SCIENTIFIC OCEAN DRILLING

CREDIT: William Brazelton & IODP

Digital Newsletter

the Drilling Dispatch

July 2023

SCIENTIFIC OCEAN DRILLING

In This Issue

Letter from...
Dr. Rebecca Robinson, USAC Chair

Dear Colleagues,

It is that time of year when we try to cram in as much science as possible before the Aug. 2nd AGU abstract deadline. The Fall 2023 AGU meeting will host a wealth of scientific ocean drilling related science talks and posters. A quick count shows at least 14 sessions highlighting ocean drilling in Sections ranging from B to V (Biogeosciences to Volcanology, Geochemistry, and Petrology) and many in between. We have compiled a preliminary list below and invite the community to share additional sessions with us so we can build a more comprehensive listing.

I am writing to encourage participation in the AGU Fall Meeting. It will be an opportunity to get together, talk about the important science we do, and make plans to continue it into the future. In San Francisco, we can focus on our science rather than the end of IODP.

In the immediate term, there are also important opportunities for the scientific ocean drilling community to stay informed about next steps and provide input into the planning process. The 2025–2035 Decadal Survey of Ocean Sciences for the National Science Foundation has been launched, and a survey of the ocean science community will likely be issued as part of that effort; please make sure you complete the survey so your voice can be heard. In addition, USSSP and USAC are hosting an online town hall on July 6 at 2 PM Eastern, entitled, “A Conversation with NSF-OCE: The Current State and Future of Scientific Ocean Drilling in the U.S.” Please register here to attend.

It is critical that we keep our focus on the future and use every means at our disposal to ensure that scientific ocean drilling in the U.S. remains vibrant and beneficial for our society and our community.

Best,
BR

View the preliminary list of AGU’23 sessions

Happening now...
Expedition 395: Reykjanes mantle convection and climate

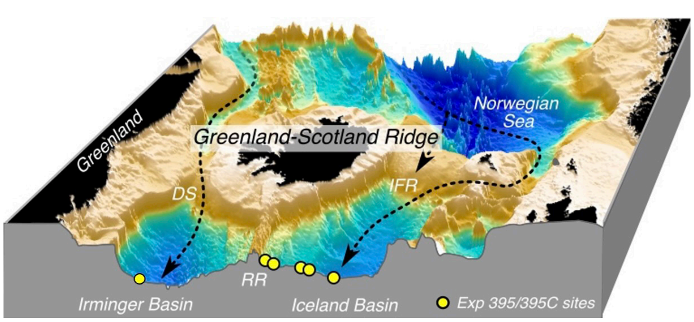
Ross Parnell-Turner and Anne Briais,
Expedition 395 Co-Chief Scientists;
Leah LeVay, Expedition 395 Project Manager

written by Jennifer Field, Expedition 395 Onboard Outreach Officer

Expedition 395 left from São Miguel Island, Portugal on the 16th of June. With roughly five days in transit to the first site, the scientists worked hard in teams to pour through and write up the data from Expedition 395C. Using this information was key in determining the drilling plan for this expedition which is continuing the work started during 395C. This opportunity gave the scientists time to get reacquainted and to ensure that everyone was on the same page with regards to laboratory and report protocols.

EXP395 scientists analyze one of the first cores of the expedition (Credit: Jennifer Field & IODP).

Sitting in the North Atlantic just south and west of Iceland, Expedition 395 has been pulling up core in two adjacent holes at site U1564. The material that is currently being examined is sediment dating is back to the late Miocene (about 7 million years ago). The science team is hoping to use this information to determine the history of the Gardar Drift. This information is of interest because it may shed some light on how the deep ocean currents from the Arctic Ocean have fluctuated over time, including perhaps even when this drift formation began. One idea is that the pulsing of the Icelandic mantle plume has altered the height of the seafloor and thus has influenced the velocity of the cold benthic water from the north and in turn cyclically changed the sedimentation in the Gardar Drift. Using this information, the team hopes to shed some light on how the change in cold water input has affected the water chemistry in the North Atlantic Ocean. These data could be used to extrapolate future impacts of sea water warming as a result of climate change.



The Onboard Outreach Officer has been busy creating short educational videos about the processes involved with seafloor coring and analysis on the JR as well as hosting Ship to Shore Events and creating social media.

Map showing the study area and drill sites for Expedition 395/395C (Credit: Ross Parnell-Turner).

