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Breakwater: Anti-Blackness in Geoscience

Lessons from Long Beach, CA

Christina Marsh

December 12th, 2022

Readers: Professor Guillermo Douglass-Jaimes

Professor Marc Los Huertos

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Preface: Sunlight and Stones

If I could gather sunlight and stones, if I could keep the Pacific Ocean water from spilling or drying up, then home could come with me (Savoy, 2015, p. 27)

I am by no means an expert in the field of geoscience, education, or Africana studies. But I may be one of the few people who have chosen to approach such varied topics in one narrative. Rather than offering you a long jargon-filled work, I'd rather offer you something with defined disciplines. "Definitions are vital starting points for the imagination. What we cannot imagine cannot come into being. A good definition marks our starting point and lets us know where we want to end up" (hooks, 2016, p. 14). Taking inspiration from *A Billion Black Anthropocenes or None* by Kathryn Yusoff and *Trace: Memory, History, Race, and the American Landscape* by Lauret Savoy, I attempt to fill a middle between looking at the grammar and poetics of my lived and learned experiences in the geosciences. My motivations lie in my varied experiences as a disabled Black woman, student, geoscientist, and aspiring transdisciplinary scholar and educator. As someone who loves and values their community and home, I often wonder what I, someone who is young and left with a lot to still learn, can contribute to such strong and varied experiences. This is a small portion of what I have learned in college and an expression of my love for geosciences communicated through a desire for it to grow and change in its reach, approach, and inclusiveness. This work serves as an exploration of self in the form of autoethnography and all the beautiful, varied knowledge I have from growing up with having the shoreline and sunlight in my backyard.



Image 1: The view from my cubicle window during my internship in Summer 2019 Credit:

Christina Marsh

I am driving down I-710 surrounded by trucks, shipping containers, and the LA river. We were all headed to the same place: the ocean. Whether as a truck driver or scientists behind a desk, we all gathered by the sea. To cramped spaces, to work boots, uncomfortable seats, and hard hats all with an ocean view. While I was on Ocean Blvd, they were on the harbor. Constructed spaces in sight of but not quite in the waves.

My first real introduction to geology was in a cubicle, not in the classroom or in a national park. This cubicle was the place I first realized that I liked how science could be used to help prevent hazards in the community and empower informed decision making when it comes to environmental justice. This cubicle with a view of Ocean Blvd was my first-time seeing geoscientists in action as part of my internship with the Port of Long Beach. Through my internship, I developed an interest in the process of collecting data and sharing it with the public—two distinct jobs, I was told. I began to consider why the scientists were not tasked with communicating their results as it related to policy and community needs. The people in charge of the policy and outreach were viewed as separate, and their work less valuable. In meetings they were talked over and discredited, and in the office their desks were distanced from all others. When expressing interest in doing both outreach and science I was laughed at by the scientists in a department meeting. I was not sure if this humor came from being the only Black person in a group of 30 people or being a woman where there were only 5 or for being the only one bold enough to assume that caring about both people and our Earth would go hand in hand. This moment mirrored the frigidness, the shock, and the flight response I felt when entering the cold Pacific waters. The familiar and slightly painful feelings prevented me from doing much more exploration of science that summer. And so, I chose to stay on the shore in policy and communication, spending my first two years of undergrad as a Public Policy Analysis major.

It was not before that moment that I made my way down to the shore to take a closer look, venturing outside the constraints of the cubicle and the preconceived ideas I had about belonging. But surely enough there I was, unable not being able to see past the shallow and frigid waters the touched the shore. There was a breakwater awaiting me, preventing access to vast

ocean that lay past it. Some claimed that the breakwater was there to protect me, calming the waves and preventing devastation from storms. But I saw it as more. As both its function and as a symbol of fear of the unknown of the true power of waves and the inevitable destruction they could bring if the constructed wall were to fall. It was there to prevent me from reaching the true depths of understanding what lies ahead and beyond the ocean's surface.

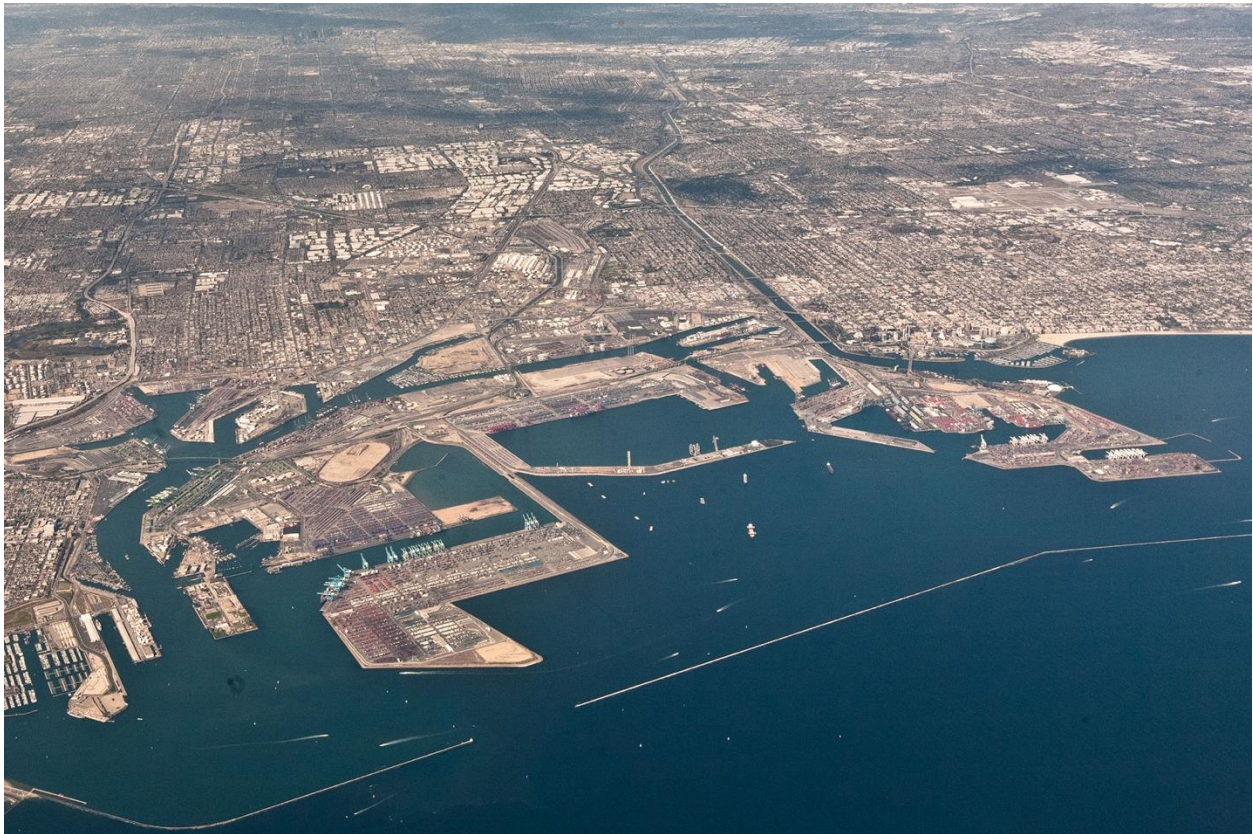


Image 2: Aerial view of the Port of Long Beach (2012)

Breakwater - Noun

a barrier built out into a body of water to protect a coast or harbor from the force of waves

a permanent structure constructed at a coastal area to protect against tides, currents, waves, and storm surges (Oxford Languages and Google, n.d.).

Breakwaters are more than just physical structures. In the context of Long Beach, they are actualizations of economic, social, environmental, geologic, and policy challenges. The breakwater to me is more than a symbol but also a signifier of my personal experiences in academia and geoscience. Constantly seeing the problems of its structure, questioning its foundations, wondering its purpose, and not always finding an answer.

Introduction

This work is split into three parts, Testing the Water, Constructed, and Wave Action. Each part addresses how geoscience fundamentally is made inaccessible for Black people through strategic and systemic exclusion in natural, educational, and scientific spaces. Part 1, Testing the Water, explores the makings of Black exclusion from the natural world through highlighting to specific examples of Black experiences, statistics about diversity, and the history of “White Geology” (Yusoff, 2018, ch. 1). Part 2, Constructed, explores the formation of educational spaces and curriculum today for fifth graders in Long Beach, CA and beyond. Part 3, Wave Action, investigates the intersections between Black theory and geoscience concepts as methods to resist/persist in hostile spaces and institutional boundaries. All of this is done through the lens of an autoethnography, which Poulos defines as, “an autobiographical genre of academic writing that draws on and analyzes or interprets the lived experience of the author and connects researcher insights to self-identity, cultural rules and resources, communication practices, traditions, premises, symbols, rules, shared meanings, emotions, values, and larger social, cultural, and political issues” (2021).

