

**Linking Past to Present in a Postcolonial Field Science:
How Scientific Training and Practice in US Geology Perpetuates Marginalization**

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Abstract

I explore power dynamics in modern US field geology and their links to the discipline's history. From undergraduate training to scientists' impact on local communities where fieldwork is situated, modern practices replicate existing power structures that can be traced to 19th century geology in the United States. I seek to understand how field geology attracts and trains the next generation of field geologists and how field geologists interact with the external communities where fieldwork is conducted. I draw upon modern and historical practices of race-based exclusion from outdoor space to argue that field geologists ignore an important legacy of racism that is crucial to acknowledge in training future scientists. Furthermore, 19th century US American geologists instituted imperialistic practices of producing knowledge that subjugated marginalized populations. I argue that field geologists continue to use these tactics today, and the training and practice of field geologists participates in imperialistic knowledge production. Through an analysis of knowledge production and training practices in field geology, I trace the imperialistic legacy of 19th century US geology in modern culture. I build upon discourse in feminist studies and postcolonial theory to illuminate the social culture of field geology through a feminist lens.

Introduction

Four years into an Earth Science PhD at an Ivy League institution, I was drawn into feminist studies. I was eager for a framework to understand what made me weary of the field: issues of underrepresentation, hostile environments, and strong cultures of masculinity. Outside of my primary research on past ice sheets and sea level, I began to engage with feminist theory and history of science, in an effort to understand the patterns of exclusion that I regularly experienced and witnessed.

I am a white-presenting Jewish Latina American woman. My mother is Argentine and Jewish, and my father is American, of Mexican Californio and Jewish Romanian descent. I received my PhD promptly at 26 years old, and hold a tenure-track position in Earth Science at a public research university. I am a computational geoscientist studying past ice sheets and sea level by modeling how the solid Earth deforms under the weight of massive ice sheets, which grow and melt over tens of thousands of years. I am not a field geologist, however my entry into geoscience was inspired by participating in field geology research and training. As an able-bodied pale-skinned geoscientist, I often was afforded the opportunity to blend in. Nevertheless, I was increasingly aware of exclusionary practices within geoscience culture, such as aggressive masculinity or tough and rugged expectations.

Prodding at these issues I found the roots lodged much deeper: the contemporary culture of United States geology owes its central values to early 19th century US geology. I could only see the visible and tangible symptoms splayed out at the surface, reflecting a web of connections between society and geology running deep and wide, perpetuating a vehicle of exclusion that acts on racialized and gendered lines.

Field geology is a subdiscipline within the Earth sciences that can apply to anyone making measurements to understand the Earth system and its history. Because nearly every research discipline in Earth sciences can trace its origin to early 19th century field geology, I find that focusing on cultures within field geology is useful in connecting historical practices to modern

ones. Moreover, field geology still serves as a beacon for the Earth sciences, drawing in the next generation of scientists and serving as a symbol of "true" geology.

Despite the origin of US field geology in imperialist and colonialist projects, prior scholarship has not analyzed this discipline from a critical feminist anticolonial perspective. This essay explores how field geology as a discipline acts as a marginalizing vehicle both within and outside of the geoscience community. It is not my intention to provide prescriptive fixes, rather, I aim to describe the power dynamics at play in modern field geology and explore their links to the discipline's history. From undergraduate training to researchers' impact on local communities where fieldwork is situated, modern practices replicate existing power structures that can be traced to early geology in the United States. Field geology attracts and trains the next generation of field geologists. This training then determines how these scientists interact with the external communities where fieldwork is conducted. In particular I will focus on the connection between comfort/interest in the outdoors and the recruitment of students into field geology. I will draw upon modern and historical practices of race-based exclusion from outdoor space to argue that field geologists ignore an important legacy of racism that is crucial to acknowledge in training a diverse set of future scientists. Furthermore 19th century US American geologists instituted imperialistic practices of producing knowledge that subjugated marginalized populations. I will argue that field geologists continue to use these tactics today, and the training of field geologists participates in imperialistic knowledge production.