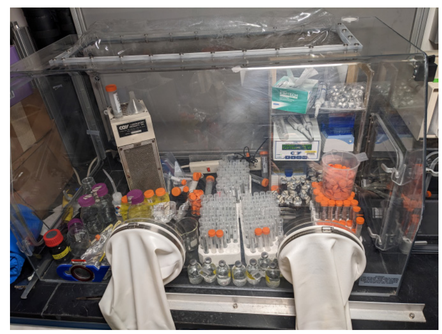
In the repository...
Expedition 399: Building blocks of life, Atlantis Massif

Andrew McCaig and Susan Lang,
Expedition 399 Co-Chief Scientists;
Peter Blum, Expedition 399 Project Manager

written by Lesley Anderson and Sarah Treadwell, Expedition 399 Onboard Outreach Officers

Origins of Life The *JOIDES Resolution* left Ponta Delgada, Portugal in mid-April and sailed to the Atlantis Massif, a large underwater mountain in the middle of the Atlantic Ocean. It is located where two tectonic plates are slowly drifting apart, making mantle rocks more accessible for ocean drilling. The massif is also unique because it hosts the Lost City hydrothermal field, where white chimneys vent warm fluids. A water-rock reaction called serpentinization causes these fluids to be rich in hydrogen and small organic molecules that can support life. Astrobiologists believe that if this chemical process occurs here on Earth, it may also take place on other planets or moons – even within our solar system. Enceladus is an icy moon of Saturn that emits plumes of water into space, and NASA is interested in flying probes through the plumes to determine if the water-rock interactions on this distant planetary body are similar to those on Earth.

The international team of scientists on Expedition 399 was led by Andrew McCaig (University of Leeds) and Susan Lang (Woods Hole Oceanographic Institution). The team set out with a primary focus to deepen legacy Hole U1309D, but the plans changed when drilling became very successful at a nearby site, U1601C. The original goal was to drill a 200m hole at U1601C, then return to U1309D. However, when the recovery rates increased to more than 100% and cores were returned at speeds unprecedented for hard rock drilling, the science party reevaluated. They decided to prioritize deepening Hole U1601C, as it was yielding historically challenging to access rock that that were of interest to all members of the science party. The group believes the >800m archive of core and the 1.2km deep borehole will be valuable to the scientific community as a whole, now and in the future.

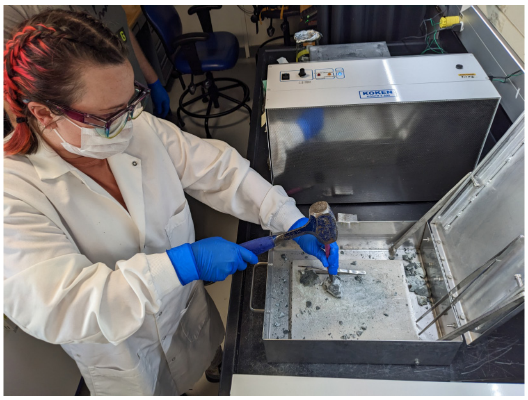


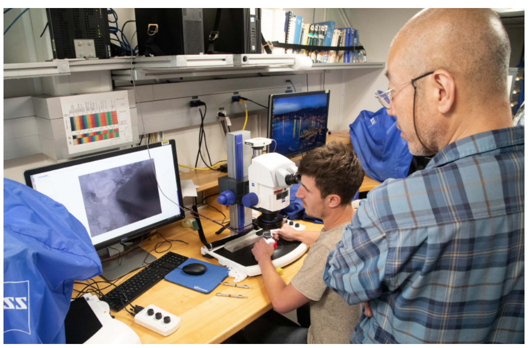
TOP: Scientsts use the Coy glove box to work with microbiological samples (Credit: William Brazelton & IODP). BOTTOM: Siem personnel prepare a reentry cone (Credit: Erick Bravo & IODP JRSO).

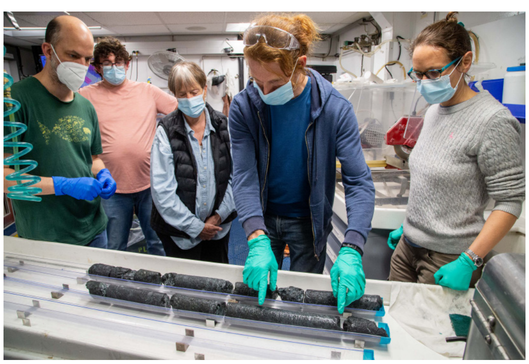
Preliminary Results Preliminary results suggest drilling accessed both more altered and "fresher" mantle rocks less altered by sea water interactions. Recovering both from a largely continuous record was very exciting for geologists who want to understand what happens before and after these rocks are brought to the surface.

The microbiologists and geochemists were equally excited. Carbonate and other minerals in the rocks indicated where there had been fluid flow, and therefore zones that may have been favorable for hosting life. They were also able to send a water sampler down the borehole to collect fluids that had been altered through reactions with those same rocks. Combined, the recovered materials provide insight into the conditions for early life on Earth – and also what the environments could be like on icy moons such as Enceladus.