As part of my ethnographic approach, I employ different methodologies to explore and critic the geosciences. I use data as a geoscientist would, jargon that an Africana theorist would, and poetics in the way many great writers I quote do. I use all of these methods and their many biases as I see fit to develop an approach that best illustrates my story. What conclusions I draw are not meant to be objective truths about the geosciences but rather to explain my truth and my reality. As bell hooks says, “to be truly visionary we have to root our imagination in our concrete reality while simultaneously imagining possibilities beyond that reality” (hooks 2000, p. 110). In approaching my own story, I employ many methodologies I have utilized throughout college and some that I utilize for the first time. In doing so, I ask the readers to look at my work with the same imagination as I approached it with.

Part 1: Testing the Water

The Pacific Ocean is notoriously cold. As a child I would often run to the shore, dip my toes in the frothing waves, and then immediately run back to the familiar, often, scorching sand. Instead of diving in, I felt more comfortable baking in the heat of the day. I took the same approach to my education and understanding in geoscience. For so long I let the allusiveness and elitism of geology stop me from exploring it. Geology being white, ableist, outdated, and colonial has prevented me from being able to explore its true depth. There is a coldness to its past and present, to the glares I get from classmates, the skepticism I get from professionals, and the ignorance comments I get from both. My time has shown me the water does not get warmer but simply through wading in it for some time, it feels that way.

Black Space and Place

Their putative transgression is to conduct themselves in ordinary ways in public while being black at the same time (Anderson, 2015)

Constructed in the 1940s during World War II, the Long Beach breakwater was built by the U.S. Navy as part of a deep-water port project. It was also built to serve as a “barrier and deterrent to enemy submarines” (Jones, 2018). Since the closing of the navy shipyard in 1997, there has been no shipyard to shelter or defend, calling into question the necessity of the breakwater (Jones, 2018).

Yet it remains a significant piece of infrastructure for Long Beach, the second largest city in Los Angeles County and often ranked as one of the most ethnically diverse in the country. In my mind, the city is the perfect place to foster an understanding of what it means to educate a diverse population. Long Beach’s strong historic Black population also meant that I learned a lot about community care, empowerment, and coexistence. Black people constitute almost 15% of the Long Beach population, making it among the top 30 cities in California with the largest Black populations (*Cities with highest percent*, 2022). With all of this in mind, I felt comfortable in many spaces, my local ice cream shop, beauty supply, grocery store. But as I left my few - historically Black city blocks– it became harder to deal with the lack of community and often hostility I encountered. I had the overwhelming feeling of being an outcast in my own city.

While the naval complex moved from our city to a neighboring one a couple of decades ago, what I still feel strongly is a police presence. I live a 10-minute walk to my area's largest and best park. That same walk would lead me past the Long Beach Police North Division which lay directly in front of that very same park’s entrance. From a young age I remember being told to

not go to that park because it was dangerous. I have since had a fraught sense of belonging whenever I visit there. This sense of ‘otherness’ was so strong to the point of I often feared hostility and violence, something I have long experienced and grown accustomed in nearly all spaces I occupied past early childhood. The policing of Black space even in recreation was so present in my life I rarely questioned or noticed it as abnormal entering that park. But I felt a lack of autonomy and a lack of safety in a space that was supposed to be open to the neighborhood, predominantly black and brown neighborhood, due to my Blackness. I felt watched, scrutinized, and intimidated for ordinarily playing in the park. This experience is not mine alone.

After all, race and racism have contributed significantly to structures in the production of space in the United States. The Black Spatial Imaginary centers “the movement and fixity of Black communities”, by theorizing and reflecting on past, present, and future spaces for Black life (Bates et al., 2017). The social and political resistance to Blackness across the world has constrained the use of the Black spatial imaginary as a conceptual framework, but this framework allows a flexibility and understanding of placemaking across scales from the individual to the group (Nunez Pedraza, 2019, p. 40). Furthermore, the dominant white spatial imaginary that has controlled the production of space has historically centered whiteness as its default (Nunez Pedraza, 2019). This whiteness is disguised and embedded into the default understandings of other social constructs to the point that these constructs seem to be non-racialized concepts. As a result, the white spatial imaginary fails to recognize and much less serve publics that are “othered” in the understanding of space and place (Nunez Pedraza, 2019). This has negatively impacted Black Americans in their experience of the built environment. These “non-racialized” concepts have contributed to the policing, containing, and surveillance of

Black occupied spaces, necessitating the need to discuss concepts such as the Black Spatial Imaginary in order to theorize and produce transformative settings for Black communities (Nunez Pedraza, 2019). The difficulty in dealing with the white spatial imaginary and white space in general is that black people are required to navigate the white space as a condition of their existence, while the reverse is not true.

African American writer Evelyn C. White gives us a strong example of how the hostility of the dominate white spatial imaginary can limit spaces she is comfortable occupying in her life. In the 1990s she had been invited to teach creative writing in a summer workshop on the McKenzie River in Oregon, at the foot of the Cascade Mountains (White, 1996, p. 283). The natural setting of the workshop was vast, with participants surrounded by hiking trails, lava beds, hot springs, and all manner of boat-trip possibilities on the river. But for White, there was something else lurking beneath the sweet sounds of summer emanating from her surroundings. “I wanted to sit outside and listen to the roar of the ocean, but I was afraid. I wanted to walk through the redwoods, but I was afraid. I wanted to glide in a kayak and feel the cool water splash on my face, but I was afraid. For me, the fear is like a heartbeat, always present, while at the same time intangible, elusive, and difficult to define. So pervasive, so much a part of me, that I hardly knew it was there” (White, 1996, p. 283).

The fear she experienced was largely informed by a collective history of violence against African Americans at the hands of white people. White recounts the brutal story of Emmett Till’s murder in 1955; the 1963 bombing of the Sixteenth Street Baptist Church in Alabama which killed four young black girls (Finney, 2014, p. 118). Despite these events being framed as “historical”, it had only been 40 years, at that point, since Emmett Till’s death. These events shaped White’s

mindset and world profoundly. It was not just fear of the unknown but also of what she knew about the “way it is” in the world to be a Black woman/person. Living through a lifetime of slights, big and small, real, and perceived, African Americans recognize, register, and adapt to a history of oppression often interpreted as a way to limit our existence. White put up walls that she hoped would keep her safe. But these same walls also limited the possibility of greater self-discovery and understanding by engaging in the many outdoor activities of the workshop. She is not alone in her concerns when considering a walk in the woods or a hike on a mountain (Finney, 2014, p. 118).

In *Life after Death*, Clyde Woods (2002) found that scholarship focused on the individual Black communities he studied was full of language of death and extinction of communities, instead of love and hope (Woods, 2002, p. 62). He points to the destruction of African American communities in cities such as Washington, DC, Chicago, Baltimore, Los Angeles, and New York to expose the disparity between the reality of destruction and the language used to mask the cause: systemic racism (Woods, 2002, p. 63). He suggests that these methods of destruction such as “the creation of educational wastelands”, “land seizures”, and “environmental racism”, to name a few of his examples, should be viewed as “human rights violations” due to their intentional harm (Woods, 2002, p. 64). He goes on to call that in history, “reports of the death of African American community life are truly premature” as many times in history African Americans have shown their resilience and protection of what little space they have (Woods, 2002, p. 65). Finney provides a partial explanation for state-sanctioned processes that continue to perpetuate false and negative information about the environments in which Black people live, which is why the analysis offered by Woods is so important. Woods analysis allows us to see how racial violence is fixed into the earth, retellings of history, and in language utilized.

The insight provided by Finney in *Black Faces, White Spaces* (2014), demonstrates how representation and racialization in academic discourse and mainstream media maintain a narrative of environmentalism that renders Black experiences invisible. This erasure sheds light on why environmental racism, or state-sanctioned racial violence in “natural” spaces, is not understood as an environmental injustice.

A contributing factor to this is the harmful notion harbored by non-Black people that Black people lack any legitimate or binding social and spatial relations. In other words, the very condition of Blackness renders the individual devoid of relationality and made “other” (Jenkins, 2021). Subject to erasure, violence, and abject terror, Black people have endured through hardship at the hand of powers widely and in specific ways within the context of the United States. Institutions such as schools are part of a larger social condition that permanently subjugates Black people by making them “socially dead in the wake of slavery’s afterlives” (Sharpe, 2016). Originating in conversations surrounding the afterlife of slavery, social death meaning the subjugation of people, by wider society, not seen as worthy to be relegated and treated as a status less than human. This “otherness” will be discussed further in Part 1.