Drawing on this theme, I will turn to how US field geologists interact with the communities inhabiting the physical space studied, in particular in postcolonized spaces. I will argue that geologists apply an intellectual framework that divides the physical geology from the people that live in this space, and that this framework provides a justification for separating Indigenous (or local) knowledge from the western (read: universal) knowledge the geologists will produce. Through an analysis of knowledge production and training practices in field geology, I trace the imperialistic legacy of 19th century US geology to the present day. I build upon theories in

feminist and postcolonial science studies and postcolonial theory to illuminate the social culture of field geology through a feminist lens.

Part 1: Recruitment and training of field geologists

The outdoors and geology recruitment

Who decides to be a geologist and why? As in other disciplines, geologists as a community share a set of values that serve to identify and train the next generation. One of these values is passion for the outdoors. Of the natural sciences, geology may have the largest proportion of courses with field trips. At many institutions, the abundance of camping opportunities on course field trips is cited as a principal reason for choosing the major. Nationwide studies that analyze factors for undergraduates in choosing geology cite outdoor opportunities, travel, and environmental interest among top influences in developing an interest in geology (Hoisch & Bowie, 2010). Indeed, research has found that "family, engagement in outdoor recreation, and personal experiences with local geology underscores the importance of informal science experiences" for participation in geology careers. The homepage for geoscience at a large US research university sums it up succinctly: "If you like science, care about the earth, are fascinated by the natural world, like working outdoors, consider geology" ("Why Study Geology," n.d.). A large number of geologists were attracted to the field by previous exposure to geology or outdoor experiences.

Field work is emphasized as crucial to a geology education (Sharp, 1988), and in many departments, it is explicitly required. By claiming that the field is integral to geology, the discipline makes a statement about who is invited. I will explore how different aspects of historical geologic field work as well as modern cultures around outdoor recreation may act to exclude people of color from joining the ranks of field geologists. In the United States less than 7% of undergraduate geoscience degrees are awarded to underrepresented minorities (Stokes,

2013). Through historical and modern practices, I consider the connection between an interest in the outdoors and the dire underrepresentation of people of color in geology.

History of scientific racism in geology

In Earth science courses, both introductory and advanced, the glorification of US American 19th century geologists is common practice. These characters were foundational in gaining national recognition for the field of geology, as well as power in the US government through creation of the United States Geologic Survey (USGS). These same geologists were entrenched in imperialistic and nationalistic endeavors, both through and outside their geologic research. For example, John Wesley Powell, a geologist famous for leading a government-sponsored expedition to raft down the Colorado River into the Grand Canyon, also conducted ethnographic work on Native American tribes in the regions he was mapping out (Stegner, 1954). With a powerful role in government decisions around Native American affairs as the director of the USGS and head of the Bureau of Ethnology at the Smithsonian, Powell was commissioned by the Bureau of Indian Affairs to report on the status of Native American tribes in the Canyonlands and make recommendations on how to integrate these peoples into white American society (Stegner, 1954). Powell collaborated with Nathaniel Southgate Shaler, a Harvard professor in geology who, at the turn of the 20th century, wrote volumes detailing how North American topography is unfit to produce civilized peoples, yet perfectly suited for the institution of slavery (Shaler, 1897). At Harvard, Shaler was one of numerous faculty involved in research with strong bends of scientific racism that contributed to the eugenics movement. Louis Agassiz, a professor in Zoology who is frequently discussed in geology courses for his contributions to glacial geology, is especially famous for his work in eugenics research (Menand, 2001). By omitting these contributions of early US American geologists to the oppression of marginalized communities, geology instructors retain a simple narrative that sanctifies these geologists as heroes, polishing them off every time the story is retold (Pico, 2019).

Nature as divine: people as primitive

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143 A common metaphor in scientific reports or expedition narratives written by these geologists is
144 that of celestial or divine objects. Powell described his descent into the Grand Canyon as a
145 descent into hell, likening the stratigraphy to pages in a bible (Powell, 1895). This language fits
146 into a larger trend in the 19th century, where wilderness was depicted as containing the
147 supernatural just behind the surface (Cronon, 1995; Merchant, 2003). In the mid-19th century,
148 landscapes inhabited by Indigenous peoples were thought to represent untouched nature, and
149 these places, uninhabited by white US Americans, became idolized as sites of national identity
150 (Finney, 2014). Through the institution of slavery, Black people were similarly rendered a part
151 of a primitive nature scene "treating them with the same mixture of contempt, false reverence,
152 and real exploitation that also marks American environmental history"ⁱ. As Caroline Finney
153 develops in *Black Faces, White Spaces*, this legacy makes it challenging for people of color to
154 take part in a simple relationship to the natural outdoor world.