Outreach Expedition 399 had a team of two Education and Outreach officers on board the ship. One was a former teacher and current logistics planner for the United States Antarctic Program, the other an informal educator and professional science communicator, both from the United States. The team provided ship to shore broadcasts, organized meetings with the press, conducted interviews and managed the ship social media and blog. Due to the record-breaking nature of this expedition, more than 20 news and media agencies have published stories about Expedition 399 science. In addition to these onboard duties, 500 postcards were sent to classrooms around the world and a museum display for the ship was organized by one of the Outreach Officers. Their outreach impacted over 3 million people in 16 countries, and 42 states.







FROM TOP: Scientists wait for operations to end at the moon pool before sampling water from the Niskin bottles (Credit: Erick Bravo & IODP JRSO). Microbiologist Jordyn Robare uses a chisel and hammer on a piece of hard rock (Credit: William Brazelton & IODP). Expedition 399 scientists look at a piece of core under the stereoscope while performing a hardness test (Credit: Erick Bravo & IODP JRSO). Members of the science party discuss which piece of core will be taken for microbiological subsampling and analysis (Credit: Erick Bravo & IODP JRSO). Expedition 399 scientists raise their hands at the bow for a group photo (Credit: Erick Bravo & IODP JRSO).

From the field...

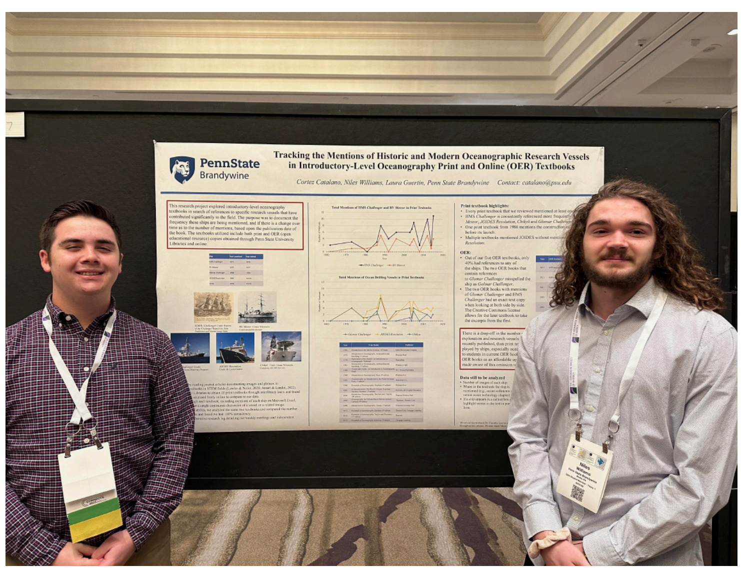
Textbook mentions of oceanographic research vessels

written by Cortez Catalano and Niles Williams (Penn State Brandywine)
Faculty mentor: Dr. Laura Guertin, Penn State Brandywine (guertin@psu.edu)

Editor's note: On a dreary Friday this April, I received an email from [Dr. Guertin](#) that brightened the day. After working so hard on the research project detailed below, Niles and Cortez won 3rd Place at the Penn State Brandywine campus-wide research symposium. On top of that, Niles was one of seven students selected nationwide for the Council on Undergraduate Research - Geoscience Division Award for Excellence in Student Research (Cortez, as a biology major, was unfortunately ineligible)! They are now writing up their results as a short piece for publication. It is my hope that their rigorous investigation will inspire thetextbook authors of the future to pay more consideration to the methods behind oceanographic science, and give scientific ocean drilling the credit it deserves.

Penn State Brandywine's Earth science professor Dr. Laura Guertin sailed last year as an Onboard Outreach Officer for *JOIDES Resolution* Expedition 390 (South Atlantic Transect I). One of her duties was to conduct ship-to-shore broadcasts with classrooms and community groups. When she returned to campus in the Fall 2022 semester, she told us that most of her colleagues said that undergraduate students typically first learn about *JOIDES Resolution* in their introductory oceanography textbooks, yet she did not recall seeing or learning about this ship when she was an undergraduate student. She wondered if and how the ship is portrayed in these textbooks.

This curiosity bloomed into a full-fledged research project in September 2022 when first-year undergraduate student and biology major Cortez Catalano approached Dr. Guertin looking to engage in undergraduate research, and we both agreed that this would be a worthwhile project to pursue. Sophomore geoscience major Niles Williams joined the project the following month, and we approached this project by doing preliminary research familiarizing ourselves with *JOIDES Resolution*. This included researching scientific outcomes and contributions to various scientific fields and excitingly taking a virtual tour of *JOIDES Resolution* led by Maya Pincus in October.



Cortez (left) and Niles (right) pose next to their poster at the research symposium (Credit: Laura Guertin).

