Achieving Inclusive Field-based Education: Results and Recommendations from an Accessible Geoscience Field Trip

Anthony D. Feig[1], Christopher L. Atchison[2], Alison Stokes[3] and Brett Gilley[4]

Abstract: Learners with disabilities are often denied field-based learning experiences in naturalistic disciplines. Geology can present substantial barriers due to rugged terrain in difficult-to-reach locations. In 2014, a field trip was executed with the dual purpose of 1) designing inclusion in field learning and 2) demonstrating to college faculty an accessible field experience. Direct observations of participants on the trip, as well as pre- and post-trip focus groups, illuminate the student and faculty field learning experience. Geoscience faculty have little guidance or support in understanding what disability is, how to reconcile accommodation with field-geology learning goals, and they cited instances where disability service providers acted as gatekeepers. The net effect of these ontologies is to reduce faculty empathy with, and thus their ability to be inclusive of, students with disabilities in field settings. Recommendations for instructors include taking campus disability-services administrators on field trips,

[1] Department of Geography, Central Michigan University, Mt. Pleasant MI 48858, USA
[2] School of Education and Department of Geology, University of Cincinnati, Cincinnati OH 45221, USA
[3] School of Geography, Earth & Environmental Sciences, University of Plymouth, UK
[4] Department of Earth, Ocean & Atmospheric Sciences, University of British Columbia, CAN

opening and maintaining communications with disability service providers, and designing pedagogically sound field trips that align as much as possible to principles of universal design. An advocacy approach is described, which focuses on the students and the educational process, instead of on institutional compliance. Finally, geoscience faculty should conceptualize disability service providers as accessibility service providers.

Keywords: field trips, Earth science, accessibility, inclusive, disabilities

Field-based Earth science education places students in an outdoor learning environment that focuses on processes that have shaped the Earth over billions of years. Field instruction is an experiential process that develops the understanding of the scale, rate, and timing of Earth processes such as mountain building, river channel movement and climate change (Garrison & Endsley, 2005). The importance of field experiences in the geoscience curriculum is well documented in geoscience education literature (Elkins & Elkins, 2007; Feig, 2010; Garrison & Endsley, 2005; Maskall & Stokes, 2009; McKenzie, Utgard, & Lisowski, 1986; Orion & Hofstein, 1994; Potter, Niemitz, & Sak, 2009; Thomas & Roberts, 2009; Thrift, 1975). Fieldwork discourse develops a student's scientific teamwork, self-management and communication skills (Petcovic, Stokes & Caulkins, 2014; Quality Assurance Agency, 2014). Aligned to these assumptions, a common component of traditional post-secondary geology curricula is completion of a field-based education component (QAA, 2014).

Field study typically requires traversing difficult terrain with few facilities and uncertain natural conditions where inclement weather, vegetative overgrowth, aggressive wildlife, and the potential for serious (temporarily disabling) injuries are common, ranging from scrapes, bumps, and fractures to heatstroke and hypothermia. These conditions can present a significant barrier for students with physical and sensory disabilities (Cooke, Anderson, & Forrest, 1997). Many laboratory-based and computational geoscientific subdisciplines can provide varying levels of accessibility. Traditionally, however, geoscience as a whole has not lent itself well to those who are unable to work beyond a controlled laboratory or classroom setting.

Students with disabilities may encounter unique challenges in any scientific discipline, yet geoscience has the dubious distinction of the lowest representation of individuals with disabilities (Locke, 2005). Due to the field requirements in undergraduate geoscience curricula,

or even in general education Earth science courses, individuals with disabilities face multiple barriers to obtaining geoscience credentials and degrees (Atchison & Feig, 2011; Cooke, et al. 1997; Hall, Healey, & Harrison, 2002; Healey, Roberts, Jenkins & Leach 2002; Locke, 2005; Hall & Healey, 2005; Norman, 2002; Stokes & Boyle, 2009). Despite this undesirable notoriety, inclusion of students with disabilities in field-based learning has formed the basis for previous studies (Cooke, et al. 1997; Hall & Healey, 2005; Hall, Healy & Harrison, 2002; Healey, et al. 2002; Locke, 2005; Norman, 2002; Stokes & Boyle, 2009). The researchers listed above argue that inclusion brings substantial advantages which benefit the geoscientific enterprise: a diversity of thought and experience, a broader talent pool, improved retention of geoscientists, and greater societal geoscientific literacy.

Accessibility Initiatives in the Geosciences

The International Association for Geoscience Diversity (IAGD) was formed in 2008 in response to the marginalization of students with disabilities and roadblocks to their pursuit of geoscience careers. This group of geoscience faculty, students and disability studies researchers aims to advise in the development of inclusive and accessible learning opportunities for students with diverse physical and sensory abilities. The term "diversity" in the IAGD is not specific to race or gender, but rather toward differently-abled students. This grassroots movement quickly developed into an international organization to not only support students with disabilities, but geoscience industry practitioners and academics with disabilities, as well as K-20 Earth science educators. Today, the IAGD is a 501c3 non-profit organization with a community-based network that spans across the United States and 30 countries. Furthermore, the IAGD has been formally accepted as an Associated Society of both the Geological Society of America and the Geological Society of London.

Inclusive geoscience education is growing an audience in both the science and education communities. Over the past eight years, the IAGD has consulted with organizations to enhance workforce accessibility, and partnered to produce instructional workshops and short courses for Earth science educators, and accessible geology field trips for students and faculty. Access and inclusion statements are also being developed to expand beyond the geosciences to other field-based STEM disciplines. In 2014, the Science Council (UK) published a *Declaration on Diversity, Equality, and Inclusion* statement which was signed on by member organizations including the Geological Society (GSL, London). This statement was followed up by the 2015 Higher Education Network (HEN) conference entitled *Accessible Fieldwork: Confronting Barriers to Inclusion*, held jointly by GSL and University Geoscience UK, an association of geoscience departments and schools based across the British Isles.