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156 *Modern representation of people of color in the outdoors*

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158 Students of color in geology courses may find themselves wrapped into a modern version of
159 this stereotype, where people of color are typed as primitive. As Finney illustrates, modern
160 popular culture still contains references to Black people as primitive, for example when Glen
161 Beck, a conservative political commentator, called Obama's America a "planet of the apes", or
162 when basketball player LeBron James was depicted similarly, as King Kong, in Vogue magazine
163 (Finney, 2014).

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165 Furthermore, students of color will simply find their face absent from modern depictions of
166 who participates in outdoor culture, and therefore geology. In a study of images including
167 people in the outdoor recreation magazine *Outside*, Black people were represented in only 103
168 of 4602 images, and these were mostly in advertisements for sporting goods in urban settings
169 (Finney, 2014). If participation in outdoor recreation is strongly linked to an interest in a career
170 in geology, then the exclusion of people of color from these activities, signaled through who is

represented in these spaces, might help to explain the challenge for geology to recruit a racially diverse student body. Furthermore, an analysis of images in geoscience textbooks showed that people of color were rarely featured, except in sections warning about climate change and overpopulation. Only 45 of 528 photos analyzed contained non-Western images, and 10 of 12 images portraying Black people were used to represent the threat of overpopulation (Phillips & Hausbeck, 2000).

Safety outdoors in the United States today

In considering the role of the outdoors for attracting geology majors, an important aspect is the perceived and real safety for geologic field research or teaching sites. The outdoor wilderness is a historical site of violence, given the number of lynching incidents that occurred in the woods. Memories of black families driven off of city or state parks by threatening mobs continue to shape how Black people view their position in outdoor spaces (Finney, 2014). Today, many of these natural outdoor sites remain outside the realm of safety for Black people. As a piece published in the New York Times explains the hesitation for a family trip to Montana: "Four black folks from Oakland, California cruising the back roads of Montana. Are you nuts?" (Finney, 2014).

Many field courses are conducted in rural regions of the United States, areas which are frequently openly hostile towards non-white US Americans. A recent video published by a geoscience undergraduate student recounted the constant racial tension he experienced as a Black person working in the field in the heart of the United States, including being stared down, being ignored by locals who spoke past him to his white colleagues, and threatening run-ins with people that had white supremacist and neo-Nazi symbols on vehicles or tattoos (Josh Anadu, n.d.). During my month-long field camp in graduate school near Death Valley, California, every time we drove out of our base camp we passed a water tower vandalized with Latinx slurs.

The issue of safety during fieldwork has previously been considered in studies that show high rates of sexual harassment and sexual assault in these environments (Clancy, Nelson, Rutherford, & Hinde, 2014). Such studies indicate that women of color are at particularly high risk for incidents of sexual harassment (Clancy, Lee, Rodgers, & Richey, 2017). Instructors in field geology should carefully consider the safety of the location where field camps are conducted in regards to the intersectional identities of students in terms of race, gender, and sexual orientation. Furthermore, leaders in the field can purposefully incorporate race in planning through clear expectations and prioritizing the safety of students of color (J. Anadu, Ali, & Jackson, 2020).

Epistemic injustice

The exclusion of discussion surrounding the racist nature of foundational geology or the historical and modern relationship between people of color and the outdoors in the United States leaves an absence in knowledge that would allow a student of color to contextualize their experience in geology. This absence in knowledge regarding a significant part of this student's social experience is an example of systemic hermeneutical injustice, a term coined by Miranda Fricker to refer to structural prejudice that limits access to shared resources for interpreting social experiences (Fricker, 2007). Without access to an intellectual framework through which to understand their lived experiences in geology, students are disconnected from epistemic resources that would aid them in understanding which parts of their social experience are shared or isolated.