While we ultimately expanded the scope of our research to other oceanographic research vessels, *JOIDES Resolution* was the original focus of our introductory oceanography textbook research, which we kept in mind as we added other ships to broaden our scope. In total, we settled on five ships to be the subject of our work. These were the *JOIDES Resolution*, H.M.S. *Challenger*, *Glomar Challenger*, *Chikyu*, and the RV *Meteor*. We selected these vessels, with the help of our research mentor Dr. Guertin, because they have all made significant contributions to the field of oceanography and include our focus with the three scientific ocean drilling ships. Additionally, we expanded the scope of our research from just print textbooks to include free online oceanography textbooks, known as OERs (Open Education Resources).

Our results showed that at least one of the five ships was discussed in each of the fourteen print textbooks we examined with publication dates going as far back as 1973. However, in the five OER textbooks we examined, only two out of five had any mentions of our ships. Importantly, we discovered that both OER textbooks misspelled *Glomar Challenger* as "*Golmar Challenger*" multiple times. *JOIDES Resolution* was mentioned in all but one print textbook published after its construction. However, the JR was not mentioned in any of the OER textbooks.

Through researching and presenting this project, we developed a deep appreciation of scientific ocean drilling and the history of oceanographic research vessels. Ships like the *JOIDES Resolution* take an enormous amount of work, funding, and technology to run. The research they conduct has led to some groundbreaking discoveries, and helped prove theories that are fundamental to our understanding of the world, such as plate tectonics. Hopefully through this project we can share our newfound appreciation of scientific ocean drilling with others. We were able to share our findings at the 2023 Southeastern & Northeastern Section Meeting of the Geological Society of America (Reston, VA) and at two Penn State University undergraduate research symposiums.

Year	Print Books	Publisher
1962	*Introduction to the Marine Sciences,* Williams	Little Brown and Company
1973	*Introduction to Oceanography,* Anikouchine and Sternberg; 1st edition	Prentice-Hall
1979	*Exploration of the Oceans : an introduction to oceanography,* Weihaupt	Macmillan
1981	*Introduction to Oceanography,* Anikouchine and Sternberg; 2nd edition	Prentice-Hall
1986	*Oceans and Coasts : An Introduction to Oceanography*, Black	W.C Brown Publishers
1988	*Introduction to Oceanography,* Ross; 4th edition	Prentice-Hal
1992	*Oceanography, an Introduction to the Planet Oceanus,* Pinet; 1st edition	West Pub CO.
1996	*Essentials of Oceanography,* Thurman; 5th edition	Prentice-Hall
2003	*An Introduction to The World's Oceans,* Sverdrup, Duxbury, Duxbury; 7th edition	McGraw-Hill Higher Education
2004	*Introductory Oceanography,* Thurman and Trujillo; 10th edition	Pearson/Prentice Hall
2005	*Oceanography: An Introduction to Marine Science,* Garrison; 5th edition	Thomson - Brooks/Cole
2008	*Introduction to Oceanography,* Denny; 1st edition	Princeton University Press
2012	*Essentials of Oceanography,* Garrison; 6th edition	Brooks/Cole, Cengage Learning
2014	*Essentials of Oceanography,* Trujillo and Thurman; 11th edition	Pearson
2015	*Essentials of Oceanography,* Garrison; 7th edition	Cengage Learning

TOP: Detail from Cortez's and Niles' poster. BOTTOM: Niles and Cortez connected to the *JOIDES Resolution* for a ship-to-shore tour during Expedition 397T (Credit: Laura Guertin)

Additionally, this project is intended to help with education and we hope that our research will inform people that these ships need to be discussed and taught in introductory-level oceanography courses. Ships like the *JOIDES Resolution* are the backbone of oceanographic research, allowing for new information to be sampled from the deep earth that has previously never been seen. But if the ships are never mentioned in textbooks, this causes a significant gap in how students learn about the process of oceanographic research. With universities encouraging faculty to develop and adopt more accessible resources such as OER textbooks for their classes, faculty need to be aware that students may be missing out on learning about the contributions and roles of scientific research vessels over time.

You can see our GSA abstract and poster in the Penn State ScholarSphere.

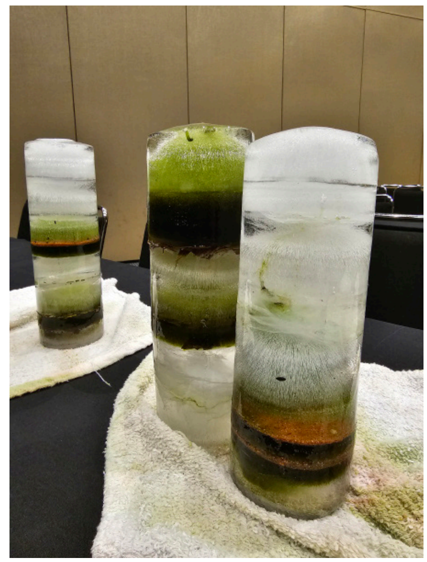
How to...
Make a model ice core

written by Lindsay Mossa (AGI)

Ice cores from continental glaciers are similar to sediment cores taken on land or by drilling into the ocean floor in that they provide evidence of past climates and geologic events, such as volcanic eruptions. The thickness and contents of each layer can provide data on precipitation, atmospheric conditions, and more. Building ice core models can allow students to make observations and learn how to correlate evidence from multiple samples.