Later that same year, the American Geosciences Institute (AGI) hosted their annual Leadership Forum (2014), this one entitled: *Accommodating Geoscience Workforce Diversity: Including the Talents of All Geoscientists*. This workshop brought dozens of geoscience society leaders together to discuss the growing lack of individuals with diverse physical and sensory abilities pursuing academic programs and careers in the geosciences. Following the lead of the UK Science Council, AGI collaborated with the IAGD to publish the *Consensus Statement on Access and Inclusion* (2015), to "increase awareness of the challenges we face and the responsibilities we have as a community, and provides examples of ethical practices toward this group of individuals" (para. 1) which has been adopted by dozens of AGI member organizations across the U.S. and abroad. In recent years, several other science organizations have begun developing policy statements that support the need for full inclusion of individuals with disabilities. For example, the Association for Science Teacher Education (ASTE) has created a

Position Statement on Equity and Inclusion in Science Education (ASTE, 2017) that will support the overall inclusion and training of future science educators.

Ability Gatekeeping

Students with disabilities are often steered into disciplines that align to their perceived physical abilities rather than those that fit their academic strengths (Barga, 1996; Hill, 1994; Rodis et al., 2001). These traditional perspectives of disability in most institutions of higher education stem from a medical model (Oliver, 1996) which treats individuals as physically flawed. This model perpetuates negative bias toward disability, and places the burden for learning accommodation on individual students, or disability support services (Moriarty, 2007). Furthermore, students with disabilities face the additional task of self-advocacy within the institution and also the classroom (Houck, Asselin, Troutman, & Arrington, 1992). In direct contrast to this deficit perspective, the social model of disability (Shakespeare & Watson, 2002) views impairments as part of the human condition, but considers that barriers to full participation in society arise from the interaction between individuals and their social or physical environments. This approach promotes a more positive social perception of individual ability and shifts the focus to deconstructing barriers within teaching practices and learning environments that limit student participation. Aligned to this social model, disability theory suggests that: a) disability is an artifact of social construction, which can be taken down by b) voices of those with disabilities valued in society, and c) viewing impairment is a natural part of the spectrum of human variation (Denhart, 2008; Healey, et al., 2006; Shakespeare & Watson, 2002). This perspective emphasizes an individual's identity (Healey et al., 2006; Shakespeare & Watson, 2002), and suggests that everyone falls on a spectrum of ability.

In accordance with disability theory, Denhart (2008) determined that most students face barriers to participation and inclusion as a result of external factors (i.e. faculty and peer attitude and perception, physical space, logistics) rather than their own physical inabilities. In a study focusing on inclusive climate, Foster, Long & Snell (1999) concluded that many students maintain rapport with other students with disabilities, but do not perceive themselves as being included in the entire community of learning. Students with disabilities often describe themselves as working much harder than their peers, yet feel that they are often misunderstood by faculty, who view them as lazy or lacking effort (Denhart, 2008) when requesting support or specific accommodations. These experiences, in addition to a fear of stigma strongly discourage students from disclosing their disability in order to request academic accommodations (Denhart, 2008).

Among numerous concerns, faculty have been found to question the validity of disability diagnoses (McEldowney, McCrary, & Krampe, 2006; Orr, 2009), which creates an overall reluctance to support diverse student learning needs. This finding is made apparent by faculty attitudes that students with invisible (or hidden) disabilities were taking advantage of the system (McEldowney, McCrary, & Krampe, 2006). Becker and Palladino (2016) suggest that a relationship exists between this view and the teacher's sense of self-efficacy. Additional studies indicate that faculty feelings towards providing accommodation are also influenced by the type of accommodation requested, and the ease of implementing them (Bourke et al., 2000; McEldowney, McCrary, & Krampe, 2006). This may stem from time constraints that faculty feel when presented with required accommodations for students with disabilities. If accommodation requires a certain level of adaptation of extant course plans, faculty may be reticent to make those adaptations (Utschig, et al., 2011). Given the logistical challenges and cognitive novelties

involved in field-based education, geoscience faculty may find accommodation in the field even more challenging, or outright burdensome.

Statement of Problem and Research Questions

This research emerged from our work as practitioners to improve inclusion and accessibility. Our efforts have included interacting with institutional disability service providers (DSPs). The geosciences present specific challenges for institutional DSPs. These offices often have limited pedagogical experience in science, technology, engineering, and mathematics (STEM), let alone experience with providing resources and support for students working outside of a traditional classroom setting. We have identified four specific research questions:

- How do Earth science faculty currently accommodate students with disabilities in field settings?
- What barriers do faculty encounter to providing accessibility to students with disabilities?
- What do faculty need to know to provide accessibility in field settings?
- What recommendations can be made to institutions and faculty regarding accessibility and inclusion in the field?

Methods

We designed a field trip accessible to participants with mobility, sensory, cognitive and socio-behavioral impairments (Gilley, Atchison, Feig, & Stokes, 2015) as a natural laboratory for answering these research questions. In designing this natural laboratory, we hypothesized that faculty could be helped to identify barriers to inclusivity, how those barriers might be mitigated and overcome, and how accessible geoscience could be sustained at the curricular and

institutional levels. Ultimately, it was our intention to foster a cultural shift in the perspective of access and inclusion for students with disabilities in the geosciences.

The Accessible Field Trip

The Geological Society of America (GSA) offers regular field trips to geologically important locations as part of its annual meeting programs. We conducted an accessible field trip during the 2014 GSA meeting in Vancouver, British Columbia (Atchison & Gilley, 2015). The trip was in the form of a "show-and-tell" style overview, with five stops that explored the local landscape as shaped by regional geologic activity, past and present. In part, we designed the trip to provide field access to geoscience students and faculty with disabilities. We also designed the trip to be a dynamic, workshop-style example for geoscience instructors, demonstrating how to design and execute an accessible field trip for students with disabilities. Both logistical and pedagogical aspects were demonstrated to participating faculty. Our purpose was to establish an opportunity for students and faculty to come together in the field setting, and to work with and learn from each other about field science and accessibility. For further details of the trip, see Atchison & Gilley (2015), Gilley, Atchison, Feig, & Stokes (2015) and Stokes & Atchison (2015).

Recruitment and Characteristics of the Study Population

Although the accessible trip included students, we focus exclusively on the faculty participants in this study. Trip participants were solicited primarily through IAGD social media, with additional recruitment via the GSA Annual Meeting's field frip listings and a Geoscience Education disciplinary listserv (email distribution list). Institutional Review Board (IRB) approval was secured at five institutions: three in the U.S., one in the U.K. and one in Canada. The multiple approvals reflect the affiliations of all project personnel.