Black Education as Fugitive Space

“While fugitivity may not yet mean freedom” (Sexton, 2016), as Darius Lovehall so eloquently put it, it’s “about the possibility of the thing” (Grant et al., 2020, p. 53)

Black education has always been and continues to be a struggle against specific anti-Black practices, discourses, ideologies, and the types of violence that Black bodies endure in school and other educational spaces. Think of high rates of disciplinary actions and heightened police

presence in majority Black schools as the most blatant examples (Jenkins, 2021). The frequent news headlines about Black students being abused by non-Black teachers and students brings this point to bear by documenting the anti-Black violence experienced by Black students (Jenkins, 2021). Last year, Davis School District, the second largest in Utah, reached a settlement with the Justice Department after the department found the school district hid 212 reports of Black students being called a racial slur and found that Black students were disciplined more harshly and frequently than white students (Medina, 2021). The Justice Department called the school district's inaction "deliberately indifferent to the racially hostile climate" (Medina, 2021). Accordingly, the origin of the Black condition, which included an absence of social existence, limited power, and no legitimate claims works as a manifestation of Black social dishonor often seen and experienced for the first time in school (Jenkins, 2021). Thus, Jenkins frames these as social death, to capture the non-existence of the slave and their dislocation and alienation from community as both a process and a condition that renders Blacks as fundamentally exposed to violence and terror.

Similarly, the endurance of school segregation works by perpetuating violence and erasure (Jenkins, 2021). Black erasure and misrepresentation in curriculum manifests as inadequate and inferior material resources, a lack of access to rigorous classes, or gaining access, only to be marginalized and further made to feel "othered". It means, "irremediable implicit biases. It means no recess, no arts, no play, no exploration, no noise, no stepping. out. of. line. Test after test after test. Teaching to the test. Learning for the test." (Grant et al., 2020, p. 50). These are systemic problems with education but are more heavily enforced and scrutinized when it comes to Black students who have been subjected to other spatial and racial structures such as redlining

which helps the poor stay poor as school funding is still partially based on property values. Poor Black and Latino children in the United States are more and more likely to attend schools where most of their peers are poor as well (Owens, 2016). And these poorer schools have less access to science (Owens, 2016).

Work that critiques the state-sanctioned processes that codify and maintain violence and erasure of Black experiences in natural and educational spaces is greatly needed. This scholarship must utilize new language that describes the presence and progress of Black life while grappling with the reality of social death. The literature focusing on endurance or “afterlife” of school segregation begins to explore this. The afterlife of school segregation necessitates the imagination of educational policies that create liberatory schooling experiences for Black students in an anti-Black world without diminishing educational policy initiatives that may serve to ameliorate the educational experiences of some Black children (Grant et al., 2020, p. 51).

Grant suggests that “Black educational fugitive space is located in these margins—where yearning and imagining meet and become. Black space fuels itself in the margins and claims ‘the ground on which we are constructing, ‘homeplace’, where Black folks can articulate a politics of refusal, and reimagine themselves in opposition to anti blackness” (Grant et al., 2020, p. 52). In Part 2, I will explore the education system and how its foundations further limit the potential for this “reimagination” of self.

Diversity in Geoscience

I am humanistic. I deeply care about helping improve the conditions of my community and when I came into college, I was quickly told that public policy would be a route that helped people. I had the experience of working at the Port of Long Beach studying environmental policy and regulations, so naturally that made sense to me as well. But I often forgot about my own desires and passions, feeling deeply unsatisfied by the commentary and reactive nature of policy I learned about. In the spring of my sophomore year of college, I was so unhappy in my academic trajectory, I decided to do something about it. I had come to the realization that the type of impact I wanted to make on society was not policy centered, but rather a holistic, and experience-informed approach. But I also knew people saw more legitimacy in formalized education and that there was always a benefit to broadening my horizons. I wanted to explore what science had to offer as I was less inclined to teach myself or experientially learn the subject matter.

My initial ideas were that geology would be a good tool for me to achieve my greater aims at promoting environmental and social justice. Obvious focuses on natural hazards and sea level rise due to climate change are things geology is willing to reckon with. But I soon learned that my vision of how to use geology was the exact opposite of how it operated as quantitative, methodical, and limited to certain definitions of who and what could be included in the process.

The culture of objectivity, or being removed from the subject matter — which is essential for science — works abysmally for topics like racism, where feelings, emotions, and identities play an enormous role (Dutt, 2020)

What I learned is consistent with what other scholars have revealed. In 2018, Rachel Bernard and Emily Cooperduck published “No progress on Diversity in 40 years,” focusing on how ethnic diversity in Earth Sciences has remained practically nonexistent. The article published in *Nature*, a respected science journal, argued that there was little to no changes in representation of racial and ethnic groups among doctorate degree recipients. The article goes on to observe that the efforts from the 1990s onwards to increase diversity have not translated to diversity at the Ph.D. or faculty level. The 1990s initiative mentioned was the National Science Foundation (NSF)’s Broader Impacts initiative (National Science Board, 2011, p. 259). The NSF Broader Impacts were established with the goal of merit review consider the potential for a proposal to benefit society and contribute to the achievement of specific, desired societal outcomes (National Science Board, 2011, p. 259).

In fact, at that time, only 6% of earth and geoscience doctorate degrees were awarded to non-white students between 1973 and 2016, or about 21 out of an average of 350 per year (Bernard et al., 2018). Even if we take a step back and look at undergraduate data, two-fifths of undergraduate geoscience programs “fail to graduate more than one student from a marginalized group per year” (Beane et al., 2021). And from 2014 to 2018, only 32 institutions, <10% of the total number of programs, conferred an average of more than one geoscience bachelor’s degree per year to Black/African American students and only six averaged three or more per year (Beane et al., 2021).

Around the beginning of the Covid 19 pandemic this article had generated over 35,000 views, again highlighting the need for diversity in geosciences. Though it has been nearly 5 years since

the article was published, no major geologic society has made tangible efforts to improve diversity. Although the American Geophysical Union (AGU) and the Geological Society of America (GSA) have since emphasized the need for DEI committees, their efforts have centered talks on diversity and inclusion at their international conferences. But geology's problems start long before ignoring voices of professional geoscientists.

GSA's current president as of 2021 (Giles, 2022) and AGU's president elect (Bell et al., 2022) as of this year are both Black, a first for both organizations. But geology is far away from being anything other than an old boys club and a "leaky pipeline" regarding gender and race. The leaky pipeline is the idea that despite interest in careers in geosciences and academia, marginalized people tend not to pursue or remain in them, the pipeline which begins at early education and ends at higher levels of academia. The issues of geoscience are systemic, reaching everyone from young students to senior faculty, regardless of perceived power and success. After being at University of Manchester for 20 years, receiving both degrees and a full faculty position from the institution, Dr. Christopher Jackson decided to leave academia in 2021. According to an interview with *Nature*, Jackson "received what was, in his opinion, a racially insensitive e-mail that constituted harassment and alluded to using social media to police staff opinions, which, he says, was the last straw" (Gewin, 2022). He filed a formal complaint with the university to no avail; the university denied their role in creating a hostile environment.

A 2021 study looked at a data set of 2,531 tenured and tenure-track geoscience faculty from 62 universities in the United States to evaluate the proportion of women by rank and discipline finding 27% of faculty are women but of those women, the fraction decreases with rank, as

women comprise 46% of assistant professors, 34% of associate professors, and only 19% of full professors (Ranganathan et al., 2021). As an attempt to move away from the “leaky pipeline” analogies, using what they coin as a “fractionation factor” (a play on isotope fractionation) to describe the rate of loss of women along the tenure track, the authors of this work operate as though adding familiar scientific jargon and numbers to the issue makes it better or more palatable. To me, this makes the work seem more trivial, but also proves these authors no their audience. Without such jargon I hesitate to think that white male geoscientists would care or be engaged in a paper about gender disparities.

The authors (Ranganathan et al., 2021) note as a caveat to this work that, “due to significant disparities in race, this work is most applicable to white women, and our use of the gender binary does not represent gender diversity in the geosciences” (Ranganathan et al., 2021). Yet the communication of findings is exactly what is wrong with how scientists communicate about issues of diversity and inclusion—they deploy statistics, numbers as markers for objectivity. Objective, statistical, numerical, empirically derived information is the only way to get across to these the majority of geoscientists. But people are not numbers and cannot be summarized as such. Sadly, the authors of this article are a group of women, half of whom are women of color, meaning that while fighting for gender equity in the geosciences for themselves, they cannot get even use their statistics to express their simple markers of identity like race. Regardless of personal stories and struggles, this study does not even encompass the most marginalized in field statistically because the information does not exist.