Materials:

- 3 Pringles® cans
- 6 beads that sink in water
- 100 mL graduated cylinder
- teaspoon
- water
- sand
- coffee and/or food dye (brown coloring can be made by mixing blue, red, and green dye.)
- crushed leaves or other plant material
- freezer
- marker
- scissors
- bin or tray
- towel
- tape (optional)
- gloves (optional)



Model ice cores A, B, and C (Credit: Lindsay Mossa).

Preparing the ice cores

- **Step 1**: Using a marker (and tape, if needed) label three Pringles® cans: A, B, and C.
- **Step 2:** Add the contents listed on the table below for Layer 1 to the corresponding Pringles® can. For example, in the can marked A, add 110 mL of water. This layer will represent the oldest section of each core. Beads are added to this bottom layer of each core so that they can be identified after the can is removed. Students should not include the beads in their analysis.
- **Step 3:** Place the cans upright in a freezer and allow the layer to freeze completely.
- **Step 4:** Repeat steps 2 and 3 with each ice layer until all layers have been added. Note that ice core C has one less layer than cores A and B.
- **Step 5:** Carefully use scissors to make a cut at the top edge of each can. Starting at the cut, peel away the cardboard of the can from the ice core. Tearing down in a spiral works well in many cases.
- **Step 6:** Place the ice cores in a bin, which will collect meltwater. Have a towel on hand for cleanup after handling the ice cores. Optionally, provide gloves for handling the ice cores.

Layer	Ice Core A	Ice Core B	Ice Core C
8	110 mL water	110 mL water	—
7	60 mL water with food coloring and plant material	160 mL water	160 mL water
6	160 mL water	110 mL water with 1 teaspoon of sand	60 mL water with food coloring
5	160 mL water	60 mL water with food coloring	110 mL water with plant material
4	110 mL water with 1 teaspoon of sand	110 mL water	110 mL water
3	60 mL water with food coloring and 1 teaspoon of sand	160 mL water	60 mL water with food coloring and a plant material
2	60 mL water with food coloring and a plant material	60 mL water with food coloring and a plant material	160 mL water
1	110 mL water (add one bead)	110 mL water with plant material (add two beads)	160 mL water (add three beads)

Questions to guide student analysis of the ice cores

- Make observations of each ice core. How many layers are there? How thick is each layer? What might that tell us? Are all the boundaries between layers clear?
- Compare the ice core models to images of a sediment core. How are they similar? How do they differ?
- Assuming the following are true, what types of interpretations could be made for this ice core?
    - dark color represents sediment
    - sand represents volcanic ash or wildfire soot
    - leaves represent various living organisms
- Could the three cores represent the exact same time periods? What is your evidence?
- Can different core samples be correlated somehow to provide a longer record? What would you have to know and do to figure that out?

(Adapted from https://byrd.osu.edu/create-classroom-ice-cores)

FEATURED VIDEO

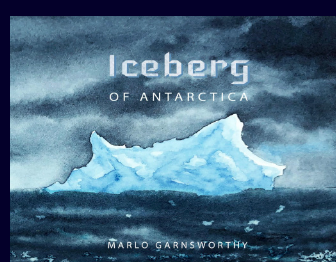
[5 things you didn't know about icebergs]

There's more to icebergs than just "Titanic" references. Learn about these captivating ocean objects in this video, created during Expedition 382: Iceberg Alley.

For your calendar

- **Community Town Hall with NSF-OCE**
  (6 July 2023; learn more and register here)
- **U.S. Advisory Committee Meeting**
  (19-21 July 2023; New York, NY, USA)
- **Submit an abstract for GSA Connects 2023 annual meeting**
  (Deadline: 25 July 2023; learn more here)
- **Apply for IODP workshop on *NanTroSEIZE Synthesis***
  (Deadline: 31 July 2023; learn more here)
- **Submit an abstract for AGU 2023 fall meeting**
  (Deadline: 2 August 2023; learn more here)
- **Apply to sail on Expedition 406: New England Shelf Hydrogeology**
  (Deadline: 16 August 2023; learn more here)

SCI COMM RESOURCE OF THE MONTH



Through lyrical prose and watercolor illustrations, it explores what we can learn about melting of the Antarctic Ice Sheet from the debris icebergs leave behind.

Icebergs of Antarctica

Spotlight on... Emily Cunningham

written by Maya Pincus (USSSP)

Credit: Emily Cunningham

How does a self-proclaimed "feral child" end up as a 2022-2023 Schlanger Fellow? If you ask Emily Cunningham, be prepared for a fast-paced ride that is just as emotional as it is scientifically captivating.