The 14 faculty participants were a combination of tenured (n=9), tenure track (n=1), and part-time (n=2) faculty at universities and community colleges in the U.S., the United Kingdom, Canada, and New Zealand. One other participant was a graduate teaching assistant, and one other was a non-faculty academic professional. Of the group, six were male and eight were female; four self-identified having a physical, sensory, or cognitive disability. All faculty participants were each paired with a participating student with a disability during the field experience.

Fourteen of the fifteen student participants self-identified as having some form of disability. The students ranged in age from 18 to 40, and were from universities in the US and Canada. Six of the fifteen were graduate students and nine were undergraduate students; two members of the latter group were not geology majors. Ten of the fifteen students were female, and fourteen were White/non-Hispanic. Participants described in this paper have been assigned pseudonyms that do not reflect their ethnicity.

Theoretical Frameworks and Methodology

This study is phenomenological participant-action research situated in critical theory. Our location in the study is not that of detached observers, but rather active stakeholders (teachers) of students with disabilities. We seek to articulate best practices in field-based learning for this population, and to increase their access to geoscience curricula through the synthesis of a widely applicable, grounded-theory model (Glaser & Strauss, 1967). Furthermore, we seek to broaden the talent pool of future geoscientists through increased inclusiveness. Geoscience education research has an established tradition of participant action research (e.g., Basu & Middendorf, 2004; Blackhorse, Semken & Charley, 2003; Boundy & Condit, 2004; Feig, 2011; 2013; Gilley, Atchison, Feig, & Stokes, 2015; Jolley & Ayala, 2015; Libarkin & Kurdziel, 2006; Riggs, 2005; Riggs, Robbins & Darner, 2007; Semken, 2005; Williams and Semken, 2011).

We also claim an activist role in accordance with critical theory. Our larger goal is to address the educational problem of systemic barriers (Barton, 1998; Freire, 2000; Nairn, 1996, 2003) to inclusion and success for students with disabilities. Furthermore, faculty themselves, especially aging faculty, may need accommodation in the field. Through identifying barriers and proposing strategies to address them, we advocate for inclusiveness in Earth science literacy through field-based scientific study.

The data we generated are personal accounts, interpersonal interactions, strategies and attitudes, in accordance with a phenomenological approach (Creswell, 2013; Feig, 2011). Through observations and interviews, we documented the experiences of teacher-scientists who are confronted with the need and desire to teach Earth processes to students with disabilities.

Data Generation and Analysis

We conducted a pre-trip focus group with the faculty participants on the day before the trip. The focus group interview protocol asked the participants to respond to the following open-ended items:

- Talk about your experiences in taking students with disabilities into the field.
- What are you expecting on this trip tomorrow?
- What does “accessibility” mean to you?
- How you do think “accessibility” is going to be done on this trip?

Follow-up questions were asked based on participant responses to the above items. We conducted a focus-group discussion the day after the trip. The following protocol was used for the post-trip session:

- Tell me about your experience on the trip.
- Did you have any “A-ha!” moments with your students? Talk about those.

- Tell me about (something the researchers observed on the trip).
- Now that we've done the accessible trip, have your thoughts about "accessibility" changed? If so, how?
- What are your thoughts about accessible geology now?

We audio-recorded the focus groups and produced transcripts, which we theme-coded using simple serial indexing (Lincoln & Guba, 1985). We also collected data through direct observation on the field trip, accompanying groups and observing interpersonal interactions and cognitive tasks typically conducted on a geology field trip. We recorded our observations and theme-coded our field notes in the same manner as the focus group transcripts.

Reliability and Trustworthiness

We established reliability and trustworthiness of pre- and post-trip focus groups and field observations through the processes of excerpting data, triangulation, and member checking. We verified our participants' veracity of experience (Creswell, 2013) by triangulating our recorded observations in the field with detached, third party observers on the trip. Reliability of our interpreted meanings have been established via member checking and data excerpts (Lincoln & Guba, 1985).

Results and Interpretations

In accordance with practice in qualitative inquiry, our results, interpretations, and synthesis are not meant to consistently describe every situation that takes place in every field location in the past, present or future. Rather, we intend to illuminate and provide a "flavor" (Mason, 2002) of the processes operating during the construction and execution of an accessible field-based learning experience.

We have labeled the emergent themes we identified as "processes." This is consistent with the way we, as geoscientists, understand the physical Earth. This terminology describes dynamic systems in which social actors and educational problems operate. The processes we interpret to be operating, based on our results, are: 1) the search for what counts as disability; 2) locating identity; 3) learning goal impingement; and 4) the overprinting of education by regulation.

Process 1: Classifying Disability

In the pre-trip focus group, participants were first asked about their experiences taking students with disabilities into the field. For 22 minutes, these faculty members engaged in a lively debate over what conditions are bona fide disabilities. Fred, a late-career professor with a mobility impairment, immediately asked the group to clarify what "disability" means. In his mind, disability means mobility and sensory impairments. Sophie, an early-career professor, suggested that learning disabilities "count," but acknowledged that hers may not be a common mindset. The group went on to debate the status of students with food allergies on a multi-day field trip, the exclusion of a student allergic to cheese from departmental pizza lunches, and students at-large with diabetes. The group decided that conditions related to metabolism were categorized as "medical," and the accommodation of these conditions, while logistically challenging, was procedurally comprehensible.