Having to write in a way that appealed to their colleagues adding to the stress and personal workload while shouldering the discrimination and stress of writing about it, is a truly awful burden for these women to face. Not only is this diversity and equity paper not in line with the authors' academic research, but most of the outreach listed on the lead authors website, is for graduate and postdocs in MIT, an already well funded, top 10 geoscience program, showing how deeply the neglect of care of underrepresented scientists are felt. In addition to that, the article affirms the idea that people of color are often given the burden of educating white people on their own marginalization. Making it so some of the department's only women of color must fight for diversity as PhD students shows how the responsibility to diversify is placed squarely on the shoulders of those already marginalized. The women of color co-authored syllabi to educate the department about, "Racism, Colonialism, and Extraction in the Geosciences", co-authored a DEI Action plan, and more. To make matters worse, half were not able to speak fully to their experiences as women of color because the data does not even exist. They did all of this while making headlines, creating accessible content for the geoscience community, and trying to graduate just like everybody else with doctorate degrees (*Members*, 2021).

The problems of diversity in geoscience go far beyond what funds and "ambassadors" can fix, especially when it is the very same people who are being marginalized that are forced to be the ones to fight for diversity in the discipline. Band aid fixes will not, fix much of anything especially problems that are historic in origin. The geoscience community has done little on the scale of improving outreach and involvement to address the source: systemic racism. Failing to seem as relevant or interesting as aspects of biology, chemistry, and physics, the geosciences begin to face educational deficits as early as elementary school. Diversity in geoscience should

not simply be an attempt at increasing racial diversity, but also should be in line with increasing what it means to be a part of geology. Incorporating different mindsets and approaches to earth processes is essential, but too often there is an emphasis on the optics and performance of diversity through the tokenizing and spotlighting of the few people of color that persist.

White Geology

America is inherently a “white” country: in character, in structure, in culture. Needless to say, Black Americans create lives of their own. Yet as a people, they face boundaries and constrictions set by the white majority (Guess, 2016)

In early America, the study of geology was formally limited to the educated white male aristocracy in much of the 18th and 19th century. As geology gained public recognition and acceptance in the 19th century, the belief in manifest destiny drove white settlers to expand rapidly into the West (Nyblade et al., 2021). Geological mapping played a significant role in, “identifying which lands were profitable for U.S. settlement through gold and other natural resource extraction, agriculture... leading to the widespread removal of Indigenous Peoples from their homelands, genocide, and harm to their knowledge systems and lifeways for the sake of profits” (Nyblade et al., 2021).

Kathryn Yusoff argues in her book, *A Billion Black Anthropocenes or None*, “White Geology makes legible a set of extractions, from particular subject positions, from black and brown bodies, and from the ecologies of place. The collective functioning of geologic languages coded—inhuman, property, value, possession—as categories move across territory, relation, and flesh” (Yusoff, 2018, ch. 1). We see this language and practice perpetuated today in areas such as oil extraction, the government control of public lands, perceptions of low wages, and select job

opportunities for recent graduates in the field (Dutt, 2020). All of this reinforces geology's extractive nature, which is often cited as a reason that geology struggles to be more inclusive.

We can understand this simply by looking at the type of language and vocabulary that is used in geology, a problem that many sciences share when speaking of accessibility. There is often a disconnect between technical communication principles and scientific practice in regard to jargon (Leonard, 2021). And when it comes to naming, none of the theories, formulas or principles I have learned about in geoscience classes have been credited to people of color. I know because I look almost every time. An example of this is within my Mineralogy class which covers the chemistry, crystal structure and physical properties of the mineral constituents of rock, we look to identify. Minerals form the Earth and are literally the foundations of our lives as they make up soils, rocks, sediments and give us vital nutrients and resources. There are over 5,800 minerals according to the IMA that have been identified (Rao, 2022) and one of the things we discuss is who names them and who are they named after. Not every mineral is named after a person but out of the hundreds that are, I found only 4 that are named after people of color all of which happen to be Asian men, Junitoite, Davemaoite, Zhanghengite, and Zaherite (Andraos, 2011). As bell hooks states in her book, *Teaching to Transgress*, "the privileged act of naming often affords those in power access to modes of communication and enables them to project an interpretation, a definition, a description of their work and actions, that may not be accurate, that may obscure what is really taking place" (hooks 1994, p. 62).

It is rare to never that I hear about a person of color in geology for their accomplishments in the field opposed to their life story or identity. hooks refers to this phenomenon: "all too often we

found a will to include those considered “marginal” without a willingness to accord their work the same respect and consideration given other work” (hooks 38, 1994). Telling stories of inspiring people of color without explaining their accomplishments is a true disservice to them and to the entire geoscience community. I bring this up as my previous section, Diversity in the Geosciences, highlights the need for change but I am also critical of the way that “diversity” is executed. The geoscience community needs to do more than highlight BIPOC and underrepresented figures, at the bare minimum, to reconcile in a meaningful way its historic ties to white supremacy. Talking about positive history and achievements of those who are marginalized does not acknowledge the harm of geology but rather does the opposite in trying to erase and overlook the issues that laid the foundation for present exclusion. Further examples of this will be explored in Part 2.

Throughout history of geoscience in America, it has looked like and been informed by white people. Yusoff continues to say that “White Geology ” acts as, “a mythology of disassociation in the formation of matter independent of its languages of description and the historical constitution of its social relations”(Yusoff, 2018, ch. 1). When asked about how geosciences have progressed in the recent past, many geologists will point to an increase in gender diversity, as the founders of GSA and the most well-known and referenced geologists were entirely men until the late 20th century, the field becoming even close to equal in gender representation is a huge departure from its roots. But even so, this is change is a nearly all white increase in the number of women in geoscience. It is beyond the mindset of most geologists to observe this change as anything but positive. But in reality, it is simply an expansion of white supremacy within the discipline. As discussed in the previous section if the only data being measured regularly is of white women

and men, then it is impossible to know the true extent to which non-white people have been excluded from the discipline. This erasure too is likely intentional. As Kendall notes, “White women aren't just passive beneficiaries of racist oppression; they are active participants (Kendall, 2021)”. By allowing for the inclusion and diversification of geosciences to be expanded to white women, appearances are kept up, but true equity is not achieved as diversity of one identifier does not align with intersectional ideas or uplift the margins. In reference to feminist studies bell hooks says that “the assault on white supremacy made manifest in alliances between white women academics and white male peers seems to have been formed and nurtured around common efforts to formulate and impose standards of critical evaluation that would be used to define what is theoretical and what is not. These standards often led to appropriation and /or devaluation of work that did not ‘fit,’ (hooks, 1994, p. 63). The same can be seen in what values and ideas are upheld by white supremacy in the geosciences. From pushes for diversity from women of color at an institutional scale to something seemingly as insignificant as the dynamic of a classroom, people of color in geosciences are made to feel as though they do not fit at any level.

Solutions for resolving the gender gap such as promoting networking and media representation of women scientists are great but what is needed is much more intersectional than the white women often seen today. In fact, as far as representation of women goes, the percentage of women earning PhDs has steadily climbed in all subfields; and in the ocean sciences, since 2009 the number of women has even surpassed the number of men earning PhDs (Bernard et al., 2018). Women briefly outnumbered men in the earth sciences for one year (Bernard et al., 2018). But with that in mind the increase in diversity is wholly unequal as women of color only make

up a mere 330 or 1.46% of total Ph.D. recipients as of 2018. Even worse, only 69 Black women have received Ph.Ds. in geoscience between 1973 and 2016 or about 0.3% of total degrees (Bernard et al., 2018).

One way to explain some of these inequities is through a concept discussed in Black theory is the otherness of Black people and experiences. For a long time into the 20th century, the representation of Black people was controlled entirely by white men whose naturalization was contingent on the establishment of difference (Finney, 2014, p. 71). By “fixing” difference and determining that difference to be “natural” as opposed to cultural, these representational authorities have ensured that Black representations are then “beyond history, permanent and fixed” and are relegated to an ideological and discursive place where meaning is protected from the possibility of change (Finney, 2014, p. 71). This highlights how the language of “natural” and ideas of its implicit definitions have been weaponized against Black people and our personhood.

Connecting more to Yusoff’s claims of exploitation and codification of resources, Finney calls attention to the “legacy of making people of color signify the natural” (Finney, 2014, p. 38). This happens among every race in different and nuanced ways. Exploitation of marginalized people and the natural environment have continuously gone hand in hand. The historic impact of whites viewing Black people as part of the natural world is that Black people are treated, “with the same mixture of contempt, false reverence, and real exploitation that also marks American environmental history—inevitably makes the possibility of an uncomplicated union with the

natural world less readily available to African Americans than it has been to whites" (Finney, 2014, p. 38).

