Interview with Isaiah Bolden, Graduate Research Fellow, University of Washington

Isaiah Bolden graduated from Bowdoin College (Brunswick, Maine) with a degree in Earth & Oceanographic Science and a minor in Chemistry. He was an undergraduate research intern at Scripps Institution of Oceanography, Woods Hole Oceanographic Institution, and also at the National Oceanic and Atmospheric Administration (NOAA). He is continuing work on geochemistry and paleoceanography, as he works toward a Ph.D. at the University of Washington. *ChemMatters* talked to Isaiah about how he came to his current position and about his research on changes in our oceans.

You went to high school in Nashville, Tenn., at Martin Luther King Jr. Magnet High School but also attended the School for Science and Math at Vanderbilt University (SSMV). That part of the country is pretty far from any ocean. What was it that led you to this strong interest in the Earth's ocean environment?

I get this question all of the time from my family and friends, and to be honest, it even puzzles me from time to time! I think I can ultimately attribute my interests in both oceanography and climate science to early exposure to scientific research during my time at SSMV. At SSMV, I worked on a variety of research projects that sought to use chemistry as a method for weaving important environmental stories—from investigating the impacts of pesticides on the global amphibian population decline to studying the linkages between residential fertilizer usage and greenhouse gas emissions. Simply put, my first experiences in how to ask and investigate my own scientific questions about the environment occurred as a high school student. By the time I was ready to start college, I was eager to learn more about how chemistry can be used to frame the changes that we see in the Earth's climate today in the context of natural climate variability, both on past and future time scales. At Bowdoin, I quickly learned that the oceans act as Earth's global climate-control system, and whether I lived near one or not ultimately had very little bearing on the necessity to investigate and communicate ocean-climate interactions in the era of anthropogenic climate change. I've been letting that idea guide my career since!

Isaiah Bolden and Sasha Seroy work to prepare island nations for the impacts of a changing climate.

Your current research is taking place in French Polynesia on the atoll of Teti'aroa. What is the goal of your project?

My research broadly focuses on understanding the complex biogeochemical cycling of carbon, oxygen, their isotopes, and trace metals in coral reefs—this includes investigations of seawater chemistry and the geochemistry of coral skeletons. Coral reefs are locations where seawater chemistry can vary significantly over very short time scales, primarily as a function of productivity and calcification. Our ability to resolve the often subtle differences between the biogeochemical fingerprints of this natural variability and stressors, such as ocean

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acidification and sea-surface warming, will ultimately lead to more accurate models of future reef productivity and calcification under changing ocean conditions. The ultimate goal of my research is to develop geochemical tools from which the calcification and productivity dynamics of reefs under climate-related stressors can be closely monitored and addressed in a more precautionary than reactionary fashion. Accessible, historically pristine, and home to a scientific field station for our studies, Teti'aroa Atoll offers an ideal, location in which to explore biogeochemical cycling within reef environments in different locations over time. It is my aim to apply the tools developed from the studies of Teti'aroa's biogeochemistry to reefs around the world—including those highly impacted by human activities.

Why is your current research important for the rest of the world?

Again, a question I'm often faced with… especially when speaking with my landlocked friends and family members! Coral reefs are known as "marine rainforests," because they house about 25% of marine biodiversity in less than 0.1% of the surface area of the ocean. That's a lot of life that depends upon a disproportionately small amount of space. Unfortunately, due to the combined impacts of human-influenced sea-surface warming, ocean acidification, and coastal runoff, this 0.1% is getting smaller and smaller, with some models estimating that all reefs around the world will be in a state of net dissolution by 2100. This threat of dissolution could translate to habitat loss for a plethora of marine organisms and subsequent social and economic impacts on fishery-dependent small island nations and communities. My research contributes to our understanding of the ecosystem-level interactions that may govern how environmental stressors actually manifest themselves on reefs. I am attempting to develop leading indicators of calcification, dissolution, and productivity to identify early signs of transitions, quantify the rates of the shifts where they occur, and help manage the impacts of changing ocean conditions on the Earth's natural marine rainforests.

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Isaiah Bolden (second from left) is currently a graduate student engaged in ocean acidification research out of the University of Washington. Isaiah served as a Hollings Scholar in 2015. While conducting research in French Polynesia, he was paid an impromptu visit by former President Obama.

PHOTOS COURTESY OF ISAIHAH BOLDEN,UW ENVIR; THINKSTOCK

While you were working on Teti'aroa, you had a remarkable surprise visit. Can you tell us a bit about that?