Emily grew up in rural East Tennessee, where the only opportunity for an Earth science education could be found roaming through the fields and forests on her father's property. Some of her earliest memories are geological ones, fond recollections of time spent exploring the nature around her. At first, she begged her dad for answers, wondering if the rocks she saw had fallen out of the sky. Then, as her understanding of the world matured, she was able to marvel at the vertically dipping beds of the ancient mountain ranges in the area. At the time she had no mechanism to explain these striking phenomena, but the natural curiosity those experiences inspired would be the driving force that shaped the rest of her life.

It wasn't until Emily got to college that she discovered that science was something she liked and was good at. When she made it to her first geology class in the summer after her second year, she knew she found her fit. Her dedication and work ethic were immediately obvious to her professors, and as a result, she was invited to do her first fieldwork, a research trip to volcanic centers in the Cascade Range of the Pacific Northwest. Finally able to apply her passion for the natural world and love of problem-solving, Emily's path was set.

Charmingly humble, Emily gives a lot of credit to her undergraduate advisor, who mentored her through this first research project, and encouraged her to apply for a masters program at the University of Missouri. There, she studied a felsic rhyolite obsidian unit, focusing on melt and volatile interactions during magmatic processes and crystallization. As she wrapped up her degree and contemplated the rest of her life, she thought that moving to Salt Lake City was a "pipe dream," inspired by her love of hiking, rock climbing, and being outside. But when she saw an opening at the University of Utah she arranged a call with her now advisor Dr. Sarah Lambart. They "really hit it off," allowing Emily to move to that "wonderful place" to begin her doctorate degree.

In her free time, Emily combines her loves of geology and being outside when she rock climbs. In this photo, she is bouldering at Lily Boulders near the Obed Wild & Scenic River on the Cumberland Plateau in Tennessee (Credit: Emily Cunningham).

Though still driven by geologic mystery, Emily has come a long way since those first years wondering if rocks fell out of the sky. She is now working with Expedition 396 cores from the north Atlantic, a region known for the excess magmatism that occurred during the continental rifting of Pangaea. Despite being the subject of investigation for decades (including Ocean Drilling Program Leg 104), scientists still have not been able to pinpoint a definitive explanation for the unusual geology. There are three leading hypotheses about mantle conditions and behavior, which Emily can describe in terms simple enough for anyone to understand. But if the solution was that simple, Emily says, "it would have been figured out by now."

TOP: Emily prepares starting materials for experimental runs using a high temperature furnace (Credit: Emily Cunningham). BOTTOM: Emily and her dog explore the salt flats (Credit: Emily Cunningham).

Emily and her lab group, including an undergraduate student whom she mentors, are using novel techniques to constrain the relative influence of each of the three hypothetical end members. For one, she has been studying first row transition elements (FRTEs)—specifically how they partition into and out of different mantle phases—as geologic tracers to understand lithologic heterogeneities in the mantle.

As if this impressive bit of geochemistry wasn't enough, Emily has also been teaching herself methods of statistical analysis, including developing monte carlo simulations in MATLAB. She is analyzing the probability of possible mantle behaviors given different mineralogical conditions. By modeling different bulk rock mineralogies, these experiments will help her determine what exactly is going on in the mantle to cause the distribution of FRTEs she observed in her bulk rock analyses.

For those of you who have not yet met Emily, this piece would be incomplete without acknowledging her modest gratitude for the people and experiences that helped her reach where she is today. She is not free of the self-confessed imposter syndrome that so often comes with being a first generation college student, going so far as to say of herself "a hillbilly talking about numerical modeling is kind of funny." But endearing self-deprecation aside, Emily is using her experiences to pay it forward. When asked about her favorite part of it all, she was quick to bring up her desire to help others, especially undergraduate students, through the big jump "from first gen to PhD."

And what's next? If you run into Emily before August, be sure to wish her success in her upcoming qualifying exams (she doesn't need luck). After that, wish her bon voyage. This winter, Emily will sail as an igneous geochemist on Expedition 402: Tyrrhenian Continent-Ocean Transition. Having previously focused on the excess magmatism of the Mid-Norwegian margin, she will now have the opportunity to apply the same techniques to an amagmatic margin. What is different, as far as mantle processes go? What is driving the difference between these two different but both rifted margins? "It fits together really nicely, I think."

