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# 1 Diversity Crisis in UK Geoscience Research Training

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

16  
17 The significant social, environmental and economic challenges of the 21st Century, as  
18 exemplified by the United Nations Sustainable Development Goals, require the work of  
19 Geoscientists<sup>1</sup>. We must address increasing exposure to geological hazards presented by rapid  
20 population growth, meet demand for rare minerals and renewable energy, and sustainably  
21 manage resources as our climate changes.

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

32  
33 However, Geoscience in the Global North is disproportionately white, a result of both historic  
34 systemic racism that impacts academia as a whole<sup>4,5</sup> and discipline-specific issues that make us  
35 less inclusive to many underrepresented groups<sup>6</sup>. To move forward progressively, we must

36 remove the bias and hostile environments that have led to inequity in our subject, listen to  
37 diverse voices, attract researchers from a variety of backgrounds, and retain them throughout  
38 their careers.

39  
40 It is crucial to address retention together with initial access; in the USA, just 6% of Geoscience  
41 doctorate degrees are awarded to students from underrepresented minorities\*, despite 31% of  
42 the population belonging to these groups<sup>7,8</sup>. Little work has previously been published on  
43 diversity in postgraduate Geoscience research (PhD and MRes courses in Geology and  
44 Physical Geography) in UK universities, but data from the UK Higher Education Statistics  
45 Authority (HESA)<sup>9</sup> paint a similarly dismal picture. This work aims to highlight issues facing UK  
46 Geoscience in a similar way to Bernard & Cooperdock<sup>7</sup>, to give international perspective to  
47 these discussions. It is difficult to expand this approach to other countries in the Global North  
48 because demographic data are not collected in most European countries<sup>10</sup>.

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

59

## 60 **The data**

61 In the UK, 18.5% of 18-24 year olds identify as BAME<sup>11†</sup> (defined as 'Black', 'Asian', 'Mixed' and  
62 'Other' in UK Census and HESA ethnicity data). While the absolute number of UK-domiciled  
63 students who identify as BAME in UK Higher Education (HE) has grown by >150,000 since

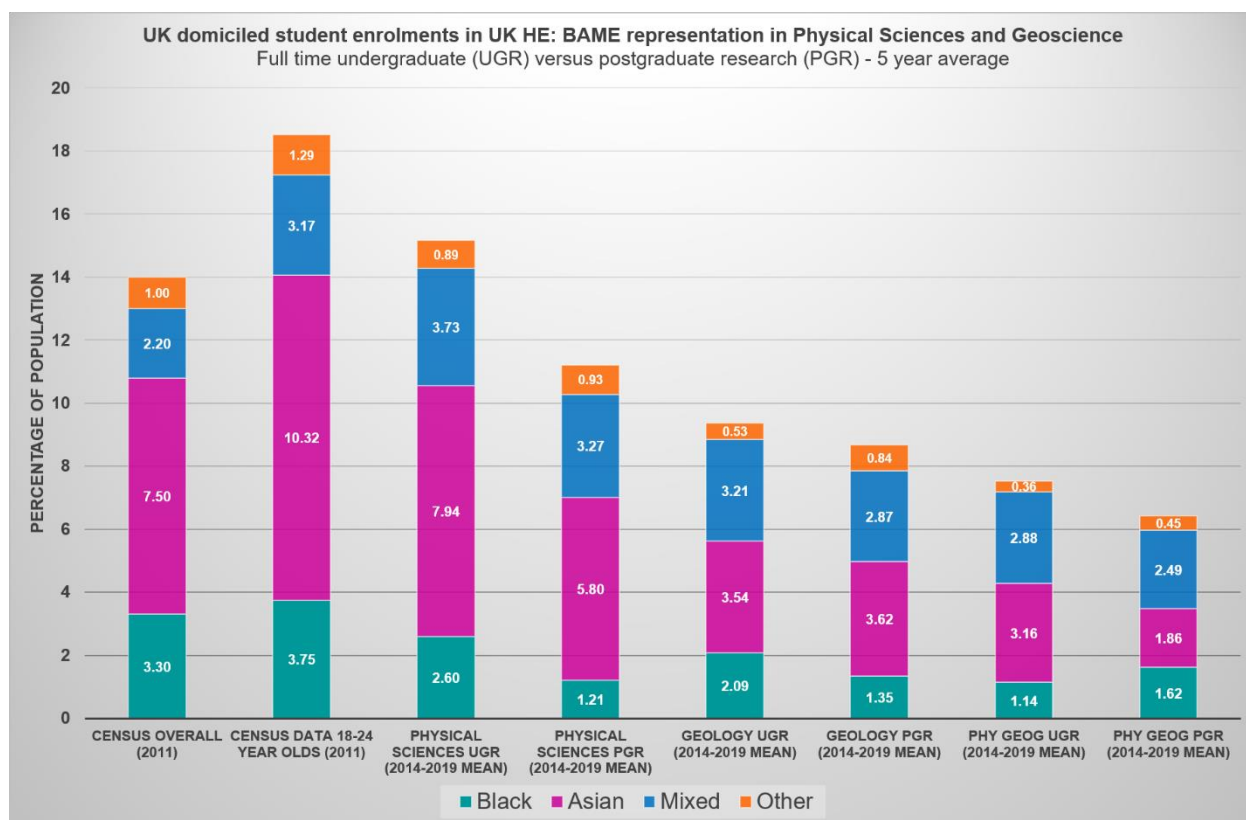
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\* defined as American Indian or Alaska Native, Black or African American, and Hispanic or Latino groups