However, the group could not agree on an understanding of disability as a larger phenomenon. Cuthbert, a late-career professor, suggested that a majority of the persons present in the group had a disability by virtue of wearing prescription glasses: "What I'm saying is that there is disability and *disability*" (emphasis his). Fred replied to this by asking, "So any student

problem is a disability? This is what I'm hearing." Maureen, a mid-career professor with a mobility impairment, immediately countered:

> *It clearly is not well defined, which is our problem. We want as scientists to categorize it, to say disability is… We can't do that, so we're frustrated by it. Obviously the thing that you have to make an accommodation for in your classroom… Well, that makes it a disability.*

The conversation quickly turned to accommodation-related paperwork, specifically the exam-accommodation forms commonly provided by campus DSPs. Fred expressed some frustration about receiving accommodation forms for what are, to him, invisible disabilities. Fred, Sophie, and Sven (another mid-career professor) discussed situations where students did not present DSP forms until after they had underperformed on an assessment. Sven expressed that "those pieces of paper…easily translate to your classroom, but then it's very difficult to determine how you translate those into field experience." The "metabolic/medical" category was brought up again, in the context of not being under the auspices of DSPs, and therefore leaving faculty unprepared to plan for or respond to events in the field. The participants alternately chafed at the presence of DSP services, and lamented their absence.

Fundamentally, though, what bothered the group most was their observation that disability is not a binary, present/absent phenomenon. Rather,

> *We think of it as you have disability and ability, that makes a black and white that really doesn't exist. What you have is a spectrum of abilities, and people that move back and forth along the spectrum as life changes. (Kim, early-career professor.)*

Cuthbert had another take on the spectrum: "*There is I think implicit a whole spectrum of unconscious bias, you will accept some disability, but you won't accept other disability."*

Interpretation. Geoscience faculty work in a naturalistic scientific field, and our habits of mind are rooted in description and categorization. We are therefore prone to spend an inordinate amount of time on questions like, "What is disability?" Non-geoscientists might be tempted to

simply roll their eyes at this habit. However, this preoccupation has specific negative consequences. Our judgments of what "counts" are in fact value judgments. If we judge a particular impairment as "not" a disability, then we are unlikely to engage with it—and the student—to construct a safe learning environment. We would instead provide the minimum required accommodation, and attempt to mitigate further "disruption" of our teaching routine. Considering what counts is also the result of wrestling with both positive and negative preconceptions of disability. If we choose to devalue a particular disability, we then carry a negative stereotype of it:

> *Is stupidity a disability?* (Fred.)

Process 2: Aggregation of Intersectionality, Adaptation, and Self-advocacy

The discussion of DSP paperwork bridged further discussion of the participants' experiences in taking students with disabilities into the field. The participants regularly grapple with the admixture of students with and without disabilities, and how their own responsibilities as teachers should be distributed. If twenty students are on a field trip, Fred asked, "and one disabled person, what are the responsibilities to the other 19 students?" Fred felt that having students with more than one type of disability would force him to choose which accommodations to prioritize on a field trip. Fred felt overwhelmed by non-uniform and multiple types of accommodations and their implementation.

Further, faculty are aware of the potential perception of "special treatment" of students with disabilities, and attendant shifts in classroom dynamics. Sven felt that to mitigate undesirable intersections, all members of the class should be made aware of the standardized accommodations issued by the campus DSP for any student with a disability.

The above exchanges, from the pre-trip focus group, describe the intersections of teachers and students both with and without disabilities. In the post-trip discussion, both Fred and Ephraim, a mid-career professor with a mobility impairment, described their positive experiences on the accessible trip. Both had, in the last few years, stopped conducting and participating in instructional and personal field excursions, respectively, owing to their disabilities, and because they felt self-conscious. After the accessible trip Fred in particular felt strong emotions as he said that the experience was "about the geology," and not his ability. Ephraim echoed this sentiment; frequently they themselves are the only persons in their classes who have mobility impairments.

During the accessible trip, we observed students placing themselves so as to maximize their engagement with the geology. On their part, the faculty experimented with strategies to facilitate multisensory experiences. On a typical geology class field trip, the expectation is that all students will walk to and examine an outcrop by sight, collect samples, and make sketches. On the accessible trip however, the expectations were that all participants would work inside their comfort zones, yet be responsible for sharing knowledge and information with each other. The trip leaders instructed participants who wanted to move themselves to a feature to bring back photographs, verbal descriptions, and rock samples. Those who did not want to go could stay back (e.g., on the level surface next to the bus). When the group reformed, the participants were to examine and interpret the images, words, and samples together.

The first stop was a beach, where sandstone cliffs lay about 100 meters from the shoreline. The purpose at the stop was to examine erosional features in the sandstone. The only paved, smooth surface to the beach and the cliffs bore a large "no wheelchairs" sign. Kira, a student who uses a wheelchair, decided (without explicit consent from the trip leaders) to move down the path anyway, determined to see the sandstones. Freya, a mid-career professor took a

circuitous path along the beach below the smooth surface where Kira had stopped. As she was climbing up to Kira, Freya struggled with maintaining her balance, and Kira reached out her hand and pulled Freya up. In the post-trip focus group, Freya marveled at Kira's matter-of-fact attitude toward working in their dyad and assisting her partner. For Freya, this was an expression of Kira's agency.

At the second stop on the trip, students were examining different volcanic rock types at that location. This stop was situated along a terraced stream ~20 kilometers from a volcano. A sloping, rocky path led to the banks of the stream, and Maria, a student with low-vision, went down the path a short way with Sophie, the early-career professor. Sophie looked for rocks, and another student came to ask Maria if she wanted to feel a lava flow. Sophie returned to the group with two rock specimens and a handful of sediment. The three of them prompted each other to feel and interpret the samples. Sophie placed Maria's fingertips on the crystal faces present in the rocks. Seeing this, Freya, who was also paired with a blind student, engaged her partner in a tactile experience with the rocks.

Sven, a mid-career professor, watched this unfold, and subsequently engaged his student partner with low vision in a tactile observation of the rocks. In the post-trip focus group Sven shared that he never asked his partner what she could and could not see. She was "quick to educate" Sven when she wanted assistance or input. He was shy in asking her because he "didn't want that to be part of her experience, I mean how many times of had she had to defend, describe, or sort of explain herself?"

At the final stop of the trip, the group was at the base of a large roadcut composed of an outcrop of granite that had been gouged by a glacier ~20,000 years ago. Glacial gouge marks have a distinctive shape, the orientation of which can be used to determine the flow direction of

the ice sheet. Knowing this, and knowing the approximate location of these features, Maria (the student) left her service animal behind, scrambled up a series of low, wet boulders, and went ~50 meters upslope. One faculty participant who watched this reacted:

My risk assessment people just dropped dead.

