Barriers to fieldwork in undergraduate geoscience degrees

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Fieldwork is an integral part of geoscience subjects, but changing career pathways and student demographics have major implications for the future of compulsory fieldwork. The ways in which fieldwork is taught and the learning outcomes it fulfils urgently need updating.

Think of a geologist. Odds are, the image that popped into your head is someone outside, holding a hammer, looking at a rock. Geological patterns exposed on the surface of the Earth are fundamental to understanding the processes that formed and shape our world. The deep relationship between geoscience and fieldwork is reflected in degree program requirements, with many courses mandating a minimum number of days in the field. In the UK, for example, accreditation by the Geological Society of London is contingent upon undergraduate geology degrees including at least 60 days of fieldwork (including a 4–6-week independent field project), and undergraduate geoscience degrees (which typically have a broader subject focus than rock-based modules) require up to 37 days in the field. Fieldtrips are a major attraction to many geoscience students and represent an excellent method for practicing core geological skills, including those relevant to industry. Nevertheless, for too many students, fieldwork represents a barrier to studying geoscience at university. These barriers are especially felt by disabled students and those from racial and ethnic minorities, all of whom are critically underrepresented in the discipline[1,2]. It is, therefore, imperative to consider the place of fieldwork in a typical geoscience degree, and ask how it can be made more inclusive.

For students new to geoscience, especially those who didn't have access to hiking and camping trips growing up, many items that seasoned field geoscientists take for granted, such as sturdy boots, good waterproofs, and a reliable backpack, must be purchased. This financial burden can be substantial, and typically occurs at a time when students face numerous other new costs. As a result, students often go to the field unprepared and are unlikely to enjoy the experience — having cold and wet feet for a week can understandably erode the desire to learn. Practical aspects of being outdoors can also be daunting for the unfamiliar. Unanswered questions about how to go to the toilet or deal with a period have a range of serious consequences, from dehydration to infections. Universities can do much to allay some of these issues by ensuring that: staff and demonstrators are adequately trained in field teaching, including clear communication about toilet stops in the field; arranging field gear amnesties for staff and graduating students; and exploring discount schemes with local retailers.

The cost of fieldtrips themselves can present further roadblocks. Almost all courses require a financial contribution, which can leave a student several hundred to a few thousand pounds out of pocket. Universities have started to address these barriers — most significantly by absorbing the cost of mandatory fieldwork — but also through the provision of bursaries and discounted or free bundles of equipment. However, these initiatives are far from universal, may not be clear at the point of application, and rarely offset the true expense of field equipment and clothing. The financial impacts of upfront and 'hidden' fieldwork costs must feature more heavily in discussions of falling undergraduate intake and the role of fieldwork in the geosciences.

Additionally, fieldwork can raise a host of accessibility issues, which need to be acknowledged and addressed. The intense nature of many undergraduate fieldtrips — involving 8–10 hours in the field each day with the potential of additional evening work — places a huge burden on both staff and students. Residential fieldtrips can conflict with work or caring responsibilities, and the long hours present both real and perceived barriers to people with physical and mental health issues[2–4]. The high levels of physical activity often required, be it hiking over rough ground or scrambling up steep slopes, can render trips off-putting or completely inaccessible to some. The needs of those who must schedule prayer breaks, or are fasting, as well as those who cannot travel to certain countries due to laws surrounding sexuality or gender identity, must be taken into account. Many of these issues can be offset, to some extent, by careful planning, advanced notice to students, and a focus on increasing accessibility and inclusivity. Both ADVANCEGeo and the Geological Society Higher Education Network curate a range of resources aimed at designing inclusive fieldwork. Some universities offer reasonable adjustments to students who cannot

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carry out fieldwork, but few communicate this clearly. Just two UK universities that offer accredited geoscience programs explicitly state that fieldwork exceptions can be made, and similar exemptions are rarely highlighted in other regions worldwide.

Harassment and inappropriate behaviour during fieldwork, affecting both staff and students, also deserve careful attention. Research on field-based disciplines has found that 65% of respondents have experienced sexual harassment at field sites and 20% have experienced sexual assault[5]. Anecdotal evidence also makes it clear that inappropriate behaviour is far from rare. As a result, some institutions have implemented codes of conduct for fieldtrips, representing a welcome step forward in addressing this behaviour.

