
176 harassment^{31,32}. The 'alcohol culture' in many Geoscience departments and at conferences³³
177 presents barriers to inclusivity for students who do not drink, who are more likely to be from
178 BAME backgrounds³⁰.

179

180 Having role-models who students can identify with is important to foster a sense of belonging in
181 the scientific community³⁴. Representation and presence of role models is a significant issue in
182 Geoscience. In 2018/2019, 'Earth, Marine and Environmental Sciences' in UK HE had the

183 second lowest proportion of BAME staff of all Science, Engineering and Technology disciplines;
184 of the 2,390 staff working in this subject area just 90 (3.9%) were BAME³⁵. In Universities with
185 largely monoethnic staff populations, BAME academics may experience feelings of isolation,
186 exclusion and 'not belonging' within their academic environment¹⁶. This is especially problematic
187 for staff who are the only BAME individual in their Geoscience departments, who are forced to
188 go to other institutions or utilise social media channels to obtain similar support and networking
189 opportunities³⁶. Such 'institutional whiteness' can result in the few BAME staff present being
190 relied upon to be representative of all BAME issues, and burdened with advancing equality of
191 opportunity for minority individuals within the institution.

192

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

197

198 In discussing these issues, it is important to note that such concerns are intersectional; BAME
199 students may experience overlapping barriers depending on their gender, sexuality, disability,
200 class, or nationality³⁷, particularly in the field. It is important to identify the multiple individual,
201 cultural, and structural dimensions that shape the way a person is marginalised and forced to
202 navigate the discipline of Geoscience. Building a culture more inclusive to BAME students will
203 be advantageous to all and can help broaden participation to a range of minority groups³⁸.

204

205 **What can we do about it?**

206 A number of suggestions have been made in recent years to improve BAME diversity in
207 Geoscience^{7,8,39,40}. We refer to many of these below, with additional thoughts from a UK
208 perspective. Our goal is to encourage academic departments to take actions to improve both
209 retention and initial access of BAME students.

210

211 ***Broadening participation at all levels***

212 *Perceptions and awareness*

213 Modernising our curriculums, and acknowledging the colonial and exclusional foundations of our
214 institutions, is a key step to addressing hostile environments⁶. By exploring links between
215 Geoscience and colonialism³, and embedding sustainable development⁴¹ into our curriculum, we
216 can improve the subject's attractiveness to those accessing it from underrepresented

217 backgrounds. Recruitment should ensure that it appeals to those without prior experience of
218 rural environments, through reassurance that such skills need not be 'known' prior to
219 application, and by including more urban Geoscience in our teaching⁴². We can promote a more
220 modern view of careers in Geoscience by giving more air-time to how varied techniques, from
221 laboratory analysis to numerical modelling, are used to solve global real-world problems.

222

223 *Representation*

224 Actions to improve representation include using the opportunity online networks (such as
225 Twitter) provide to invite diverse international Geoscience researchers to deliver departmental
226 seminars, highlighting a wider array of role models for students. We can actively support grass-
227 roots initiatives to amplify BAME voices (such as the recent Black In Geoscience Week), and
228 invest resources in racially diverse promotional materials and ambassador outreach schemes -
229 without disproportionately placing the burden of such work on BAME members of our
230 community⁴³. Recognising and rewarding students and staff who become involved in outreach
231 and engagement will improve experiences while enhancing representation⁷.

232

233 There are no data available for BAME diversity at postdoctoral level for the Geosciences, or
234 granular data for representation at faculty. We need to better understand the trends that
235 influence representation at the highest levels of our discipline. It is clear, and has been
236 recognised⁴⁴, that we must increase the diversity of our faculty staff. This will involve addressing
237 a host of systemic issues (see Barriers to Progression below).

238

239 *Removing barriers to entry*

240 The funding of immersive summer schools dedicated to students from underrepresented
241 minorities and low-income backgrounds is a proven method of increasing accessibility to
242 science degrees³⁹. Working collaboratively together with schools/colleges and other universities
243 can make such initiatives more viable and increase their reach⁴⁵.