Spotlight on...
Isabel Dove

written by Maya Pincus (USSSP)

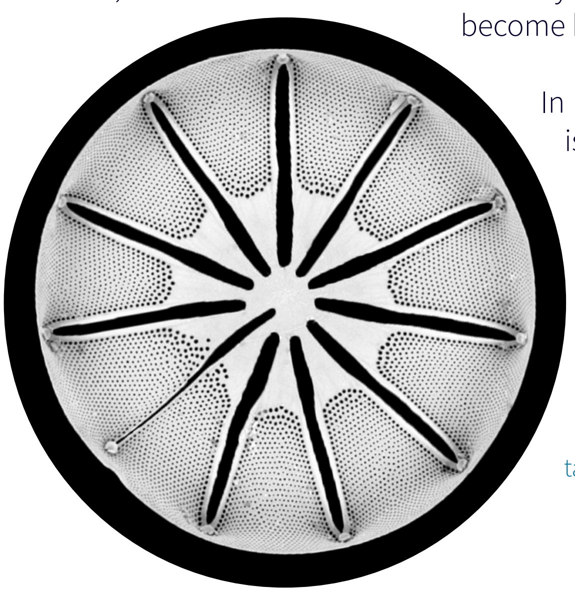
Credit: Isabel Dove

In every one of Earth's oceans, the dark, salty water is full of millions of microscopic organisms. Many humans live their entire lives without giving a single thought to these minute creatures, but even without our knowledge, their influence on cycles of energy and matter spans the globe.

Those in the scientific ocean drilling community may already know that these petite powerhouses are diatoms, a common type of phytoplankton. But few know as much about them—and the implications they have on the global carbon cycle—as 2022-2023 Schlanger Fellow Isabel Dove.

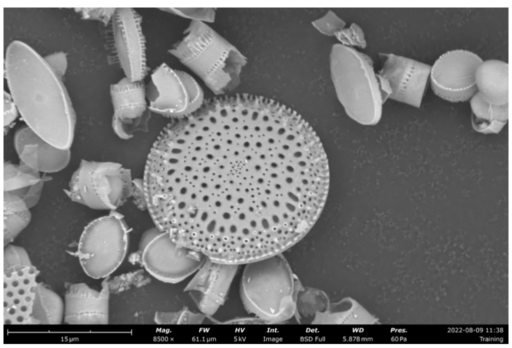
When Isabel first started college at Colgate University, she probably would have been surprised to find out that she would end up devoting the rest of her education to paleoceanography, the history of Earth's oceans preserved in layers of marine sediment. Like so many of us, she showed up unsure of her future, aware of her love for the natural world, but assuming that would lead her to environmental studies or maybe geography. But like so many of us have discovered, the pull of that first geology class was inescapable, and after four years in the field (three of those spent doing research under the great paleoclimatologist Dr. Amy Leventer), Isabel knew she had found her niche.

It was never a question of whether she would go to grad school; it was only *Where?* and *How soon?* In her last year as an undergraduate, she had the opportunity to sail on the *JOIDES Resolution* as a diatom micropaleontologist for the non-IODP JR100 expedition, which set out to extend high resolution records of the northern margin of the Antarctic Circumpolar Current and the South American continent. While at sea, she met University of Rhode Island professor Dr. Rebecca Robinson, who would soon become her graduate advisor.



In an exciting blend of methods and applications research, Isabel is focusing her research on diatom-bound nitrogen isotopes. Diatoms grow shells made of opal (if you didn't know, "They're really pretty!" says Isabel), which preserve ambient nutrient levels at the time of their growth. Due to the way that the diatoms fractionate nitrogen as they consume nitrate during photosynthesis, the ratio of ^{14}N to ^{15}N in their shells is a proxy for the extent of nutrient utilization in the oceans.

Scanning electron microscope image of the diatom *Asteromphalus flabellatus,* taken by Isabel during the JR100 expedition.



The uninitiated may wonder why we bother to care about the nutrition of diatoms, microorganisms 200 times smaller than a dime, but Isabel can adeptly illustrate the connection to much larger matters. This brings us to the biological pump.

At this point I should pause, and offer a confession. In writing this piece, I listened to the recording of my conversation with Isabel at least three times. I replayed some parts five, six… even ten times. Superficially, this is because prior to our conversation I knew almost nothing about the topic of her research and Schlanger Fellowship. While I consider myself a competent geoscientist, micropaleontology and biological processes are about as far from my areas of knowledge as it gets. But the real reason I bring this up is that at no point during those repeated listenings did I ever get bored or feel like I wanted to stop. Isabel is so enthusiastic about what she does that it's contagious. Talking with her made me actively want to learn more about her field, because she did such a good job telling the story.

So. The biological pump. When scientists talk about the "biological pump," they are referring to the process by which carbon dioxide is removed from the atmosphere and stored in the deep ocean through the natural activity of organisms. Isabel, in her study of diatoms, is focusing specifically on the marine biological pump. This still may sound abstract, but the removal of CO_2 from the atmosphere and subsequent storage in the ocean has tremendous implications both geologically and societally. We know that the infamous gas is responsible for trapping heat in Earth's atmosphere, leading to the warming climate that is wreaking havoc on our planet today. If we consider CO_2 in the context of Earth's history, its relative presence (or lack thereof) can be responsible for the glacial/interglacial cycles that shaped climatic changes in the past.