Maria pressed her face against the vertical surface of the outcrop, ran her hands over and across the gouges, and surmised the direction of past ice flow. She made a mental construction of the site in her determination to engage with this outcrop.

Interpretation. Fred's frustration at the highly variable nature of disability and accommodation belie his and others' preconceived notion of disability as binary; that is, present/absent whatever it may be, with a blanket accommodation that fits all student needs. For him, confronting the greater complexity of the "spectrum of ability" is an intersection with otherness. Professors Sven and Freya also intersected with student agency and self-advocacy, as it was clearly a new experience for them. The accessible trip allowed students to place themselves in a position to self-advocate owing to the established ground rules, which were pedagogically informed by universal design principles and emphasized access and inclusion, rather than singling out students with disabilities for accommodation. For professors such as Fred and Ephraim, the trip was less about agency in the field, and more about emotional satisfaction, as well as intellectual satisfaction as geologists who were enabled to engage professionally with the regional geology. Students and faculty felt actively adaptable to the setting, versus being passively accommodated.

We interpret these interactions, the self-advocacy we observed, and the agency expressed as an aggregate process. In geology, an *aggregate* is a collection of sediment into a rock. This metaphor is apt for describing how intersectionality, self-advocacy, and adaptation were coëval

with each other during the accessible field trip. Faculty were compelled to examine how they were situated when they worked with their partners. The intersectionality they experienced enabled them to reflect on their preconceptions, to perceive ability as a spectrum and not as a binary phenomenon, and to facilitate meaningful multisensory experiences. They were receptive to student self-advocacy, which in turn generated more intersections between preconception and experience on the trip. Both students and faculty adapted to place themselves as novice/expert geologists to observe and appreciate the local geology.

Inclusive teaching is a difficult process, and requires an engagement with otherness. Geoscience teachers who express negativity toward otherness will be reluctant to embrace accessibility in the field.

Process 3: Rifting Between Learning Goals and Accommodation

Participants described dissonance between wanting to provide accommodation, but perceiving that accessibility comes at the expense of expected student outcomes. They wondered how a student can learn about an outcrop that they cannot access. Steve posed educational objectives against meeting "accessibility issues," and stated that while faculty may not want to admit it, occasionally tradeoffs exist between accommodation, accessibility, and the learning objective. He wanted to know how much it was necessary to alter the objectives in order to accommodate students with disabilities. After the accessible trip, Ephraim remarked that the majority of the participants had disabilities, and wondered how that "detracted" from the learning, and the geology, and the enjoyment of nature aspects. That said, Ephraim felt that because "not all eyes" were on him (and his disability) during the trip, then the "geology and education" parts of the trip did not suffer. The learning goals of the trip were structured around the theme and intention of field accessibility. As far as he was concerned, this was because the

learning objectives scaffolded accessibility, and accessibility in turn scaffolded the learning goals.

As a teacher, Ephraim frequently confronts situations where a field trip he leads is organized to see one particular geologic phenomenon, but conditions (e.g., weather, construction, etc.) there preclude inclusion, so therefore another phenomenon is examined. During the trip, Ephraim wondered if he and others were "going off-script" by adapting to field conditions. He was very conscious of whether doing so would compromise the trip's geological objectives. The group agreed that "off-script" incidents are typical of field trips anyway. They were confident that going off-script yields valuable, unforeseen teachable moments. In their experiences, weather, road/trail construction, and even private landowners that deny access to their property can be welcome opportunities. Yet in contradiction to this, they were all conscious of a necessity to make sacrifices when a student cannot access a feature due to a mobility or sensory impairment. They felt risk-averse when presented with an accommodation need before a field trip. They were reluctant to "wing it" in this situation.

At the same time, the participants insisted that the best pedagogical approach to geology is the combination of classroom and field settings. One is hard pressed to find a geologist who does not. Yet our participants came into the accessible trip experience feeling that they would rather give alternative assignments to students with disabilities (problem sets, additional readings) or simply cancel the planned trip. They felt that the time demands of structuring an accessible trip, and the (to them) necessary trade-offs involved were too much of a challenge. After the trip, the faculty felt more positively about field accessibility, but they still struggled with reconciling learning goals and accessibility. Professors Sophie and Freya particularly resented feeling this dissonance. Sophie felt that accommodation (which for her "begins where

adaptation ends") should arise as a response to situational randomness encountered on a field trip, but at the same time, not "lowering expectations out of kindness."

One feature of the accessible trip was the scheduling of breaks for rests, lunch and snacks, and restroom access. The faculty agreed that on a typical field trip, such arrangements are handled on an ad-hoc basis, and that usually "the field is the bathroom." This is because they want to maximize contact between the students and geologic features. The group reflected on how scheduling these breaks would impact both travel time and contact time. One trade they were comfortable with, though, was seeing less geology in exchange for multisensory experiences that were shared by all students, with and without disabilities. After the accessible trip, they felt that it was possible to structure their future trips such that students who could not access a feature would be able to engage in a peer-to-peer exchange with students who could access it.

Interpretation. Our study population of faculty practitioners self-selected to engage with accessibility in this study, and we are mindful of their extant buy-in when interpreting these results. On the one hand, they are interested in engaging pedagogically with accessibility. On the other hand, their concerns about taking students with disabilities into the field are common. While scientists may be risk-averse, we are also predisposed to experimentation: "What if I did this? How about that? What parameters can I adjust in a situation?" While laudable, this experimentation is unsound because the experimental conditions are not reproducible; classroom situations and interactions with students are exceedingly variable. The same is true of field trips: the path chosen, the combination of students and their abilities, and even the weather will all vary from trip to trip. Nevertheless, our participants' responses suggest that, for them, altering a trip's learning objectives vis-à-vis a required accommodation is better than winging it.

Our participants unanimously insisted that the best pedagogical approach to geoscience teaching and learning is one that integrates classroom and field experiences. All too frequently, the attempt to reconcile accommodation and pedagogy results in two basic types of faculty response. The first is the "shot in the dark." Instructors may hastily, randomly or deliberately choose problem sets, readings or videos of similar trips as an alternative to field learning. This is an "easy" way for busy instructors to provide required accommodation. However, this strategy eliminates field-learning experiences for students with disabilities, while preserving them for the remaining population. We assert that the act of depriving selected populations of essential learning experiences would lead to feelings of low self-efficacy, anger, and resentment among Earth science faculty at-large. These feelings reduce overall teaching effectiveness. They further reduce engagement and buy-in to accessibility. Lastly, the shot-in-the-dark approach can be interpreted as discrimination, even if unintentionally so.