† 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 identities<sup>56</sup>. 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 2003, there remain pronounced disparities between white and BAME students in their  
 65 continuation into postgraduate research<sup>9</sup>. These disparities vary between disciplines, and  
 66 between ethnic groups within the BAME identifier.

67  
 68 In the 2018/19 academic year, the proportion of UK-domiciled BAME students enrolled in UK  
 69 HE overall was 24.8% at undergraduate level<sup>9</sup>, dropping to 18.1% in postgraduate research.  
 70 The Physical Sciences<sup>‡</sup> had 16.8% BAME student undergraduate enrolment in 2018/19 (the  
 71 third lowest of the nine Science, Engineering, and Technology subject groups assessed). This  
 72 number drops to just 12.1% at research postgraduate level<sup>9</sup>.



73  
 74 *Representation of BAME (Black, Asian, Mixed and Other ethnic minorities) in Physical Sciences and*  
 75 *Geosciences from Higher Education Statistics Agency data<sup>9</sup>, alongside ethnicity data from the*  
 76 *2011 UK Government Census<sup>11</sup>. HESA data are based on full-time “all undergraduate” (UGR) and full-time*  
 77 *“postgraduate research” (PGR) categories and are a five-year mean average of data from 2014/15 to 2018/19.*  
 78

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

<sup>‡</sup> Physical Sciences includes Chemistry, Materials Science, Astronomy, Physics, Geology and Physical Geography

81 10.1%, and in postgraduate Geology research 10.4%. This slight increase reverses when a  
82 five-year average is used. Physical Geography was the worst of all Physical Sciences, with  
83 8.5% BAME representation on undergraduate courses dropping to just 5.2% in postgraduate  
84 research<sup>9</sup> (see Figure for five year averages).

85  
86 The proportion of Black students (i.e. the 'B' of BAME) in postgraduate Geology research has  
87 been consistently lower than the proportion taking up undergraduate study since 2015. On  
88 average, over the past 5 years, just 1.4% of postgraduate Geology research students were  
89 Black (10 Black students in 2018/19)<sup>9</sup>, compared to 3.8% of the UK 18-24 population<sup>11</sup>.

90  
91 Note that although we present quantitative data here, we acknowledge that voices and insights  
92 are vital in this debate<sup>12</sup>. Our analysis in this article is not only informed by the data, but also by  
93 the valuable experiential knowledge of our colleagues and peers. We also synthesise salient  
94 information from wider analyses and initiatives that can inform action specific to the  
95 geosciences.

96

### 97 **Factors involved in BAME inequity in research training across UK HE**

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

101

102 Rates of BAME students entering undergraduate study in the UK have grown considerably in  
103 recent years<sup>13</sup>. However, BAME students applying to high tariff universities (e.g. the Russell  
104 Group) are less likely to be offered places than white students with comparable A-level  
105 qualifications<sup>14</sup>. For example, BAME applicants to Mathematical, Physical and Life Sciences  
106 subjects at Oxford are 5.8% less likely to receive an offer than their white counterparts, a  
107 discrepancy which persists even after accounting for prior attainment and course choice<sup>15</sup>. In  
108 2018/19, Black students made up just 3.9% of students at 'high-tariff' universities, compared to  
109 12.2% at low-tariff universities<sup>9</sup>.

110

111 Once at university, the well-documented awarding (also known as attainment) gap means that  
112 BAME students are less likely to gain a first or 2:1 degree classification than their white peers<sup>16</sup>.

113 They are also particularly vulnerable to exiting their undergraduate degree before completion<sup>17</sup>.

114 *Leading Routes*, a UK initiative to prepare and support the next generation of Black students,

115 report that although a range of factors have been proposed to explain this attainment gap, an  
116 “unexplained gap” still exists. It is likely that unconscious bias and inequitable frameworks  
117 (structural, organisational and cultural) within higher education systematically disadvantage  
118 Black and minority ethnic students<sup>18</sup>. A lack of BAME representation at faculty level likely  
119 contributes to this hostile and isolating environment and has been linked to BAME students not  
120 continuing to PhD level<sup>19</sup>. Across the UK 10.8% of professors are BAME; just 0.7% (140 out of  
121 21,000) are Black<sup>20,21</sup>.