During our March 2017 field campaign on Teti'aroa, our lab group had an opportunity to share a bit of our research with a vacationing former President Barack Obama! Talk about a wonderful experience to have as a graduate student. The highlight of the visit was the former president's knowledge of ocean acidification and its impacts on marine organisms. In one exchange, my doctoral advisor explained the goals of some of our research on Teti'aroa and why it is an ideal site for such investigations on reefs, and the former president responded by juxtaposing our research with previous studies he had read on the impact of natural volcanic CO_2 on marine life in the Mediterranean Sea. Of course, we were collectively astounded, but it was a moment of great reflection and appreciation, as it reminded us that our research on corals has a tangible impact on the world and, when communicated properly, can leave a meaningful mark on the public… even at the highest levels of government.

Do you remember any turning point or defining moment when you felt like you went from being just a student to feeling like a "real" scientist?

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I think that part of feeling like a "real" scientist is realizing that you never really stop being a student. You simply grow in your abilities to investigate questions you have as a student, and it's an ongoing process—for me, at least. I've always thought of science as a public good, especially in the geosciences in the modern era. The times I've felt like a "real" scientist are defined by moments when I applied a variety of analytic and communication tools to use science as a way to address the public's concerns from many perspectives. For example, while working with NOAA, I synthesized congressional briefing documents on the impacts of ocean acidification on the economies of coastal New England states. It was an amazing experience working with public officials to use science to directly address the concerns of constituents.

What is the coolest part of what you do now?

By far, the numerous opportunities for conveying research through teaching, outreach, and communication are the coolest part of what I do as a geoscientist. Whether it's to high school students, undergraduates, the broader public, or my own family, I try to embrace every opportunity to engage in a discussion on oceanography and climate science and its impact on society. I know how crucial early exposure to these fields was in forming my own career path, and I feel it is my duty to do my part in advocating the need and benefits of earth science research to as many audiences as possible.

What do you feel is the biggest problem with our oceans worldwide?

It's my opinion that the warming associated with anthropogenic fossil fuel emissions of CO_2 is the biggest problem our oceans face today, with tangible impacts on coral reefs and a multitude of other marine ecosystems. Warming contributes to steric sea-level rise and the melting of ice at the poles. With this meltwater comes the freshening of the surface ocean and the potential for ocean stratification, which can have detrimental impacts on current circulation. Because ocean currents distribute both heat and nutrients within the interior of the ocean and throughout the globe, excess heating of the surface ocean from CO_2 emissions has the potential to disrupt the balance of the entire global climate system. Thus, coral reefs are only one of many ecosystems that face threats from increased warming.


Isaiah Bolden hiking around the Swiss Alps in 2013.

Is there anything the average person can do to help?

Absolutely, and on multiple scales. Landlocked or not, an individual's carbon footprint is still a fraction of the total excess greenhouse CO_2 that contributes to the bleaching of coral reefs, sea-level rise, and global climate change. On an individual level, doing whatever you can to curb your emissions and carbon footprint is a large step in the right direction. Recycling whenever possible, promoting and using low-emission methods of transportation, and reducing overall energy usage are all great practices that aid in reducing one's impact on the Earth's climate system. I implore people to ask more questions and to be more curious about their environment! Don't hesitate to engage in discussions about why the oceans and climate matter with your friends and family. The more people who know why we should be concerned about our practices, the better.

What are your goals for graduate school and for your career?

Access to education in the science, technology, engineering, and mathematics (STEM) fields should not be a privilege, and I try to spend a significant amount of my time as a graduate student working toward increasing educational accessibility and diversity in the geosciences. This has so far taken multiple forms—from facilitating workshops on climate variability for local populations in the equatorial Pacific region to serving as an "expert" judge and mentor for Seattle science fairs. Outreach, communication, and education are facets of an academic career that are as important as research and publication. My main goal for graduate school and beyond is to continue to let this idea guide my research endeavors in oceanography, redefining what it means to be a scientist along the way.

What advice would you give to high school or undergraduate students interested in pursuing a career in science?

Don't be afraid to ask questions, seek out research and enrichment opportunities, find out what makes you passionate, and pursue it!

What sorts of things do you like to do when you aren't at work?

I love living in Seattle, and I try to get out and take in the natural beauty of the area as often as possible—yes, even in the Seattle rain. To balance out the physical activities, I'm also a fan of eating my way around the city and exploring different cuisines. My more indoor-oriented pastimes include playing board games and escape-the-room games with friends, and I also compete in weekly trivia on a team with other graduate students. CM

—Michael Tinnesand