The second response is "one size fits all." In this approach, the instructor alters the curriculum so that *no* students have a field experience. Field trips are distilled into virtual trips, video clips, still images or written descriptions, and presented as, "If we could go there, you could see this." Outdoors learning is deleted entirely. The result of this action is that faculty feel an essential component of teaching has been taken away from them and their class. This too may lead to feelings of anger and/or resentment towards students with disabilities. In extreme cases, faculty may believe that their courses are "dumbed down," and that appropriate accommodation takes place at the expense of effective education. Buy-in and engagement are effectively eliminated. This ethos subsequently propagates through the institution and the discipline.

We again invoke a geologic metaphor, this time one of rifting. Rifting is the slow separation of plates of the Earth's crust. Eventually, these landmasses develop very different

characteristics from each other, and their original configuration requires intentional study to observe and piece together. Accommodation and learning goals are difficult to reconcile not because they conflict, but because they drift apart.

Process 4: Education Subducted by Regulation

Faculty narrated their negative experiences with DSPs. They viewed DSPs as promulgating accommodation on a reactive, "checkbox basis." They see students pigeonholed into checklists of accommodations that are oriented exclusively towards evaluation and assessment (i.e., exams and quizzes). "For the midterm you need to do this," Ephraim was told, but "for the rest of the year, I don't know what the student needs, I don't know how to better help them learn, I don't know if I need to give them more materials, just okay they need more time on a test, more time on this exam and that's kind of as far as it's really gone." Janice, a contingent faculty, said that DSPs strain relationships that shouldn't be strained. She described being told, "You need to get all your videos captioned in two weeks, or a week, or tomorrow."

Faculty participants narrated a number of instances when alternate assignments were outright proscribed to them as accommodations. Ephraim expressed his frustration this way: "Oh, you can do this alternate assignment for this student," then they're off on their own and they're not interacting with everyone. What's the point of that?" He described a suggestion that students be given a reading assignment instead of identifying rocks. This was an anathema to the geology faculty, given that rocks are the cornerstones of the discipline. He was frustrated at the instruction to separate his students and deny them the experience of having a rock in their hands. As Freya said, "Alternate reading assignment is not gonna cut it figuring out how sandstone and granite are different, and [you, DSP,] tell me how I can make this happen."

In instances where faculty felt they could facilitate a meaningful learning experience through an ad-hoc accommodation, they were frustrated by institutional policies that prohibit informal accommodations. They balked at the choice of either breaking the rules or letting the student struggle. They were angry at the implication that helping students without official paperwork made them "unethical," and by doing so they were somehow "cheating."

The discussion turned to the group's perception of accommodation being driven not by student needs, but by financial pressure or the potential for litigation. Vehicles with wheelchair lifts are expensive to use, and faculty were frequently denied their use by the institution. Janice's supervisor questioned why she couldn't do something on campus (the rocks are off-campus). Institutional polices, in their view, are crafted not for student success but to address liability issues.

Finally, some faculty described DSPs as limiting access to their programs. Maureen felt that she has had very little opportunity to interact with students with disabilities, because by the time they matriculate, they do not think that the geosciences are a viable option. She described these students as being "weeded out" by external forces. Sophie, the professor with a disability, related what her DSP told her when she was a student and indicated her interest in science:

> *'For the love of mercy, why are you doing something hard? If you have a special need, why, why, why work hard that way? Why go in that direction? You've got so many other issues, why are you going there?' And so that's what the science faculty and a student wanting to go in science kind of represents. It's exhausting going through school having been questioned so many times about why I was making the choices I was making and to have to convince other people of your right to be there just shouldn't be part of what a student has to go through.*

Ephraim had similar experiences. For him, however, the cause of such negative messages was the absence of a DSP staff member with a science background. Because of this, DSPs steer students away from science because of its perceived greater difficulty, and DSPs want to work within the familiar boundaries of non-science majors. Janice felt abandoned by her DSP because

the staff did not have a familiarity with science. It was up to her to find information on accommodation and pedagogy.

The problem of DSPs lacking a science education knowledge base was driven home by Freya, who, in a moment of frustration, paid a visit to her DSP. At issue was the required accommodation of using the testing center. Freya's problem was that she would have to bring mineral specimens to the testing center. These specimens are required to remain in the geology lab classroom by her campus Environmental Health and Safety (EHS) Office, because they contain heavy metals such as lead and vanadium. She was caught in a choice between violating DSP policy or EHS policy, both of which carry severe consequences. She found that her DSP was very receptive to her saying, "if you want the student to take the lab outside the classroom, tell me how we can work with each other." In the ten years since this incident, Freya has cultivated a healthy relationship with her DSP, to the point now that they use her as an "ambassador" to students with disabilities who have an interest in science.

Interpretation. Some DSPs act as gatekeepers of science. They strive to serve students with disabilities in good faith, particularly with regard to assessment. However, some DSPs may in fact be cutting off access to knowledge itself. We are compelled to view this as a social justice issue. Denying a group of students access to science, even indirectly, violates their rights, reduces the diversity of the future geoscientific workforce and undermines the advancement the human scientific enterprise.

Regulation and education are fundamentally at odds in this situation; the former impacts the latter, but the converse is not true. Litigation carries widespread and severe consequences. As a result, institutions will tend to focus on accommodation and compliance. However, *accessibility* at the classroom- and program-scale is localized and not checked for compliance.

Accessibility, then, is a fuzzy educational problem relegated to the teacher; accommodation is a focused legal problem relegated to the institution. As long as institutions face down the possibility of culpability and legal action, regulation will always be prioritized over education—even if it is not more *valued* than education. We suggest that this process is pervasive in all settings, to the point that the unintended net effect of disability regulation may be to reduce the disabled student to an abstract construct of paperwork and potential litigation.