Undergraduate geology programs have a small number of majors that are students of color. Therefore, these students are less likely to have their experiences validated by others with similar experiences. Furthermore, students of color may not be successful in having their voices heard. As Kristie Dotson describes, because the audience (leaders in geology departments) may not identify the speaker (a student of color) as a knower, their epistemic authority may be questioned (Dotson, 1998). This epistemic silencing limits the ability of

students to be supported or even to testify to their own race-modulated experiences. Furthermore, Dotson defines the idea of "testimonial smothering", where a speaker may identify limitations in the audience's willingness or ability to appropriately understand the testimony of their experience. Testimonial smothering results in the speaker curating their testimony, such that it only contains content that the audience is deemed competent to grasp (Dotson, 1998). Thus, students of color, realizing the limits of their leadership, may offer abridged palatable versions of their experiences – such that leaders will inherently be limited in knowing how race modulates students' experiences.

Part 2: Field practices that subjugate the local for the global

By training the next generation of geologists without regard to a history of imperialist and eugenic practices by foundational US American geologists and by ignoring the safety or representation of people of color in spaces where field geology is conducted, the discipline perpetuates these same practices of exclusion. I now turn to research practices in field geology today. I wish to analyze how these practices mimic the marginalizing imperialism imposed by 19th century US American geologists. First, I consider how field sites are chosen without regard to how scientists will interface with inhabitants of these spaces. I examine how field geologists privilege sites that are considered remote or untouched by Western scientists. Next, I dissect how field geologists build an intellectual framework that produces value for scientific knowledge created by Western scientists while devaluing the contributions of local knowledge in geology research. Finally, I turn to field research goals, underlining how these rarely serve the interests of communities where research is conducted, and whose inhabitants provide essential resources.

Field sites: entering and exiting

Can we set field geologists today apart from their imperialist 19th century counterparts? I am inspired by Donna Haraway's assertion that is difficult to imagine "the possibility of new stories not strangled by the same logics of appropriation and domination" (Haraway, 1989). Modern geologic fieldwork shares some themes with 19th century nationalist-driven geology. The history of military involvement in nationally sponsored geography and geology expeditions leaves the field as a site of conquest, centuries later, since geologists are trained with similar approaches to fieldwork. As examined by Matthew Sparke in "Displacing the Field in Fieldwork", fieldworkers are free to enter and leave their field site, a position that communities inhabiting this space cannot claim (Sparke, 1996). In this way, field geologists mimic the military in how they enter a site unexpectedly, dominate this space and acquire resources, and remove themselves when their goal is complete. The status of the fieldworker plays an important role in acquiring this level of power. The position of gender and race mark the fieldworker in the new field space, and modulate access to power over resources in this space (Henderson, 2009; Vanderbeck, 2005). Guides, which rarely exist, about how to conduct field work are void of any content regarding how individuals would interface with different cultures. Unlike other disciplines that conduct field work, there is rarely a required ethics training. Field geologists rarely consider the population inhabiting the physical space they are targeting. Rather, they consider the geologic questions to be of primary interest, and the principal motivation for choosing a field site.

Field sites: valuing the remote

Geologists place especially high value on field work in remote-to-access areas. In scientific talks it is common to show photographs from the field that highlight an especially dangerous aspect of field work (crossing a river rapid, scaling mountains in a blizzard, or camping near polar bears). These stories from the field elicit awe and honor, and act to reify the notion of the tough and rugged geologist. Indeed, these narrative fits snugly into the "hero-scientist" role, which, as Mary Terrall analyzed in "Heroic narratives of quests and discovery", required "risk-taking and physical toughness, to accompany the intellectual brilliance required of the

successful man of science" (Terrall, 1998). These actions linked to masculinity, as "men sought glory through the emulation of soldiers", which rendered science a means for seeking honor. In a similar vein, by choosing (and bragging about) dangerous field sites, these geologists prove character through sacrifice, a theme analyzed by Rebecca Herzig in *Suffering for Science* (Herzig, 2005). As Herzig illustrates, the suffering by scientists which legitimizes their place as heroes can only be accessed by some bodies. For example, the Peary expedition to the Arctic glorifies the suffering of the two white men explorers, extolling how their brilliant discoveries rested on these sacrifices, while diminishing and silencing the contributions of the Matthew Henson, the black male explorer who was "arguably the most crucial member of the team" (Herzig, 2005).