There are two aspects of Isabel's research that make her work novel. For one, she is studying diatoms from two ocean-drilling expeditions, ODP Leg 178: Antarctic Glacial History and Sea-Level Change (the famous core 1098!), and IODP Expedition 318: Wilkes Land Glacial History (core 1357). Samples from these two locations allow her to compare coastal sediments to those from the open ocean. To date, there are no published records of nutrient utilization and biological pump efficiency in polar coastal regions, so Isabel's findings will provide valuable insight into the possibility of sequestering carbon on the Antarctic continental shelf.

TOP: Isabel waits for the PAL sample aboard the JR (Credit: Isabel Dove). MIDDLE: SEM image of sediment from ODP Site 1098. The big diatom in the middle is a *Thalassiosira antarctica* and it is surrounded by Chaetoceros resting spores (Credit: Isabel Dove). BOTTOM: Isabel helped scan Site 1098 cores for XRF data at the Gulf Coast Repository (Credit: Isabel Dove).

LEFT: Isabel (middle) excitedly helps carry the last core of JR100 onto the catwalk of the *JOIDES Resolution* (Credit: Sarah Kachovich). RIGHT: Isabel aboard the R/V *Endeavor* in the Gulf of Maine (Credit: Isabel Dove).

The other thing that makes Isabel's project so fascinating is her work with diatoms in the genus *Chaetoceros*. These organisms are known for their ability to form resting spores to preserve energy through periods of environmental stress. One challenge that Isabel has faced through this process is the fact that different diatom species fractionate nitrogen differently, meaning that in order to accurately interpret her findings, she needed to first groundtruth her data. *Chaetoceros* resting spores are especially important diatoms to study because they form when nutrients are depleted and because their relative abundance in sediments changes over time.

It is a testament to Isabel's dedication to her work that she accepted this assignment. In order to get this information, she had to measure how living diatoms respond to lab-controlled environmental changes. This forced her to learn how to raise diatoms in culture. She was essentially "doing pretty heavy biology, when I have no biology training." At the same time, she describes learning something new as her favorite part of the process. Her rigorous experiments led to some pretty unexpected results, and right now "Becky [Robinson] and I are the only people in the world who know this, and I'm really excited to publish and see the new research that comes out of this surprising finding."

Despite the intense new challenges her research has brought on, Isabel always finds ways to bring delight into her work. While at sea during JR100, Isabel collected mudline samples from the Chilean margin, which were full of resting spores. When she got back to her lab, she figured out how to revive them. She now smilingly refers to these as her "zombies," because she is studying diatoms that "died" hundreds or possibly thousands of years ago.

Over the next several months, keep an eye out for signs of Isabel's work. As she prepares to defend her dissertation next spring or summer, she is gearing up to publish her results to share what she's learned. And one last thing—if you aren't already impressed by the creativity Isabel has demonstrated as she translates diatom records into the story of Earth's past, be sure to check out her knitted data visualizations, in which she combines her talent for textile arts with her love for science.

Creative COREner

'3.9.2.haiku'—a literary porthole into deep ocean drilling—represents symbiosis in both form and function. It's a string of dozens of voices of distinct species of scientists who travelled from countries all over the world to live in close quarters and work together aboard the JOIDES Resolution for the long-term, mutual benefit of all. The poem describes, in sequence, 68 sediment cores spanning more than 70 million years and constituting the whole of a hole.

Find us on the web!

You don't need to wait for next month's newsletter to keep up-to-date with our adventures in science! We update our blog and social media regularly. Get involved, and stay in touch!

Twitter: **TheJR**

Facebook: **JOIDES Resolution**

Instagram: **joides_resolution**

Web: **https://joidesresolution.org**

Call for contributions

If there's one thing that can be said about the International Ocean Discovery Program (and the Integrated Ocean Drilling Program, and the Ocean Drilling Program, and the Deep Sea Drilling Program), it's that we are a tight-knit community. Just as much as this newsletter is for you, we want it to be from you, too! In future editions we will highlight our readers by featuring the following community contributions:

- **From the Field** - Have you had an experience with scientific ocean drilling that you want to share? Write a piece to tell us your perspective "from the field" for our next edition. Bonus points if you include some pictures!

- **Scientist Spotlight** - Do you know someone who's making waves in the ocean drilling scene, whether it's a grad student or accomplished scientist? Send us a nomination! Briefly tell us why this person deserves a shout-out, and ideally how to get in touch with them. Self-nominations are also accepted.

- **Photo Montage** - Thanks to everyone who submitted photos for past themes! For the next issue please send in your photos that illustrate the theme **Selfies at Sea**.

- **Creative COREner** - Scientists are creators too! Send in your paintings, drawings, digital designs, poems, short stories, sculptures, or any other ocean science art you've made.

Send your contributions (and questions and concerns) to mpincus@ldeo.columbia.edu no later than July 20, 2023 to be featured in next month's newsletter.

See you next month!