Our interest in connecting Earth science and disability education leads us to invoke the geological metaphor of subduction. Subduction is a geologic process that takes place when two plates of the Earth's crust collide such that one plate is forced under the other and is subsequently destroyed. Remnants of this subducted plate are turned into discrete magma bodies and intrude upward into the overriding plate. These bodies are compositionally distinct from the overlying plate, but are now a part of it, and secondary to it. Subduction illustrates well is our interpretation of the relationship between regulation and education; regulation overrides education and ultimately disperses education into itself.

Empathy Displacement: The Net Effect of the Four Processes

Our study participants were troubled by an information vacuum of what counts as disability. They described a lack of knowledge and guidance in situating themselves and their students. Participants struggled to reconcile accessibility with learning goals. They felt that their concerns for student learning and welfare were superseded by their institutions' compliance-oriented, shotgun approach to accommodation. Faculty described constraints on their teaching persona and environment, and described the stigmatization of students with disabilities. They narrated instances of DSPs acting as gatekeepers of science.

Each one of these lived and perceived truths impacts a teacher's expression of empathy for his or her students. It is not appropriate to say that their empathy is reduced or eliminated; our participants still clearly *felt* empathy, but they could not translate feeling into action. We label this phenomenon as "displacement" because empathy is not destroyed, it is moved aside. This label is particularly meaningful to Earth scientists, because displacement is a ubiquitous mechanism in Earth systems. For example, fault movement is measured as length of displacement of rock layers, and warmer air displaces cooler air as the sun warms the atmosphere. We find significance in drawing clear analogies between planetary processes and human interactions. Earth science teachers and learners are social actors that reside on the planet. Human-environment interaction is a core concept in geoscience, and our analogy adds another aspect to this interaction. Perhaps, in more than an allegorical sense, empathy is an Earth systems process.

Empathy is also a hallmark of effective teaching (Palmer, 1998). Empathy displacement compromised the agency of our participants. Their empathy towards and concern for their disabled students is curtailed. The empathy-displacement process operated consistently among our participants, who brought to our study already high levels of empathy. This leads us to extrapolate the persistence of this process among the wider population of geoscience faculty, and to other faculty populations.

Discussion and Recommendations

We return to our fundamental research questions:

- How do Earth science faculty currently accommodate students with disabilities in field settings?

- What barriers do faculty encounter to providing accessibility to students with disabilities?
- What do faculty need to know to provide accessibility in field settings?
- What recommendations can be made to institutions and faculty regarding accessibility and inclusion in the field?

When it comes to the question of barriers for faculty, the lack of knowledge and information is certainly a barrier, as is lack of experience. The knowledge base and efforts required for accessibility include: 1) a basic understanding of the lived experiences of students with disabilities, i.e., empathy; 2) a repository of teaching strategies and techniques from which to draw, as well as a community of experienced peers; 3) collegial relationships with DSPs; and 4) an understanding of how to reshape their basic geology learning goals in a manner consistent with universal access. We consider these items to be a "to-do" list for accessible field learning, completed in the order presented. Each item on this list is discussed below.

The first item on this list is largely intrinsic to the faculty member himself or herself. The willingness to engage with students with disabilities is a prerequisite to understanding. Successful engagement enables the teacher to position students to self-advocate and take agency in the physical setting—accessing rocks—as well as in the cognitive domain—understanding rocks. We note that *successful* engagement is less on point here than the actual *willingness* to do engage. What if the teacher wants to engage, but does not know how? This teacher needs the community of peers noted in item two. In fact, the needed network of peers and the pedagogical repository exist for geologists in the form of the IAGD. Its members have voiced an interest in and commitment to inclusive learning. Our simple recommendation is for faculty to reach out, both to students and to each other: "Don't go it alone."

The IAGD also serves as a knowledge base, which is the second item needed for accessibility. The IAGD listserv and community forums regularly circulate queries on "tips and techniques" for a variety of situations. For example, a query was posted to the IAGD listserv (W.B. Whalley, personal communication, October 17, 2016) seeking advice and input regarding pedagogy appropriate for students with color vision deficiencies (CVD). Two days later, A. Jolley (personal communication, October 19, 2016) circulated a list of resources and scholarly articles to the listserv members. This is one example of a living network of experienced peers. The teacher who posted the original query then indicated his intention to use these resources to engage his student (W.B. Whalley, personal communication, October 21, 2016).

Backed by a supportive peer network, the faculty member should then reach out to DSPs, and we recommend that she or he visit the office in person to meet with the administrator-in-charge. During this visit, the faculty member should 1) explain the use and purpose of field learning, 2) outline the steps she or he has taken towards accessible design and 3) seek feedback on those steps. When a DSP acts as a gatekeeper or takes a strongly compliance-oriented approach to field learning, it should be assumed first that the office is in the position of having no exposure to or experience with field pedagogy. To assume that the DSP has no interest in accessible field learning is inappropriate. In fact, some of our faculty participants described their own successes with this tactic. In one instance, the request for testing at the DSP office was in conflict with laboratory safety concerns, and the faculty member said to the DSP, "tell me how we can work with each other." This was the beginning of her lasting and productive relationship with her campus DSP.

Some faculty will ask, "Why does it fall on us, the faculty, to reach out? Why can't they do it?" It is because the business of the DSP is service and support, and our business is teaching

and learning. We are the only ones who can initiate a relationship based on teaching. We are the ones who are with the students in the classroom. We are the ones who have custody of the educational process. We know our curriculum and what our discipline requires of newly minted geologists, and we cannot wait for DSPs to spontaneously figure out what we need to accommodate students in the geosciences. And to be honest, we might react defensively to their unsolicited outreach.

That said, DSPs must reciprocate this outreach, taking an interest in accessibility, as well as accommodation. We recommend that faculty invite the DSP administrator to attend a field trip. This task is crucial. Such an invitation, extended on behalf of the desire to serve students, is compelling. If the administrator's schedule does not allow him/her to attend, we recommend inviting the campus chief academic officer, or even the chief executive. Even if no administrator joins the field trip, accessible learning is brought into the foreground by the invitation itself.