Although under researched in its direct connections to geology, race and racialization have been profoundly impacted by. Science has actively sought and been weaponized to define the Black body as subhuman. Dehumanization and animal imagery have been used for centuries to justify violence, specifically slavery, against Black people (Rabinovitz, 2008). Yusoff says, "to trace racial matterings across the category of the inhuman, and specifically the traffic between the inhuman as matter and the inhuman as race, is to examine how the concept of the inhuman is a connective hinge in the twinned discourses of geology and humanism. It is a hinge that establishes an extractive axis in both subjective and geologic (or planetary) life" (Yusoff, 2018, ch. 1).

Part 2: Constructed

In Summer 2021, my advisor suggested I explore the field of geology. I was struggling to find a science that felt applied and relevant to how I viewed the world, a science that I could use as a tool and framework to improve the conditions of my community while also serving as my major concentration within Environmental Analysis. I was about to enter my junior year of college and the urgency of finding the proper major concentration had set in. At that point the only thing I knew about geology was that it studied deep time and rocks, so my advisor recommended I talk to a department faculty member. I reluctantly agreed. This reluctance was because I had yet to meet a STEM faculty member that, upon first meeting, had noticed my personhood. Certainly, faculty I had worked to build relationships with and had spent a semester in class with were kind, but others would not give me the time of day to engage in my genuine curiosity. Or they would

engage until I mentioned the idea that their disciplinary studies could have broad impacts on society. And they would completely shut down if I brought up social justice, race, or community. To make things worse the only thing I knew about the geology faculty at Pomona College was that they were an entirely white department and I had never even considered taking a class with them.

And yet on a random unusual rainy summer day I sat and somewhat shakily opened a zoom call anticipating a brief uninspiring conversation about the requirements for the geology concentration that I had already read a long-winded description of. But within 5 minutes of opening my zoom, something told me this would be different. I distinctly recall the excitement and all-encompassing relief I felt when the faculty member asked me where I grew up and proceeded to list everything he knew about the geology of Long Beach. Talking of oil, of faults, of beaches, of its age and so much more. I was awestruck that despite thinking I knew nothing about geology, I seemed to know so much about it in that moment as we engaged in conversation about the impacts of infrastructure constructed to support these parts of my home and its geology. He talked to me for over an hour on zoom explaining to me generally what geology was about, answering many of my random often google-able questions. I ended the conversation asking something I had feared to ask a scientist since my precollege internship: can geology be used to improve health, safety, and justice in my community? With moments pause, the faculty member told me he had never thought about it like that, but that the answer was certainly yes. Somewhere during the call, the rain had finally stopped, the storm had calmed.

Institutional restraints and structural racism that I discussed in Part 1 are not the only constructed boundaries in a field like geology. When individual minds can be closed off to further exploration and education on new frameworks, change is still possible. Even having that short conversation with a geology faculty member showed me that expanding even the smallest part of someone's perspective is possible. Even in the case of the expert faculty member, it was simply a willingness to listen to a different perspective that allowed him to change the idea of how he constructed the discipline in his mind. And in doing so, he changed the course of my college and academic career forever.

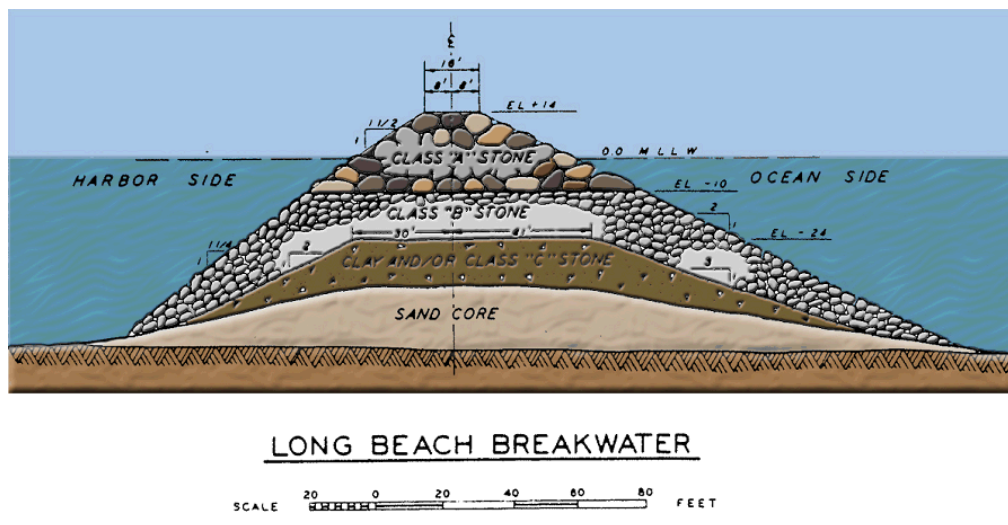


Image 3: Breakwater cross section illustration (Zell, 2015)

Breakwaters are made out of two key components: sand and stone. The breakwater became one of the most obvious examples for how geology, people and justice could merge. Its deceptively simple construction of sand and stones has become a point of contention between public and elite government and corporate interest. The structure was the first thing I thought of that defined both Long Beach and geology.

The Long Beach Breakwater, amassing a 2.5-mile-long structure of concrete, boulders, and rocks, was constructed in the 1940s to shelter the U.S. Navy Pacific Fleet. The ships are long gone, but the massive structure remains, trapping water near the shoreline by inhibiting the natural flow of the ocean currents. The structure impairs swimming and water-based recreation due to trapping elevated bacteria levels, trash, and debris in the water and along the shoreline. These bacteria and debris come from both container ships and the LA River draining into the ocean. According to a 2010 report by the U.S. Army Corps of Engineers, in Long Beach “an average of 4,000 tons of trash and debris is deposited on City beaches annually” (Army Corp of Engineers, 2010).

An argument in favor of maintaining Long Beach’s breakwater is that it allows the city to make economic gains. Without the breakwater, the wave action would erode the islands. These artificial islands are used to tap into what remains of the third largest oil field in the United States: Wilmington Oil Field. The islands are operated by the oil operations manager for the Long Beach Gas & Oil Department. In 2020, revenue from oil production funded \$18.9 million of the city’s budget. Additionally, the Port of Long Beach has a lot at stake, as the breakwater prevents long wave action from rocking barges as they unload and protects their infrastructure as well (Orlowsk, 2014).

While there are plans by the city of Long Beach to slow oil revenue dependance as it becomes less profitable and increasingly depleted and to stop this industry’s contribution of revenue to the city completely by 2035, Long Beach is becoming more dependent on the Port of Long Beach.

The port has been expanding its capacity for larger ships and increasing revenue by 11% or about \$45 million dollars in a single year (AJOT, 2022). This maintains the breakwater's relevance to the city and makes any action trying to remove it seem unlikely.

What does it mean for something constructed to sit in the middle of our shoreline? What impacts does this have on the greater communities? What does it mean to value economics over human health and wellbeing? How does it change the landscape? And how do I, as a community member and student, learn from this and other economic investments such as the oil field as it relates the rest of the community?

Environmentalists and scientists say that the benefits of the breakwater are preventing coastal erosion and the breakwater asking for new habitats for marine life. But what are these habitats and how did they come to exist is rarely asked. What habitats were destroyed in the construction of the breakwater? If marine life survived for millennia without it, does it really benefit them?

I frequently find push back when questioning the foundations and constructions that shape my experiences in the natural world, in the classroom, and at their intersection in geology. Part 2 of my thesis is a summation of lessons I have learned and reflected on in the process of learning about geology in the classroom. What I see happening in my hometown now and how early curriculum can be a catalyst for more students to discover geology. I will look at how the building and framing of the breakwater parallels challenges associated with educational standards and processes.

Geoscience Education and a Black Experience

In 2014, Southern California felt the effects of Hurricane Marie. The heavy waves generated by the hurricane caused major damage to the Long Beach Breakwater, with the middle section of the breakwater taking the brunt of the impact (Garcia et al., 2019). Through evaluation it was decided that repairs needed to happen. Since then, there has been strengthened resolve concerning whether to continue to provide its upkeep or to destroy it. Similar conversations have been surrounding “making space” for marginalized voices across academia and all institutions (hooks).

My first experience being excluded in a STEM class started as early as fourth grade and has persisted every year to the present. More so and differently than the racism that would follow me in the social sciences and humanities, this was a complete erasure of self and identity. Educators in STEM often act “color blind”, as they claim race has no relevance to the topic areas they teach. But how do you expect students to leave their identity at the door when white educators and their peers most certainly do not, constantly weaponizing their power and privilege?