In addition to the accessibility issues described above, it is important to consider that the prominence of fieldwork in geoscience largely reflects traditional employment routes. For decades, the major employers for geoscience undergraduates were oil and gas, or mining. These industries rely heavily on skills typically acquired in the field, which are vital to the identification and extraction of valuable resources. However, times, and the geosciences, are changing. Extraction industries account for an ever-decreasing proportion of graduate employment, with growing fields such as sustainable development, geotechnical pathways and renewable energies attracting a greater number of geoscience graduates. Employers now expect a broader range of training than just field mapping skills. Mathematics and digital skills, including modelling, are as vital to the geosciences today as traditional rock identification has always been. It is therefore time for geoscience fieldtrips to refocus their objectives and address the changing needs of geoscience graduates, rather than simply aiming to spend as much time in the field as possible.

Increasingly, students are gaining access to field skills through technologies such as Google Earth, iPads and drones. These methods utilise students' digital skills and increase the total amount of time spent engaging with fundamental geological techniques. In addition, virtual fieldtrips present an alternative for those unable to conduct 'traditional' fieldwork. A common concern is that these techniques are not as 'good' as traditional methodologies, or that they may be used to fully replace outdoor fieldwork. We encourage geoscientists to instead view them as supplemental, with the ability to fulfil the role of outdoor fieldwork for students for whom fieldwork is unreasonable. Nevertheless, we maintain that 'traditional' fieldwork presents a range of learning outcomes that are difficult to achieve in a virtual environment, making it imperative that field-based trips are continued and made inclusive to as wide a range of people as possible.

Undergraduate fieldwork is a major draw for many students — vistas of sunlit outcrops in Greece and the Bahamas feature heavily in online prospectuses, adorned with enthusiastic student testimonials. New and innovative fieldtrips are often used to attract students. However, no matter how much a student loves the great outdoors and the breath-taking geology on offer in far-flung places, it is hard to engage with the independence of thought central to fieldwork if they are preoccupied with financial debt, an over-long hike, worries about changing a tampon, or insufficient field gear. We do not anticipate a future in which fieldwork no longer forms a core part of undergraduate geoscience degrees. Nevertheless, given the concerns outlined above, fieldwork must adapt; we can no longer ignore its exclusionary nature, nor the long hours, difficult working conditions, and inappropriate behaviour that occurs. Guidance from professional bodies, perhaps as part of an accreditation process, or in the form of 'best practice' guidelines (for example, from recent workshops 'Confronting Barriers to Inclusion' and 'Future Science - a vision for the next 25 years'), may assist the development of an inclusive fieldwork vision that benefits all students, opening the door to those from a wide range of underrepresented backgrounds: a critical objective in these times of shrinking geoscience enrolment.

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Competing interests
S.G., C.J. and N.S. are members of The Inclusion Group for Equity in Research in STEMM (https://www.tigerinstemm.org/).

RELATED LINKS

GeolSoc Accreditation Requirements: https://www.geolsoc.org.uk/Education-and-Careers/Universities/Degree-Accreditation/Aims-and-Requirements-for-Accreditation
Toilet stops in the field: An educational primer and recommended best practices for field-based teaching: https://osf.io/gnhj2
AdvanceGeo In The Field: https://serc.carleton.edu/advancegeo/resources/field_work.html?fbclid=IwAR3l7tyc4Gcfe1HJfKsKVkOg4KuqmrU5DRX5xnSrBQAfs2_QrKqrDE7M2D8
Good Practice in Inclusion, Diversity and Equality in GEES Higher Education: https://www.geolsoc.org.uk/HEN-Higher-Education-Network-Annual-Meeting-2019
Confronting Barriers to inclusion - Opening the gate to accessible fieldwork: https://www.geolsoc.org.uk/Events/Past-Meeting-Resources/Confronting-Barriers-to-inclusion-opening-the-gate-to-accessible-fieldwork
University Geoscience UK: 'Future Science - a vision for the next 25 years': https://www.geolsoc.org.uk/UGUK-GSL-17-Future-Science