Despite our opposition to the overregulation of accommodation, we do see the need for enforcement in certain circumstances. There are faculty who disregard accommodation in order to "weed out the unfit"; who refuse to acknowledge that DSPs do more than prescribe extended time on exams; and who do not recognize the multidimensional nature of ability. In the absence of buy-in, enforcement is necessary.

Finally, the geology teacher must consider how all students can achieve the learning goals of the field trip. On a practical level, this means answering questions such as, "Do *all* the students really need to go up that particular slope to see that particular feature? Or can I organize the students such that some can go up there, make observations, and bring data back to the group?" Those data might be rocks, or a photograph of the outcrop, or a shared understanding. It may be possible to achieve learning goals through multisensory experiences. For example, on the

GSA Accessible Field Trip, the group was presented with a tactile map of the local setting, using textures (e.g., sandpaper, puff-paint) to represent variations in the landscape (Gilley, Atchison, Feig, & Stokes, 2015). These maps were intended to accommodate low-vision participants, but all the participants interacted with them.

Moving Toward a Meaningful Faculty-DSP Relationship

We have specific recommendations for institutions regarding their disability service providers, and the DSPs themselves. First, we are highly critical of making compliance the top priority in what should be a praxis of accessibility. The fundamental issue here is whether the narrative of the DSP is one of compliance or one of social justice. Does the institution position the DSP in conflicting roles of advocate/enforcer? Is the DSP denied a curriculum specialist, or someone who can broker a discussion of barriers between faculty and DSP staff? Is the DSP chronically understaffed? If the answer to any of these questions is "yes," then the DSP does not have the agency it needs to fulfill the mission it has been charged with.

With this in mind, disability service providers could take a more active role in defining their "brand" to the campus. Too many faculty, as we have seen here, view "disability" as a medicalized legal issue, bearing the threat of punitive action. DSPs could work to rebrand themselves as accessibility service providers (ASPs). Networks of faculty "ambassadors"* that have been successful in working with the DSP/ASP could be formed to facilitate the shift away from the misconception among faculty that the service providers "just do exams." The ultimate goal would be to replace, in words and actions, enforcement with education. Several goals can be accomplished when education displaces enforcement in an institution's technical core. A mission focus from compliance to education will generate buy-in among faculty, because faculty will see

* Or in the case of the University of Plymouth, U.K., "Disability Champions."

the service provider as a partner in teaching. The provider and the faculty are then a partnership that puts the student learning experience foremost, and works to *make* things happen versus *prevent* things from happening; being proactive versus reactive. Working together to open the door to the ethos of learning, versus working separately to shut the door to the threat of culpability.

All that said, if faculty claim to "are about the student first, as we generally do, then we must do our part in this partnership. We have a responsibility to design experiential learning with inclusivity in mind; to ask for help in its implementation; to listen to the student; to assume that the disability service provider will act in good faith. This last point is perhaps the hardest. It is all too convenient for faculty to label this partnership, and its give-and-take, as institutional meddling, hell-bent on diluting the purity of science, and as dismantling the dispensary of faculty knowledge. As teacher-scientists, though, we assert that "pure science" which is neither accessible nor inclusive is useless. Hence, any call for reform of DSPs must come with a call for reform of faculty attitudes and behaviors. Who wants to be useless?

Limitations and Future Research

Field experiences are site-specific, time-specific, and iterative. No two field trips are the same. Therefore, the lived experiences from which we have extracted meaning will not be repeated exactly. In addition, our participants were self-selected, and their engagement in the process is possibly higher than that of a random sample of geoscience faculty. Finally, our goals for how faculty should conceive of campus disability service providers is laudable. However, the hard truth is that faculty in general (speaking anecdotally, of course) tend toward a state of inertia, and that reconceptualization will, at best, be slow in coming.

A next logical step in the study of field trip design is to involve disability service providers in the design of accessible field experiences. This should be an action-research effort designed to integrate the multiple realities and lived experiences of disability service providers, field-science faculty, and students with disabilities. We are currently developing a theoretical model of an individual's "spectrum of ability" in the multiple instructional environments. Our model seeks to describe the interactions between ability and novelty space (Orion and Hofstein, 1994) in field-based learning.

Conclusion

Up to now, little has been documented about the experiences of geoscience students with disabilities in field settings. Our research shows that four processes work against accessibility and inclusion by reducing the empathy of faculty. Our participants reported that current practice of accessibility and accommodation is either guided by campus disability service providers, or left to them as faculty to figure out. What they struggle to figure out is:

- The search for disabilities that "count."
- The reticence of faculty to engage students with disabilities, thus providing them with opportunities for agency and self-advocacy in the field.
- The reconciliation of accommodation and learning goals.
- The overprint of education by regulation.

We assume that Earth science teachers outside our study population have similar circumstances. Furthermore, our findings can be extrapolated to other disciplines with field-based components, such as archeology or ecology.

The necessary elements of accessibility in the field include empathy, peer support and knowledge, partnerships with DSPs, and learning goals that are mindful of access and inclusion.

We recommend that Earth science teachers proactively engage their institutional disability service providers to craft a partnership in accessible education. We also recommend that DSPs take an active role in rebranding themselves to the campus community. Such a partnership would emphasize the mission of DSPs as one of accessibility, focused on the education of students, rather than the enforcement of regulations.

The results we report here largely come from observations on the field trip—outdoors, in buses, next to rock outcrops. Faculty-student pairs mixed with each other in all settings. Field trip leaders provided narration and explanation supplemented with adaptive equipment, but minimal guidance during exploration phases. No accommodation regulation was formally promulgated, and no discussion of compliance took place. When faculty had accessible learning modeled to them, and then were trusted to carry it out, what emerged was an inclusive learning community. This community displayed tactics for other ways of knowing, and met the educational goals of the field trip. The learning goals were not reduced in number or in rigor. Going in, many of our participants were skeptical that these things could be accomplished on the accessible field trip. Many Earth science faculty at-large likely remain skeptical that the field is a place for students with disabilities, yet it happened on this GSA Accessible Field Trip. Accessible field learning is happening more often through opportunities offered by the IAGD and in many geoscience departments across the world.

Geologists have an expression for when we encounter something in the field that defies our expectations: “If it *does* happen, it *can* happen.”

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