Testing the ocean's chemistry and climate impact

March 16 2023, by Janette Neuwahl Tannen

The NOAA GO-SHIP vessel prior to departing Brazil. Credit: Melissa Miller

A team of graduate students and researchers from the University of Miami is navigating through the northern Atlantic Ocean on an international research voyage to learn more about how the ocean is

changing through time.

The team of 11 ocean researchers and seven students, as well as one alumna, from the Rosenstiel School of Marine, Atmospheric, and Earth Science and its Cooperative Institute for Marine and Atmospheric Studies (CIMAS) is joining scientists from 15 organizations across the country. The group of about 60 scientists is collecting water samples from a variety of depths and locations in the Atlantic to gain insight about how the ocean's chemistry is evolving as water temperatures warm.

The cruise is part of the GO-SHIP program, which seeks to monitor the transformation of our oceans as a result of climate change.

"This is one of the most important climate change projects that these two agencies are involved in," said Chris Langdon, a professor of marine biology and ecology at the Rosenstiel School, and one of the principal investigators for this cruise. "Approximately 25 percent of all the carbon dioxide emitted into the atmosphere each year dissolves into the ocean and it's critical to know if that amount is changing, because the earth would be warmer today if the oceans were not absorbing that much carbon dioxide."

Aboard the 274-foot Ronald H. Brown, which is the largest vessel in the NOAA fleet, scientists and students are collecting water samples at 24 different depths about every 60 miles along the same latitude in the Atlantic Ocean. As part of the program, they take the same voyage approximately every 10 years, according to Leticia Barbero, an associate scientist at CIMAS as well as at NOAA's Atlantic Oceanographic and Meteorological Laboratory, and one of two chief scientists for the current voyage, which lasts from March to May.

In fact, Barbero is also one of the lead investigators for all the U.S.-based GO-SHIP cruises. She pointed out that the trips are critical

because the data gathered on board helps scientists worldwide understand how—and at what rate—the oceans are soaking up carbon dioxide. While global oceans absorb between 25 and 33 percent of the carbon dioxide from the atmosphere, that amount could be decreasing with time, she noted.

"We want to find out how much carbon that humankind is producing is being stored in the ocean, as well as where it goes in the ocean. And we want to evaluate that decade after decade," said Barbero, a chemical oceanographer focused on tracking the movement of carbon dioxide. "We are also looking at how the ocean's temperature and oxygen concentration have changed. This is important because seawater has dissolved oxygen in it, which fish and other organisms in the ocean use to breathe. And certain parts of our oceans are getting dangerously low concentrations of oxygen today."

The voyage began in early March when the research vessel motored out of Suape, Brazil, toward the equator and then turned north to travel up through the Atlantic. In April, the ship will stop in Spain to refuel and then continue along a specified latitude to its destination in Reykjavik, Iceland.

Langdon—who studies how ocean chemistry affects marine life, especially corals—sent a team of graduate students and staff scientists on the massive research vessel but trained them in Miami and in Brazil before the voyage. With the help of scientists on board, his team will be using the ship's large conductivity, temperature, and depth sampler, or the "CTD," to collect ocean water around the clock. Specifically, they will be measuring dissolved oxygen, pH, and total alkalinity in the water.

"It's an ideal way for students to be exposed to what this field is all about, and a lot of the things they have learned about in their classes that relate to climate change come from data collected on these trips. So,

they can make connections to what they are learning in class," said Langdon, who has been on several research cruises, including one that sampled ocean water along North America's eastern coasts, and others in the Gulf of Mexico and the Antarctic Ocean. "The way it works is water collection instruments are lowered from the side of the boat with a cable, then students do chemical analysis in real time, and they have six hours to measure it before they do it all over again."

While one of Langdon's graduate students, Emma Pontes, has attended three research cruises in the past, master's degree candidate Riley Palmer is going for her first time. Palmer will be on board for the entire two-month voyage, and said she is looking forward to broadening her field research experience.

"This is a unique opportunity that most people don't have access to, so it will be good for my career and personal development," said Palmer. "Also, I'm excited to get more comfortable with applied water chemistry benchwork and to see what other labs are doing on board."

One trend that has been noted on many of the GO-SHIP voyages is that as the oceans warm, the water's pH levels are decreasing—which means it is getting more acidic, according to the scientists. In the early 2000s, Langdon was one of the first to discover the critical importance of pH in ocean water to sustain marine life. And the more acidic seawater is, the harder it is for marine organisms that calcify to thrive. This is an unfortunate phenomenon Pontes has seen firsthand in her research with Langdon.

"Ocean pH is decreasing and that's a huge problem for corals, clams, shellfish, and anything that forms a calcium carbonate shell or skeleton," Pontes said.

To that point, for the first time on this cruise, according to Barbero,

scientists also will be collecting ocean water samples to explore their biological, environmental DNA.

"I'm really curious to see what will come out of that," she said. "This will be our baseline to see the distribution of organisms along the ship's path by looking at the DNA. We can then relate it to environmental measurements like temperature, oxygen concentration, and depth to understand why there are certain concentrations of certain plankton groups, for example, in a given area—and then we can see if they are still there in 10 years."

The team also will be deploying ARGO floats, which are instruments that sample seawater from under the water and periodically send data back to shore.

Throughout the frenetic analysis of water samples, however, there will likely be some incredible moments, Pontes said. On past trips she has seen dolphins, a pod of pilot whales, and other marine life around the ship. She is hoping to see an ocean sunfish or a killer whale this time. Yet, the aspiring research scientist also understands the importance of the trip.

"We need to be tracking what's happening in our oceans and these are some of the only long-term, comprehensive datasets of the world's oceans," Pontes said. "These are really good tools for monitoring changes in the ocean's chemistry, especially with the impact of climate change."

Provided by University of Miami