122

123 Aspects of the PhD application process that negatively affect marginalised and  
124 underrepresented students, such as emphasis on prior attainment, preference for graduates  
125 from research-intensive, high-tariff universities, and fixed notions of academic excellence, have  
126 recently been raised in an open letter to UK Research and Innovation (UKRI), the UK national  
127 funding agency<sup>22</sup>. Although these factors affect students from a broad range of minority groups,  
128 many of them are particularly relevant to BAME applicants. The letter outlines nine short-term  
129 actions to be taken, including the publication of candidate demographic data at application,  
130 interview, offer and acceptance stages, which would provide a clearer picture of postgraduate  
131 recruitment diversity. UKRI have recently published a diversity report<sup>23</sup> that reveals just 9% of  
132 UKRI studentships were awarded to ethnic minorities (the Office for National Statistics uses the  
133 term ‘ethnic minority’ rather than BAME) in 2018/2019; a dismal statistic considering that 19.4%  
134 of 18-34 year olds (the demographic to which the majority of studentships were awarded) are  
135 BAME<sup>11</sup>. For the Natural Environment Research Council (NERC), the national funder of  
136 Geoscience and Physical Geography, these numbers are even lower, with just 6% of  
137 studentships going to ethnic minorities<sup>23</sup>. However, in 19% of cases ethnicity was “unknown” or  
138 “not disclosed”, highlighting the need for improved reporting and transparency.

139

## 140 **Factors involved in BAME inequity in UK Geoscience**

141 Geoscience programmes have additional, subject-specific structural and cultural barriers to  
142 diversity<sup>6</sup> and BAME accessibility.

143

### 144 ***The early pipeline***

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

149 people live in urban locations in the UK<sup>24</sup>) or to children from low-income households, who in the  
150 UK are disproportionately more likely to be Pakistani, Bangladeshi, Chinese or Black than  
151 white<sup>25</sup>. A 2019 report by the UK Department for Environment, Food and Rural Affairs  
152 concerning access of BAME communities to protected landscapes<sup>26</sup> found that 18% of children  
153 living in the most deprived areas never visit the countryside at all, and that Black and Asian  
154 families are the least likely group to visit the countryside.

155

156 A scarcity of celebrated diverse role models, and the stereotype of a Geoscientist as a white  
157 man<sup>27</sup>, are perception issues that may be particularly discouraging to those from minority ethnic  
158 backgrounds. Such stereotypes can be reinforced by the promotional materials used by  
159 University departments and funding bodies alike, which typically feature generic images of  
160 white, adventurous, able-bodied students in rugged environments.

161

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

167

168 Furthermore, a career pathway in Geoscience, particularly in postgraduate Geoscience  
169 research, may not be seen to offer the financial security of other professions such as Law or  
170 Medicine by some minority or low-income communities<sup>30</sup>.

171

### 172 ***Retention into postgraduate research and beyond***

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

180

181 Having role-models who students can identify with is important to foster a sense of belonging in  
182 the scientific community<sup>34</sup>. Representation and presence of role models is a significant issue in

183 Geoscience. In 2018/2019, 'Earth, Marine and Environmental Sciences' in UK HE had the  
184 second lowest proportion of BAME staff of all Science, Engineering and Technology disciplines;  
185 of the 2,390 staff working in this subject area just 90 (3.9%) were BAME<sup>35</sup>. In Universities with  
186 largely monoethnic staff populations, BAME academics may experience feelings of isolation,  
187 exclusion and 'not belonging' within their academic environment<sup>16</sup>. This is especially problematic  
188 for staff who are the only BAME individual in their Geoscience departments, who are forced to  
189 go to other institutions or utilise social media channels to obtain similar support and networking  
190 opportunities<sup>36</sup>. Such 'institutional whiteness' can result in the few BAME staff present being  
191 relied upon to be representative of all BAME issues, and burdened with advancing equality of  
192 opportunity for minority individuals within the institution.

193

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

198

199 In discussing these issues, it is important to note that such concerns are intersectional; BAME  
200 students may experience overlapping barriers depending on their gender, sexuality, disability,  
201 class, or nationality<sup>37</sup>, particularly in the field. It is important to identify the multiple individual,  
202 cultural, and structural dimensions that shape the way a person is marginalised and forced to  
203 navigate the discipline of Geoscience. Building a culture more inclusive to BAME students will  
204 be advantageous to all and can help broaden participation to a range of minority groups<sup>38</sup>.