How are these honor- and character- building rites sanctified? Field sites seen as remote or difficult-to-access are privileged because they are considered pure and untouched knowledge vessels by Western scientists. Geologists will explain that "no one" has mapped this region since pre-plate tectonics theory (1970s) or that there are no measurements of X technique in this region, to justify why the site should be studied. These sites are in remote regions of postcolonized spaces, in Africa, South America, and Asia, for example in the mountains of Peru, the shorelines of Madagascar, or valleys in the Himalayas. Challenges accessing a field site, such as trekking through mountains for days with little (or rotten!) food, or hitchhiking on motorbikes, become an aspect of scientific rigor, and the more remote or untouched by other scientists, the more prestigious the work. These challenges are safer for certain identities: my colleagues who are white men have even told tales of lodging at brothels (perhaps due to budget constraints or poor planning), which could be dangerous for women-identifying and non-binary identifying people.

In an eerie flashback to 19th century geology, spaces deemed wild, natural, and primitive are privileged for field work, and one feature of these spaces is their inhabitation by Indigenous populations. Thus, the field sites most valued by geologists are those where the Indigenous population forms a part of this nature scene, rendering communities of color invisible as humans, and camouflaged into the landscape. Geologists are therefore drawn to conducting

research in these areas to gain legitimacy through the heroic explorer scientist trope, forcing the geologists into a position where they must interface with largely communities of color. The white US geologist then creates the inescapable power structure between the outside postcolonial Westerners and the local postcolonial non-Westerners. Unaware, or unable to articulate these power dynamics, the US geologist mimics the same oppressive practices performed by 19th century colonialists, exploiting natural and human resources to attain their scientific goals.

I wonder if field geologists form an intellectual wall between the physical geology they are studying from the humans that inhabit this space, or whether geologists in somehow view this population as part of the existing toolset at their field site. If the prior, geologists' determination to separate the geology from the people mirrors other scientific disciplines that impose strict boundaries between the scientific and the social (Harding, 2008). However, the alternate case recalls 19th century geologists who wrote about Indigenous people in their same reports about rocks, imagining them as a primitive part of the landscape they studied, even going as far as to using the ancientness of landscapes to make claims about the primitiveness of Indigenous people on this land (Chakrabarti, 2019). In this latter case, the field site blends natural and human resources.

Universal versus local knowledge: capitalizing on Indigenous knowledge

Geologists rely on community resources for their work, by hiring field assistants or guides, or simply for advice on how to navigate community dynamics. Those who provide this work or knowledge rarely receive credit or compensation commensurate with value ultimately produced. In placing value only on knowledge produced by Western geologists in non-Western spaces, these scientists partake in the capitalization of local knowledges. Field geologists rely on these local knowledges for their scientific work: they must gain access regions of interest and they must acquire as much local knowledge of the physical geography as possible. This knowledge forms a crucial component of field geology. However, locals that provide this

knowledge rarely receive sufficient compensation, whether in the form of monetary value or intellectual credit. Nevertheless, "universal" knowledge produced by US geologists in these countries creates value back home, both monetarily, in terms of funding for the scientists, and status-wise, increasing the prestige of the scientist.

My impression is that US geologists feel little accountability to properly compensate local assistants or colleagues. My discussions with field geology colleagues imply that inclusion of these local assistants or colleagues as intellectual contributors is a nicety rather than an obligation. It is not standard to include these intellectual contributions as coauthorship, and I think this practice may result from Western scientists viewing these individuals as less powerful in US-dominated geoscience world. Yet the labor and knowledge that local communities share with field geologists produces real value. As Mohanty suggests in *Feminisms without Borders*: "It is the colonialist and corporate power to define Western science, and the reliance on capitalist values of private property and profit, as the only normative system that results in the exercise of immense power" (Mohanty, 2003). Western geologists, trained with these values, approach the field in a desire to produce scientific knowledge, and therefore profit off this physical space by creating important scientific value. This valuable scientific knowledge advances the field geologist, who ignores or undervalues the contribution of local workers in order to amass scientific prestige and power.

Such practices can be identified as "scientific colonialism", situations where scientific knowledge is acquired at a source, but the processing or production of that knowledge occurs somewhere else, and the profit resulting from this knowledge production (such as peer-reviewed articles, grants, or graduate degrees) is not received by those at the source (Nicholas & Hollowell, 2007). The scientific results produced by field geologists help these scientists secure further funding in addition to increased standing and prestige in the Western scientific community. Through a Marxist perspective, we can see how, despite Western field geologists' reliance on the knowledge and labor of local communities, they continue to exert a monopolized control over the means of knowledge production, while local communities are

barred or limited to access to controlling the means of production (La Salle, 2010). The strong power differential between the US field geologist and the local inhabitant transforms local knowledge into a universally-recognized and profitable knowledge.