Psychologist and educator Dr. Beverly Tatum asserts that we are not living in a color-blind society as often suggested but rather a “color-silent society, where we have learned to avoid talking about racial difference” (Tatum, 2017, p. 31). I was not only the only Black person in all of my honors and AP science and math classes in high school, but I was sometimes the only woman. My race in these classrooms was never mentioned, but it often felt like it should be. How can someone look at this classroom and call it equal? How can someone teach about the environment and not touch on environmental justice? I was often praised for the bare minimum but if I achieved beyond my peers or received higher grades, I was seen as a threat.

hooks suggests that there is a great challenge in teaching in a “multicultural” classroom setting as learning how to teach well in the setting of diversity looks different given the makeup of the classroom. She observed that “often, if there is one lone person of color in the classroom she or he is objectified by others and forced to assume the role of ‘native informant’” (hooks, 1994, p. 43). As someone who often works as the “native informant”, or the one to serve as the sole orator of my culture, class, and gender, it took me so long to see myself as anything other than the root of the problem. I was “othered” so profoundly that it became impossible for me to see the spaces, particularly in school as being the proprietor of antiblackness and not that my blackness was a problem.

The making and remaking of anti-Black discourses that we see today in theory, media, and higher education spaces, have the capacity to instill in students a set of truths about Black people. Because children enter school as young as 3, how anti-Blackness is framed through received curricular knowledge can be specifically dangerous. Schools are spaces where students receive knowledge about academic disciplines, including language, math, history, and geography. This knowledge is often not presented as contested or partial, but rather as the “truth” about disciplines (Grant et al., 2020, p. 74). Students are expected to acquire this knowledge and then show evidence of its acquisition through the use of standardized tests. Thus, knowledge in school curriculum has “a powerful, hegemonic quality” (Grant et al., 2020, p. 74). Returning to hooks assertion that the power of being able to name gives way to privileged access, communication, and most importantly dominant interpretation, the current constructions of education as I and many other Black students have experienced are far from a universal “truth” let alone our truth. K-12 curriculum has influenced my self-perception from historic depictions to the present-day

erasure of Blackness from science. I look to evaluate how education in Long Beach and beyond has likely not been adequate in making me and others feel like our “truth” even exists let alone that we feel represented in what we learn.

Elementary Earth Science Curriculum

In 2013, about two years after I completed the 5th grade, the State Board of Education (SBE) of the California Department of Education adopted the Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve (*NGSS for California Public Schools 2022*). Overall, the new standards emphasize critical thinking over rote memorization, more hands-on science projects, and requires students to collect and use data, with a focus on students giving an evidence-based explanation for what they discover. But the national science standards (i.e., the Next Generation Science Standards (NGSS)) also are specifically designed to “provide a globally competitive STEM education for US students” due to the key role STEM plays at ensuring economic development and competitiveness (Williams et al., 2021). Within this framework, science education is important not for the role it plays in producing environmentally or socially just and healthy societies, but because of the economic and political value it holds (Williams et al., 2021).

Fifth grade is the first real introduction to earth and physical sciences in the state. The Department of Education sets nine science standards for fifth graders divided into the following: two life sciences, three earth sciences, three physical sciences, and one engineering science. A study by the National Survey for Science and Mathematics Education shows that elementary school teachers spent three times as much time teaching math and English language arts in 2018

as they did science, adding up to about 27 minutes per day of science instruction (*Report of the 2018 NSSME, 2018*).

The NGSS states it is not a curriculum and that development of equitable and meaningful science education based on the standards should be taken up by local school communities (Hoeg, 2017).

To find curriculum that aligns with the NGSS, Long Beach looks to Amplify, a private curriculum and assessment company that is currently owned by the Emerson Collective. The Emerson Collective was founded by Laurene Powell Jobs, widow of Steve Jobs, and is a for-profit corporation focused on education, immigration reform, the environment, media and journalism, and health (Harris, 2018). Amplify's science program has been adopted by several large urban districts, including Chicago, New York, Denver, and Los Angeles. In all Long Beach Unified School District elementary schools, curriculum from Amplify Science is being used to guide all lessons. Amplify serves 15 million students across all 50 states and in California, it is the "#1 most adopted California NGSS curriculum" (*Amplify, 2020*). Developed in part by the University of California Berkeley Lawrence Hall of Science and funded by the National Science Foundation there is no obvious reason to call into question the legitimacy and quality of content produced (*Amplify, 2020*). I soon realized this may not be the case, upon receiving resources from a teacher and accessing what free information that was made available to me via the Amplify website.

Situating Science Curriculum as Relevant

The first resource I found was from the Earth System lesson guides. The lesson and its associated book are both called, *Drinking Cleopatra's Tears* (*Amplify, 2020*). Its purpose is "to provide an

opportunity for students to reflect on the concepts of evaporation and condensation that they have learned in this chapter and to think about how they apply to the Earth system more broadly” (*Amplify*, 2020). What confused me upon reading this lesson and its associated book was not the content being taught but rather the delivery. Students in the state of California do not learn world history until the 6th grade so it is unclear why a reference to Cleopatra is relevant to the subject. Additionally, the book never seeks to clarify why Cleopatra was chosen as her name is mentioned only five times and over only two pages. The concept of water moving globally and over history being articulated through Cleopatra feels like a lazy and performative choice to feign representation as many of the book's characters are also drawn with different skin tones. The book makes no additional mention of specific people or historic figures.

The author of the reading, Kevin Beals, has authored nearly a dozen other books on the natural world and none of these books utilize a racialized historic figure in the title and of the three others I was able to review, none include even included people. The choice to use Cleopatra is one I find troubling because of the controversial and political use of her portrayals in media. Scholars have articulated that before discussing who Cleopatra was, we must “be honest that any casting of Cleopatra is one that conforms to a modern political desire or social fantasy, whether that fantasy is of a White antiquity or a desire for inclusive representation in popular media” (Kennedy, 2020). With competing visions for who Cleopatra was, broader conversation about racializing or attributing historic figures’ race even through suggestion of tan skin tone are brought into question. When scholars push the idea that “her family tree defines her Greekness, Egyptianness, or Africaness, or even her ‘race’ at all, they perpetuate the idea that the modern racial identities we inhabit are universal across time and place” (Kennedy, 2020). Bringing these

ideas into a science classroom is impossible to deal with without properly addressing the underlying historic tension and this author does not even attempt to do so.

Studies have shown time and time again that it is “clear that many students have had unpleasant experiences with science education, and one of the most common complaints is that science lessons seemed to be pointless memorization of information that had no relevance of their lives” (Dolan et al., 2009, p. 2). While I know this to be true from my experiences, the misuse of information to try to assert relevance as with this odd framing of Cleopatra, can be even more damaging than trying to form no social relevance at all. While socio-scientific issues (SSI) have considerable potential to improve science education in elementary school, practicing this is hard under the current educational system that remains anti-Black. The problems of geoscience education, include whose lens and constraints we use to define fundamental principles and process. Recalling hooks, the privileged act of naming often affords those in power access to modes of communication and enables them to project an interpretation (hooks, 1994, p.62). By introducing Cleopatra with little background of who she was, it suggests that this may be racialized and attempts to make her “apolitical” by erasing her history and the history of contention. Tatum asserts that even if we “refrain from mentioning race, the evidence is clear that we still notice racial categories and that our behaviors are guided by what we notice” (Tatum, 2017, p. 31). Amplify’s commitment or lack of commitment in understanding racial and marginalized identities jeopardizes children’s views of self and jeopardizes their learning. But this seems unsurprising from a company whose statement on “Diversity Equity Inclusion and Accessibility”, is mere 5 sentences long.

Exploring a lesson plan, I was sent by a local teacher titled *Carbon in the Global Ecosystem* there was no specific mentions of historical figures and the lesson asks students to think about how “the amount of carbon in a closed ecosystem does not change, so when the amount of carbon changes in one part of the system, it must also change in some other part of the system” (*Amplify*, 2020). This lesson relies on the use of an article to teach students about how carbon moves through the Earth system and how the burning of fossil fuels is changing the distribution of carbon in the system. What I find most interesting about this lesson is that without mentioning people it has a greater potential to promote social and spatial awareness to the environment than *Drinking Cleopatra’s Tears*. While mentions of dinosaurs and historical figures, may be fun and illustrative in *Drinking Cleopatra’s Tear*, they do not allow for the seeing of self in the environment or for an effective grasp of technical concepts without being muddled by other factors. Returning to the socio-scientific issues (SSI), we see that studies clearly show, “it is imperative the students have a solid comprehension of elementary science concepts being discussed prior to implementing SSI techniques” (Dolan et al., 2009, p. 2). These SSI techniques focus on creating interdisciplinary connections that are authentic, relevant, and meaningful to society (Ewing et al., 2020). For example, when looking at the water cycle, you cannot avoid connections to water pollution and treatment today. In examining water pollution, we must talk about social systems like government as well as science to understand the full consequences of pollution (Ewing et al., 2020). But by introducing these interdisciplinary concepts simultaneously, educators risk a misuse and misunderstanding of concepts among students (Dolan et al., 2009, p. 2). *Carbon in the Global Ecosystem* highlights hands on activity to reinforce scientific concepts prior to introducing fossil fuels and cross lesson connections to

climate change but does so chronologically, integrating them at different stages of the lesson and thus avoiding confusion (*Amplify*, 2020).