205

## 206 **What can we do about it?**

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

211

### 212 ***Broadening participation at all levels***

#### 213 *Perceptions and awareness*

214 Modernising our curriculums, and acknowledging the colonial and exclusional foundations of our  
215 institutions, is a key step to addressing hostile environments<sup>6</sup>. By exploring links between  
216 Geoscience and colonialism<sup>3</sup>, and embedding sustainable development<sup>41</sup> into our curriculum, we



217 can improve the subject's attractiveness to those accessing it from underrepresented  
218 backgrounds. Recruitment should ensure that it appeals to those without prior experience of  
219 rural environments, through reassurance that such skills need not be 'known' prior to  
220 application, and by including more urban Geoscience in our teaching<sup>42</sup>. We can promote a more  
221 modern view of careers in Geoscience by giving more air-time to how varied techniques, from  
222 laboratory analysis to numerical modelling, are used to solve global real-world problems.

223

#### 224 *Representation*

225 Actions to improve representation include using the opportunity online networks (such as  
226 Twitter) provide to invite diverse international Geoscience researchers to deliver departmental  
227 seminars, highlighting a wider array of role models for students. We can actively support grass-  
228 roots initiatives to amplify BAME voices (such as the recent Black In Geoscience Week), and  
229 invest resources in racially diverse promotional materials and ambassador outreach schemes -  
230 without disproportionately placing the burden of such work on BAME members of our  
231 community<sup>43</sup>. Recognising and rewarding students and staff who become involved in outreach  
232 and engagement will improve experiences while enhancing representation<sup>7</sup>.

233

234 There are no data available for BAME diversity at postdoctoral level for the Geosciences, or  
235 granular data for representation at faculty. We need to better understand the trends that  
236 influence representation at the highest levels of our discipline. It is clear, and has been  
237 recognised<sup>44</sup>, that we must increase the diversity of our faculty staff. This will involve addressing  
238 a host of systemic issues (see Barriers to Progression below).

239

#### 240 *Removing barriers to entry*

241 The funding of immersive summer schools dedicated to students from underrepresented  
242 minorities and low-income backgrounds is a proven method of increasing accessibility to  
243 science degrees<sup>39</sup>. Working collaboratively together with schools/colleges and other universities  
244 can make such initiatives more viable and increase their reach<sup>45</sup>.

245

246 The fieldwork conducted both as part of summer schools and in our Geoscience degrees can be  
247 adapted to be more inclusive. For example, fully subsidised equipment and trip costs would  
248 remove barriers to students from low-income backgrounds. Some field locations may require  
249 risk assessments that acknowledge heightened risk for BAME staff and students<sup>46</sup>. We must  
250 hold our professional bodies, such as the Geological Society of London in the UK, accountable

251 for change; we can push for accreditation reform that improves inclusivity (e.g. reducing the  
252 number of mandatory days in the field), and encourages the facilitation of best practise  
253 knowledge exchange and reflection (e.g. when it comes to risk assessments and field codes of  
254 conduct).

255

#### 256 *Early pipeline*

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

266

#### 267 ***Retaining diverse geoscience researchers***

##### 268 *Remove barriers to progression*

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

274

275 Ring-fenced opportunities, either paid internships created through cultivating links with industry  
276 or fellowships specifically targeted at BAME students (such as two new studentships in the  
277 White Rose Doctoral Training Partnership<sup>49</sup> and Esri UK's new scholarship to support Black and  
278 mixed Black heritage students in Geography and Geoscience<sup>50</sup>), are clear pathways to  
279 increased chances of progression for underrepresented groups. Institutions can also implement  
280 BAME staff development opportunities to mitigate occupational underrepresentation and  
281 facilitate career progression; the StellarHE programme<sup>51</sup> aims to equip BAME academics with  
282 the skills and confidence needed to progress to senior leadership roles in the HE sector.

---

<sup>§</sup> Higher Education Funding Council for England

283

284 We can ensure that the application processes for postgraduate and faculty opportunities are as  
285 transparent as possible to ensure improved diversity in successful applicants<sup>39</sup>, by pressuring  
286 funding organisations and institutions to be transparent in their recruitment processes. In the  
287 UK, we can encourage Centres for Doctoral Training (CDTs) and Doctoral Training Partnerships  
288 (DTPs) to share best practice for broadening participation, starting by ensuring that interview  
289 panels fundamentally understand these barriers.

290

291 *Effective initiatives and action research*

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

299

300 *Address hostile environments*

301 Initiatives do not end at recruitment: it is vital to ensure that equal effort is invested into fostering  
302 inclusive environments and providing ongoing support. Allocating more resources to training in  
303 equity and inclusion, and creating more 'champions' of diversity to support the interests of  
304 minority groups and encourage reflection within Geoscience departments<sup>53</sup>, would be a  
305 significant step forward in creating this supportive environment.

306

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

312

313 The less diverse a field is, the more prevalent implicit biases become<sup>8</sup>. We must act now, and  
314 have those difficult conversations, to create a modern Geoscience research culture that reflects  
315 the diverse nature of the planet we study.

316

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319

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