Scientific knowledge is seen by the geology community as devoid of social forces, especially for research subjects such as deep time geology, which operate on non-human timescales. Thus, an intellectual separation is formed between the knowledge produced and the practices employed for obtaining this knowledge. By cleaving the practice of geology from the science of geology, scientists can ignore their work's serious social footprint. Dividing the social and scientific enables geologists to devalue knowledge already held by Indigenous communities about the landscapes they inhabit (Agrawal, 1995). Through this framework, geologists can justify the small monetary and intellectual compensation they provide to local workers who are crucial to completing research tasks. Training field geologists with this toolset guarantees that the next generation will practice and then transmit practices of imperialist knowledge production.

Towards community-based methods in geology?

Geologists invade field spaces and freely use both natural and community resources to answer their driving scientific questions. When they do so, geologists hardly acknowledge that the community inhabiting their field space is crucial for completing fieldwork, and that research questions investigated are rarely driven by community desires. In other disciplines that conduct fieldwork, such as sociology or anthropology, it is now common practice to consider community-based participatory research practices. From this framework, good research is research that includes the community studied at every stage of the process, including research priorities (Jordan, Gust, & Scheman, 2005). Scholars have considered what constitutes ethical scientific research, and in analyzing research with Native American populations, Kim TallBear argues for the need of "strong objectivity" in the field by speaking "in faith", acting in concert, rather than for, the given population (Tallbear, 2014). In archeology the adoption of community-based practices and collaboration with descendant communities has become

common place, although archeologists' approach to these practices does not always result in the goal of redistributed research power (La Salle, 2010; Wylie, 2019).

These community-based participatory research methodologies are not constricted to studies involving human populations: there is space to bring these methods into field geology. In fact, geology holds an obvious connection, through research with urgent implications for our understanding of deadly natural hazards like earthquakes, volcanoes, landslides, and tsunamis. In many previously colonized regions, poor infrastructure makes natural hazards a particularly serious threat. Of course, incorporating such methods requires that field geologists abandon current one-sided practices, and open a two-way dialogue, listening closely to the voices of the community at the field site. In the field geology community there would first need to be recognition that the current practice of extracting resources from the community is exploitative and unequal. As La Salle highlights, to move beyond collaboration, to move beyond consultation and working side by side, it is necessary to change our roles in research by giving up control over the research program. Giving up this control would allow "power firmly in the hands of the people who are most closely affected by what research they choose to do"(La Salle, 2010). This means not only that a research project might completely change directions, but also that the project might be abandoned altogether. Thus, geologists would not direct research programs but may instead work as technicians, helping communities accomplish their own research objectives.

Perhaps I am optimistic, but I can envision a system where networks of geoscientists build around the desires of communities where fieldwork is conducted to propose novel projects and collaborations. Field geologists could converse with community leaders in their desired field site to find out what geo-concerns are most relevant to the population. For example, geoscientists interested in studying past sea level one-hundred thousand years ago in Madagascar might listen to the need for research on changing fishery conditions at their desired field site, and connect the local community with fishery scientists equipped to tackle their questions. While I have found that humanitarian projects led by geoscientists exist, these kinds of projects

determine the needs of the given population from the exterior, and do not include these populations throughout the research process("Geoscientists without Borders," n.d.). Community-based geoscience research cannot be considered a charity. Rather this is the only kind of field research we should deem acceptable, as it produces science that, through conjunction with society, truly meets the needs of people and consciously detaches itself from exploitative colonialist research practices.

Conclusion

Through this essay I explored how historical and modern practices in US field geology lead to exclusion within and subjugation outside the geoscience community. The geosciences suffer from a severe underrepresentation of minorities at all academic levels (Bernard & Cooperdock, 2018). This underrepresentation, in part, may result from an absence of acknowledging the social context through which the discipline first developed, as well as the discipline's relationship to marginalized communities today. There is a deep history of race-based exclusion from outdoor spaces, and this could exacerbate why Black students and other minorities express less interest in geology as a major. Further, by glorifying figures in geology who were involved in marginalizing imperialist practices, we rob students of the opportunity to contextualize their experience with the historical record of geology practices. We cannot ignore that the real and perceived safety for conducting field geology work is a substantial concern for people of color, and the high prevalence of sexual harassment in the field exacerbates this issue for women of color. In addition, the representation of people of color in popular culture images of outdoor spaces, as well as in geoscience textbooks and faculty lists, leave little space to imagine a future in this discipline.