Both lessons address a number of NGSS Disciplinary Core Standards with both addressing of parts of ESS2. A Earth's Materials and Systems. While the (5-ESS2-1) used in *Drinking Cleopatra's Tears* makes explicit mention of the biosphere and human interactions in the environment, (MS-ESS2-1) addressed in *Carbon in the Global Ecosystem* mentions only "living organisms" explicitly when talking about life. But overall, they aim to accomplish the same goal of helping fifth graders grasp earth systems and are contrasting examples of elementary earth science curriculum. Amplify's curriculum is varied and ultimately up to the discretion of the educator using them to determine their effectiveness. But the variation between lessons is not something to be overlooked as proper science education has both individual and societal ramifications for students in deciding if they want to continue on studying science in the future formally or informally (Dutt, 2020).

Making Science Relevant: Urban Geoscience

According to the Census, 80.7% of the US population lives in an urban area (US. Census Bureau, 2021). Yet, much of the geoscience curriculum does not cover any of the built environment. Many studies have shown that place-based education, regardless of the discipline being taught, boosts student achievement and improves environmental, social, and economic vitality as students learn to take care of the world by understanding where they live and taking action in their own backyards (Powers, 2004, p. 17). So how are students living in urban space supposed to learn about geoscience in a relevant, placed based way when the field has limited to no

existing literature on “urban” geology? These human constructed landscapes have often been discredited as less natural and less relevant to environmental histories we choose to focus on being visions of pure and untouched landscapes (Rosen et al., 1994). This disconnect between the lived and the learned experiences has been a continuous struggle in asserting my perspective on the environment being fundamentally shaped by my experiences growing up in an urban environment, one few in my geology program. When speaking of the relevance of science it is impossible to overlook the disregard for teaching of curriculum relevant to urban environments. The idea of urban geoscience works to change that.

Urban geoscience broadly defined is the application of the earth sciences to problems arising at the nexus of the geosphere, hydrosphere and biosphere within urban and urbanizing areas. It is not widely thought about in academic and industry contexts (Wilson et al., 2016), but rather it is thought of as a tool and framework to encourage further participation in geoscience. With roots as early as 1930s, formal involvement in urban geological studies began in the 1970s, with Jackson mapping and investigating patterns of natural and human erosion and sedimentation as a part of the San Francisco Bay Region HUD study and Wilson investigating the surficial geology and geoarchaeology of Calgary (Wilson et al., 2016). Both men talk about how urban geology is often overlooked because of the assumption that construction of infrastructure prevents studies of landscape, but in reality, construction allows small excavations to occur constantly, briefly revealing soil, unconsolidated material and rocks providing valuable new data and interpretations (Wilson et al., 2016). With the collection of these temporary exposures can, allow three-dimensional mapping of geological units, especially of Quaternary sediments, which also happen to make up a large part of Long Beach’s geology.

Actualizing these place-based and urban geology methods have proven to be a challenge.

Although methods such as involving urban residents in citizen science projects educates them about the geology of their local area, which has been a constant challenge for geologists, it has been an important component of outreach, especially in areas at high risk from natural hazards and climatic shifts. This also allows residents to engage with and become more informed about environmental decisions being made in their communities (Wilson et al., 2016).

Starting in the early 2000s there was an increase in surveying curriculum in geoscience that focused on urban environments, with the idea that effective curriculum could be based on everything from skyscrapers to schoolyards. Some studies on the topic suggest that perhaps good urban geoscience education is simply good geoscience education (Abolins, 2004). “Good geoscience education” meaning the effectiveness of education that is being place-based and grounded in the strength of pedagogy and delivery. While this “urban” curriculum was used sparingly, so far little research has been conducted to evaluate to see if the curriculum improves outcomes or understanding of geoscience foundations. And with poor upkeep done to maintain and update resources, example syllabi and course guidance is outdated and hard to find from geologists like Abolins and beyond. The United States Geological Survey (USGS) has a long list of lesson plans and activities relevant to different science disciplines that are free and accessible. But the website lacks any geology specific lessons that explicitly teach about urban or built environments (*Lessons Plans & Activities 3-5*, n.d).

Overall, geoscience education at the elementary school level needs work in maintaining relevance and the effective communication of concepts. The establishment of new state standards in science the NGSS are not enough to promote improved STEM education. More resources and time must be devoted to formal and informal geoscience education starting from a young age.

Part 3: Wave Action

Yet we make our lives among relics and ruins of former times, former worlds. Each of us is, too, a landscape inscribed by memory and loss (Savoy, 2015, p. 19)

My next-door neighbor, Ms. Doris Topsy Elvrod is my definition of Long Beach royalty. She taught me everything I know about local politics. Not only was she beloved by the community for her phenomenal wit and care for all she also made a mean peach cobbler and a great friend.

In summer 2019, while I worked at the Port of Long Beach, Doris would tell me about her time there and how she worked her way up in local politics. She was a member of the Harbor Commission and was credited as part of the reason the Green Port Policy came to be in Long Beach. The Green Port Policy was adopted by the Harbor Commission in January 2005 with the objective to protect the community from harmful environmental impact of Port operations, promote sustainability, engage with the community, use the best available technology to reduce emissions and to distinguish the Port as a leader in environmental compliance and stewardship (Kanter, 2012). Doris pursued a degree in chemistry but instead found her love of public service taking hold. Her list of achievements is long and her impact even greater, she served as a commissioner for the city, was twice elected as vice mayor, and opened the African American

Heritage Society of Long Beach (*Doris Topsy-Elvord, 2022*). She told me who to get to know and who to avoid. Most importantly, she told me about all of the people who came before me. She passed late last year at the age of 90 (*Doris Topsy-Elvord, 2022*).

My many conversations with Doris gave me the courage to be the first in many of my academic pursuits. She showed me where I came from and shared with me the many memories of her time battling segregation in school and the workplace. The power of her memory and the memory of my many community members is enough to motivate me and lift me up to do what's often equally hard as it is potentially beautiful. She showed me the beauty of making waves and the potential for them to create change.

In reflecting on my past few years exploring geology, the fact of geology as a whole and the Pomona College geology department being white -- and thus lead by white, western ideals -- are not things I see changing anytime soon. They are protected from change by institutions and knowledge foundations that have strong support behind them. But in the few moments that I think about where I started, testing the water, experiencing tender moments of shared memory and livelihood with my next-door neighbor, or having exchanges with open minded faculty, I begin to feel a bit warmer for just a second as I still stand in the water. Things systemically and overall are not made less oppressive, but I am simply made stronger and more empower through the courage of others. These moments are not enough to tear down constructions of white supremacy or to let the full force of change approach me wading at the shore, but these moments of inspiration build the momentum for waves to form to cause a little damage to the way these structures have limited my own change and growth. This energy has been enough for me to

begin to visualize what a future could look like in geoscience, in the depths of the open ocean that lay past the breakwater.

“Radical Openness”

I am the first to admit that I have much to learn. But there is much that I have come to realize that I have accomplished. Some of these accomplishments have been due to community support and care and the instillment of a mindset I learned from bell hooks: radical openness, a concept rooted in persistence through the process of being “other”, to being the native informant, to being the only black queer disabled environmental scientist and geologist I know in higher education. hooks says that “those of us who live, who ‘make it’, passionately holding on to the aspects of that ‘downhome’ life we do not intend to lose while simultaneously seeking new knowledge and experience, invent spaces of radical openness” (hooks, 1989, p. 19). I plan to make my own waves and have begun to do so in the Pomona geoscience community. I have been open to conversations and asserting my authentic position in moments of contention, I have done the work to educate myself on the challenges that other marginalized people face in the geosciences, and I have done my best to not let the trials of existing within spaces in geoscience break me down.