244

245 The fieldwork conducted both as part of summer schools and in our Geoscience degrees can be
246 adapted to be more inclusive. For example, fully subsidised equipment and trip costs would
247 remove barriers to students from low-income backgrounds. Some field locations may require
248 risk assessments that acknowledge heightened risk for BAME staff and students⁴⁶. We must
249 hold our professional bodies, such as the Geological Society of London in the UK, accountable
250 for change; we can push for accreditation reform that improves inclusivity (e.g. reducing the

251 number of mandatory days in the field), and encourages the facilitation of best practise
252 knowledge exchange and reflection (e.g. when it comes to risk assessments and field codes of
253 conduct).

254

255 *Early pipeline*

256 By working further back along the pipeline, we can help those from BAME communities foster a
257 love for nature and an appreciation for the outdoors. Natural heritage organisations need to
258 work closely with community leaders to welcome and nurture positive experiences for BAME
259 children and young people in green spaces, and universities can play a part in this through
260 outreach activities. Black2Nature camps run by youth campaigner and environmentalist Mya-
261 Rose Craig have opened pathways that have enabled young people from deprived areas in
262 Bristol to learn about birding, conservation and wildlife. Such is the impact of this work that Mya-
263 Rose Craig was the youngest person in the UK to be awarded an Honorary Doctorate from
264 Bristol University for her achievements⁴⁷.

265

266 ***Retaining diverse geoscience researchers***

267 *Remove barriers to progression*

268 Once in college or university, the provision of research experiences with universities, provided
269 together with mentoring and financial support, has been shown to benefit retention into graduate
270 schemes and full-time employment⁴⁵. The work of such initiatives should be closely monitored
271 and evaluated throughout to understand impacts, as in the HEFCE[§]-funded ‘Discover Postgrad’
272 project that aims to improve progression to taught postgraduate courses for BAME students⁴⁸.

273

274 Ring-fenced opportunities, either paid internships created through cultivating links with industry
275 or fellowships specifically targeted at BAME students (such as two new studentships in the
276 White Rose Doctoral Training Partnership⁴⁹ and Esri UK’s new scholarship to support Black and
277 mixed Black heritage students in Geography and Geoscience⁵⁰), are clear pathways to
278 increased chances of progression for underrepresented groups. Institutions can also implement
279 BAME staff development opportunities to mitigate occupational underrepresentation and
280 facilitate career progression; the StellarHE programme⁵¹ aims to equip BAME academics with
281 the skills and confidence needed to progress to senior leadership roles in the HE sector.

282

[§] Higher Education Funding Council for England

283 We can ensure that the application processes for postgraduate and faculty opportunities are as
284 transparent as possible to ensure improved diversity in successful applicants³⁹, by pressuring
285 funding organisations and institutions to be transparent in their recruitment processes. In the
286 UK, we can encourage Centres for Doctoral Training (CDTs) and Doctoral Training Partnerships
287 (DTPs) to share best practice for broadening participation, starting by ensuring that interview
288 panels fundamentally understand these barriers.

289

290 *Effective initiatives and action research*

291 To ensure our efforts are effective and long-lived, we need to put forward progressive funding
292 bids for evidence-driven action research that works to address data gaps, advocates for real
293 change, and develops effective strategies to broaden participation. We can be more
294 multidisciplinary, and work with other subjects and bodies facing similar challenges, sharing
295 transferable solutions across the HE sector. Historically, white women have been the main
296 beneficiaries of equalities policymaking⁵²; universities and professional bodies must ensure that
297 equalities initiatives effectively target people from minority ethnic groups.

298

299 *Address hostile environments*

300 Initiatives do not end at recruitment: it is vital to ensure that equal effort is invested into fostering
301 inclusive environments and providing ongoing support. Allocating more resources to training in
302 equity and inclusion, and creating more 'champions' of diversity to support the interests of
303 minority groups and encourage reflection within Geoscience departments⁵³, would be a
304 significant step forward in creating this supportive environment.

305

306 Crucially, we need to acknowledge the hostile environments that deter BAME students from
307 both applying to, and continuing with, our discipline. A recent petition for an anti-racism plan for
308 the Geosciences has reached over 25,000 signatures at the time of writing⁵⁴; these problems
309 are real and felt by many in the discipline. We must address personal and structural biases⁵⁵,
310 and go beyond this to be actively anti-racist.

311

312 The less diverse a field is, the more prevalent implicit biases become⁸. We must act now, and
313 have those difficult conversations, to create a modern Geoscience research culture that reflects
314 the diverse nature of the planet we study.

315

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318

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