I identify how racist and imperialist methodologies are perpetuated in the training of geologists through field work practices in postcolonial spaces. Seeking legitimacy through rugged fieldwork, geologists place themselves in third world countries, entering into a lopsided power dynamic. These geologists rely on local community resources and knowledge in order to

complete scientific goals. However, the motivation of scientists to amass prestige and power through their individual intellectual contributions results in the under compensation of local workers. Furthermore, the primary research goals of field geologists rarely consider the interests of the community inhabiting their field site, let alone include their participation in the development stage of selecting research questions. Inverting the current research process to include communities inhabiting field sites in the primary stages of research development has the potential to transform the scientific knowledge produced in field geology, uncovering new subjects of inquiry. Nevertheless, current training practices act to reinforce and reperform the imperialist relationship between the field geologists and the community at the field site.

I am interested in exploring the relationship between the field geologist, and the physical space inhabited, because I believe that lodged somewhere in this space we can begin to understand the roots of exclusion and exploitation in geology. I can envision a field geology that opens up a space for new faces. This space would be created by explicitly discussing the legacies of foundational geologists entrenched in scientific racisms and imperialistic expansion. This space would acknowledge the complex relationship between students and the outdoors. This space would consciously detach itself from the logic of oppression, drawing upon scientific methods that adopt community-based research practices and defetishize the third world as a site of rugged and primitive wilderness to conquer. In this space field geology could come to terms with its past, and begin to set the stones for the future.

References

- Agrawal, A. (1995). Indigenous and Scientific Knowledge : Some Critical Comments. *Indigenous Knowledge and Development Monitor*, 3, 3–6.
- Anadu, J., Ali, H., & Jackson, C. (2020). Ten steps to protect BIPOC scholars in the field. *EOS*. <https://doi.org/https://doi.org/10.1029/2020EO150525>
- Anadu, Josh. (n.d.). Hazards of Field Work While Black. Retrieved October 27, 2020, from YouTube website: https://www.youtube.com/watch?v=W0B7xwGkl00&fbclid=IwAR2J-fuDcmRrBGApXXFFNxitxoOAq4NugVTJPbFmEeCZX8q6_PNZx6VgLGc
- Bernard, R. E., & Cooperdock, E. H. G. (2018). No progress on diversity in 40 years. *Nature Geoscience*, (April). <https://doi.org/10.1038/s41561-018-0116-6>
- Chakrabarti, P. (2019). Gondwana and the Politics of Deep Past. *Past and Present*, 242(242).