I may not yet be in a place where I can work against any of the systemic injustice, I mention in Part 1 and Part 2, but I have learned to hold strong in my perspectives and create space. Through the fostering of community, reliance on friends willing to listen to me, finding professors who have encouraged me, and through the creation of a quasi-cohort program, Equity in the Environment, I have “survived”. As hooks says: “without such spaces we would not survive. Our

living depends on our ability to conceptualize alternatives, often improvised. Theorizing this experience aesthetically, critically is an agenda for radical cultural practice” (hooks, 1989, p. 19). When I was unable to find a space for myself in the geosciences, I decided to help create that space through the Equity in the Environment group. With geology and environmental science being the only science majors at Pomona College that did not have an administrative run cohort, I decided it was time to make an alternative. A student run collective that helped build community, confidence, and knowledge for unrepresented students. The formation of this group has been a constant learning process and it is by no means the most organized or radical space to exist, but it is a start and a chance for future students to build with an existing foundation.

Despite creating this support within Pomona College, I want to continue to promote and explore what change means on a larger scale within the geoscience community as this space of “radical openness” I have created at Pomona is temporary and not stable. hooks says, “this space of radical openness is a margin - a profound edge. Locating oneself there is difficult yet necessary. It is not a ‘safe’ place. One is always at risk. One needs a community of resistance (hooks, 1989, p. 19). By continuing to assert and develop my perspective in new spaces I hope to form this community of resistance.

Transformation: Marginality as Resistance

Many Black theorists have discussed ideas of margins. The margins are escape but not yet freedom as Sexton says, “an anti-black world that shapes and structures every aspect of black existence, except—or including—whatever escapes. Fugitivity is not freedom, or not yet” (Sexton, 2016). This fugitive margin is a method used extensively in Black history and

something that I will continue to occupy. But part of the problem with this space I occupy in geoscience is that it is not space I have been given or possess – it is in flux, moved, and changed by the many people who can influence it. The space at which this thesis occupies, for example, is at the margins of a discipline of science unwilling to fully accept it or allow it.

How to remark what is always already marked?... It may be that the remedy to dispossession lies not in the spirit of claiming or reclaiming possession but in the paradox of an even greater and willed dispossession. But how, under constant assault, to defend what cannot be possessed? (Sexton, 2016)

I am constantly being tested and trying to be removed from the space I occupy, and this will be by burden to bear in the margins for the foreseeable future. I do not own geology or dictate its usage and there is something powerful behind the idea that no one does. My ideas seem radical, but truly I want to visualize geoscience to be all encompassing, a web of connections, an umbrella. Similarly, to how environmental justice connects everything from the carceral system to housing to food, I think geology can do just that and assist environmental justice movements.

Lauret Savoy begins to do this beautifully in her book *Trace: memory, history, race, and the American landscape*. As a professor of geology and environmental studies at Mount Holyoke, she explores and reflects on her ancestry in the context of the American landscape while she simultaneously draws upon geology in a new and fascinating way. From faults, to plantations, to burial grounds, to the Pacific Ocean, she makes sense of childhood lessons and the beauty of pasts known and unknown. She also speaks of possession and slavery in the chapter “Properties of Desire”. She asks, “who owns memory” and that is something I have constantly reflected on (Savoy, 2015, p. 89). Throughout my thesis I have examined dominant narratives and through doing so, have been shown the power in counternarratives and telling my truth. In expressing my memories throughout this thesis, I have taken as close to ownership as possible over how I think

about geology. There are so many narratives that don't match mine and in looking for this margin to exist in, I aimlessly looked for narrative that could reflect even part of my own instead of documenting my own. In this documentation, I have memorialized my counternarrative. Geology could benefit from centering these "marginal" narratives further and investing in stories that expand the definition of geoscience.

Weathering: Geoscience in Black Thought

Theory is not inherently healing, liberatory, or revolutionary. It fulfills this function only when we ask that it do so and direct our theorizing towards this end (hooks, 1994, p. 61)

Direct connections between Black studies and geology are seldom mentioned. Despite this, Black theory has often utilized elements of the earth processes in work connecting it to everything from Christina Sharpe's writing on the afterlife of slavery to Octavia Butler's speculative fiction. This intersection is where I find solace and stability. Knowing that I will not be the first nor the last person to express artfully and often painfully their and their communities' experiences of anti-blackness. It was people like Sharpe, Butler, and hooks that first showed me what hope and historical reckoning looks like through theory.

Christina Sharpe poses the question, "What must we know in order to move through these environments in which the push is always toward Black death?" (Sharpe, 2016, p. 106). She asserts that the "Weather" is the totality of Black peoples' environments; the weather is the total climate; and that climate is anti-blackness as 'the singularity.' The singularity being an "infinite mass density, final state of matter before black hole and at the same time a weather event or phenomenon that occurs in particular time/date/circumstance" (Sharpe, 2016, p. 106). Weather is

a concept known well to many in our day to day understanding of temperature, wind, moisture, etc. Weather is much more than that to geologists, weather is one of the fundamental processes that shape the Earth. Sharpe continues to say that weather necessitates changeability and improvisation and that it is inherently temporal producing foster and surrounding new life/ecologies in its atmosphere (Sharpe, 2016, p. 107). In geology, the process of weathering breaks down the rocks and soils into smaller fragments and then into their constituent substances. Weathering can act as waves crashing into a breakwater for example chipping stones and fragments loose, transporting them back to shore and sweeping them out to sea. In drawing parallels between antiblackness and weather, Sharpe points to the constant change and many forms that Black life has had to take throughout history due to slavery and the afterlife of these systems. Even when trying to move past the storm or weather that goes as quickly as it comes, we cannot ignore or brush off the reality of slavery in the past, we cannot ignore the truth that subjugation of Black life continues today. This is something the geoscience community has yet to reckon with. The constant production of new ways of thought that Black people create to resist white supremacy are not enough to stop the storm. I take from reading Sharpe's work that no one event regardless of its inevitability of repeating, but the totality of the environments in which Black people struggle, the machines in which we live, are what Sharpe calls the weather.

Sharpe demonstrates the strength the Black people have employed to resist normal constructs of time. Black life and weather are both transect and transformational in relationship to time and space. Weather to me is one of the smallest units of actionable change of planetary processes. It is both immensely easier and more difficult to weather a storm for a day than experience

persistent changes to climate and circumstances. I still do not know how to answer Sharpe's question, but I do know that change will come.

Conclusion

In the wake, the river, the weather, and the drowning are death, disaster, and possibility (Sharpe, 2016, p. 105)

Collecting information for this thesis was incredibly hard. It was harder than being, as hooks calls it, the "native informant" and went far beyond my many experiences. Exploring topics in this thesis was not just an intellectual challenge but a challenge of heart and futures unknown.

I assert that the future of geoscience hinges on its reformation, willingness to engage with historic roots in white supremacy by all community members, and expansion in its disciplinary bounds. Geology is often described as interdisciplinary but what disciplines are being centered is what is truly limiting. Geology fails to seem as relevant or interesting as aspects of biology, chemistry, and physics. When studying the Earth and its process, it is absurd to ignore how race and lived experience intersects with work being done, much less the needs and influences of humanity.

Geology along with many other sciences ask us to detach ourselves from what we are studying. Our lived experiences and identities rendered irrelevant and unimportant. But, for many people in the margins these identities and backgrounds are driving their study and passions. This deprives geoscience of the potential for great and passionate scholars. It puts geology in a fragile and ruinous position. To me the field is at an impasse: to reform or face the consequences. The assertions and observations I expressed in my thesis are just that. They have little bearing in the

broader reality, but I know that existence of people like Laurent Savoy and Rachael Bernard must be reckoned with by the broader field. I am not sure if I am meant to stay in the geoscience, but I do now know that there are others who will fight for a more just geology.

True progress is when we get past the awestruck elements of Earth's vastness and get into how the study of it can be used as a tool to comprehend and improve upon existing structures however natural or unnatural, they may be. I imagine a future where geology as we know it is dead and after a storm, we see possibilities of futures for Black people and other marginalized groups to exist and contribute to whatever takes shape in the death of "White Geology" (Yusoff, 2018). There are impossible possibilities faced by those Black people who appear in the door and dwell in the wake. Here is Edwidge Danticat (1996) on this in an excerpt from *In the Wake: On Blackness and Being*, "The past is full of examples when our foremothers and forefathers showed such deep trust in the sea that they would jump off slave ships and let the waves embrace them. They too believed that the sea was the beginning and the end of all things, the road to freedom and their entrance to Guinin" (Sharpe, 2016, p.105). It is a fundamental part of geology to explore how past conditions have created the present and yet the community at large cannot seem to apply such a simple concept outside of their own individual works, continuing to chronology, and create narratives of the past about all parts of earth. All parts of earth except for the margins and without care for society at large. I hope this thesis has brought you some further thoughts and reckonings.

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