- <https://doi.org/10.1093/pastj/gty016>
- Clancy, K. B. H., Lee, K. M. N., Rodgers, E. M., & Richey, C. (2017). Double jeopardy in astronomy and planetary science: Women of color face greater risks of gendered and racial harassment. *Journal of Geophysical Research: Planets*, 122(7), 1610–1623. <https://doi.org/10.1002/2017JE005256>
- Clancy, K. B. H., Nelson, R. G., Rutherford, J. N., & Hinde, K. (2014). *Survey of Academic Field Experiences (SAFE): Trainees Report Harassment and Assault*. 9(7), 1–9. <https://doi.org/10.1371/journal.pone.0102172>
- Cronon, W. (1995). *Uncommon ground: Toward reinventing nature*. New York: Norton & Co.
- Dotson, K. (1998). Tracking Epistemic Violence, Tracking Practices of Silencing. *Hypatia*, 26(2).
- Finney, C. (2014). *Black faces, white spaces: Reimagining the relationship of African Americans to the great outdoors*. Chapel Hill: The University of North Carolina Press.
- Fricker, M. (2007). Hermeneutical Injustice. In *Epistemic Injustice: Power and the Ethics of Knowing*. <https://doi.org/10.1093/acprof>
- Geoscientists without Borders. (n.d.). Retrieved October 21, 2020, from <https://seg.org/About-SEG/Geoscientists-Without-Borders>
- Haraway, D. (1989). *Primate visions: Gender, race, and nature in the world of modern science*. New York: Routledge.
- Harding, S. (2008). *Sciences from Below: Feminisms, Postcolonialities, and Modernities*. Duke University Press.
- Henderson, F. B. (2009). "We Thought You Would Be White": Race and Gender in Fieldwork. *Political Science and Politics*, 42(2), 291–294.
- Herzig, R. (2005). *Suffering for science: Reason and sacrifice in modern America*. New Brunswick, N.J.: Rutgers University Press.
- Hoisch, T. D., & Bowie, J. I. (2010). Assessing Factors that Influence the Recruitment of Majors from Introductory Geology Classes at Northern Arizona University. *Journal of Geoscience Education*, 58(3), 166–176. <https://doi.org/10.5408/1.3544297>
- Jordan, C., Gust, S., & Scheman, N. (2005). The Trustworthiness of Research: The Paradigm of Community-Based Research. *Metropolitan Universities: An International Forum*, 16(1).
- La Salle, M. (2010). Community Collaboration and Other Good Intentions. *Archeologies: Journal of the World Archeological Congress*. <https://doi.org/10.1007/s11759-010-9150-8>
- Menand, L. (2001). Morton, Agassiz, and the Origins of Scientific Racism in the United States. *The Journal of Blacks in Higher Education*, 34(34), 110–113. Retrieved from <https://www.jstor.org/stable/3134139>
- Merchant, C. (2003). *Reinventing Eden: The Fate of Nature in Western Culture*. Routledge.
- Mohanty, C. T. (2003). *Feminisms without borders: decolonizing theory, practicing solidarity*. Durham: Duke University Press.
- Nicholas, G., & Hollowell, J. (2007). Ethical challenges to a postcolonial archeology: the legacy of scientific colonialism. In Y. Hamilakis & P. Duke (Eds.), *Archeology and Capitalism: From Ethics to Politics*. Walnut Creek, CA: Left Coast Press.
- Phillips, J., & Hausbeck, K. (2000). Just Beneath the Surface: Rereading Geology, Rescripting the Knowledge-Power Nexus. *Women's Studies Quarterly*, 28(1/2), 181–202. <https://doi.org/10.1002/mmce.20539>

- Pico, T. (2019). The Darker Side of John Wesley Powell. *Scientific American*. Retrieved from <https://blogs.scientificamerican.com/voices/the-darker-side-of-john-wesley-powell/>
- Powell, J. W. (1895). *Exploration of the Canyons of the Colorado*. New York: Dover Publications.
- Shaler, N. S. (1897). *Nature and Man in America*. New York: C. Scribner's Sons.
- Sharp, R. P. (1988). Earth Science Field Work : Role and Status. *Annual Review of Earth and Planetary Sciences*.
- Sparke, M. (1996). Displacing the Field in Fieldwork. *BodySpace. Destabilising Geographies of Gender and Sexuality*, (206), 212–233.
- Stegner, W. (1954). *Beyond the Hundredth Meridian; John Wesley Powell and the Second Opening of the West*. Cambridge, MA: The Riverside Press.
- Stokes, P. J. (2013). Why are there so few Hispanic students in geoscience ? *GSA Today*, 24(1), 52–53. <https://doi.org/10.1130/GSATG176GW.1.52>
- Tallbear, K. (2014). Standing With and Speaking as Faith A Feminist-Indigenous Approach to Inquiry. *Journal of Research Practice*, 10(2), 1–7.
- Terrall, M. (1998). Heroic Narratives of Quest and Discovery. In *Configurations* (Vol. 6, pp. 223–242). John Hopkins University Press.
- Vanderbeck, R. M. (2005). Masculinities and Fieldwork : Widening the discussion. *Gender, Place & Culture*, 12(4). <https://doi.org/10.1080/09663690500356537>
- Why Study Geology. (n.d.). Retrieved from <https://geosci.unc.edu/students/prospective-students/why-study-geology/>
- Wylie, A. (2019). Crossing a Threshold : Collaborative Archaeology in Global Dialogue. *Archaeologies*, 15(3), 570–587. <https://doi.org/10.1007/s11759-019-09385-4>

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¹ Outka in (Finney, 2014)