Eos

Confined at Sea at the End of the World

Embedded on a research cruise in the Antarctic, a journalist joins a scientists' "summer camp."

By **Sofia Moutinho** 23 May 2024



An ice floe floats in the Amundsen Sea close to the shore of West Antarctica. Credit: Sofia Moutinho

As I stood on the bow of the icebreaker, cold wind gently touched my skin, and the neversetting summer Sun shone over snow-covered mountains emerging from the calm sea. Dozens of penguins accompanied the ship. They swam like torpedoes, cutting through the glassy water below while snow petrels surfed on gusts above. And a lazy seal, lying like a giant slug on an ice floe, lifted its head as the sounds of camera shutters filled the air.

All Roads Lead to Science



I was on a cruise in Antarctica. Every year, hundreds of tourists pay thousands of dollars to see this landscape.

But this was no vacation. I had joined GEOTRACES 17-ANT (GP17-ANT), a scientific cruise led by an international research team focused on understanding marine biogeochemical cycles. Launched in 2010, the GEOTRACES initiative surveys every major ocean basin in the world, including the Southern Ocean, where we sailed.

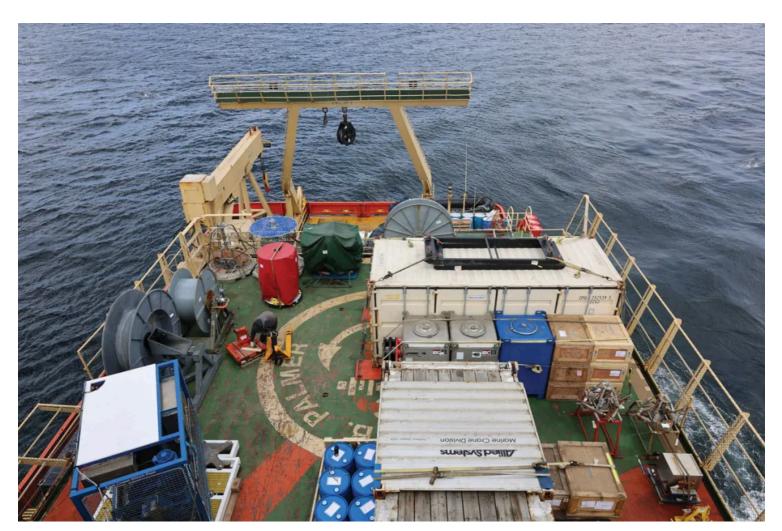
The Art of Doing Fieldwork on the Moon

Confined at Sea at the End of the World

Snapping Science in the Field

Charting New Territory

For 65 days, we cruised alongside the icy continent on the 94-meter <u>R/V Nathaniel B. Palmer</u>, a U.S. icebreaker. Within the confines of the ship's steel walls, 35 researchers worked in shifts around the clock, with no weekends, holidays, or days off. Hundreds of kilometers from civilization, we remained at sea at all times with little to no Internet connection or phone service. The scientists' job: collect and analyze thousands of liters of water, snow, and sea ice.



Boxes, crates, and barrels of scientific equipment crowd the deck of R/V Nathaniel B. Palmer. Credit: Sofia Moutinho

"Americans call this a cruise, and of course, everybody immediately thinks of a huge cruise boat with many fun activities," said <u>Carl Lamborg</u>, an oceanographer at the University of California, Santa

Cruz, who studies mercury in the ocean. "But it is not a cruise, really. It is an expedition with a lot of work."

Going South

Our journey started in the small Chilean port town of Punta Arenas in November 2023. The *Palmer* left port late because of 69-mile-per-hour (111-kilometer-per-hour) wind gusts that forced the port to close for a day and because of problems with some essential cargo:

- A \$13,000 consignment of acid destroyed in transit from the United States to Chile had to be replaced.
- A crucial piece of equipment, needed and tailored for the ship, didn't fit the space where it should go, so metalworkers had to be called in to adapt it to the *Palmer*'s actual specifications.
- Some lab boxes and personal luggage (including mine) were lost in the airport.

When the weather allowed and the issues were resolved, we left Chile. We navigated 4 days through Drake Passage, which separates South America and Antarctica and is universally recognized as one of the roughest seaways on the planet. Seasoned mariners shared stories about facing 10-meter-tall waves in the passage, but we were lucky: Waves didn't surpass 5 meters high on our worst days.



Laura Moore prepares Rosie the rosette on board the Nathaniel B. Palmer. Credit: Sofia Moutinho

It took us another week to cross the Antarctic Circle at 66°S and reach one of Earth's most remote places: the Amundsen Sea, in West Antarctica. Only <u>a few research cruises had ventured there</u>, and no GEOTRACES expedition before ours had done so.

As Lamborg talked to me in the ship's main lab, the continuous sound of ice crashing against the ship's hull muffled his voice. Sea ice melts during the Antarctic summer—but it never melts totally. During our journey, the *Palmer* plowed through the Amundsen Sea, ramming through blocks of sea ice up to 2 meters thick.

In addition to sea ice, we also encountered several immense icebergs, like B-22A, the fourth largest in the world and 4 times the size of New York City.

West Antarctica and the Amundsen Sea are home to the fastest melting glaciers on the continent, including <u>Thwaites</u>, known as the "Doomsday Glacier" because of the catastrophic effect its collapse would have on sea level rise. (B-22A calved from Thwaites in 2001.) Scientists estimate that <u>West Antarctica is currently losing about 80 billion metric tons of ice per year</u>.

All that discharge is not only increasing sea level but also changing the ocean's chemistry. As the glaciers melt, they dump into the sea a variety of materials trapped from the atmosphere or scraped from Antarctic bedrock hundreds or sometimes thousands of years earlier.

The goal of the scientists of GP17-ANT was to map the distribution and concentration of different trace elements in the water to understand how the ecosystem is changing as the planet gets warmer. Trace elements such as iron, thorium, and manganese can reveal details of ocean phenomena such as algal blooms, currents and circulation, and carbon storage.

"Most of the work in this region has been focused on the geophysics of ice melt," said expedition coleader **Phoebe Lam**, a chemical oceanographer at the University of California, Santa Cruz. "But we are using chemistry to look for clues to understand the geochemical and biological environment of this part of the ocean."

Work, Eat, Sleep, Repeat

The search for these trace elements involved a lot of hard work. It didn't matter whether it was day or night; a weekend; or even Thanksgiving, Christmas, or New Year's Eve (holidays we spent on the *Palmer*).

Despite long hours and hard work, the shared experience bonded the researchers into an onboard fraternity. "It feels like you're at a summer camp" with people passionate about the same things you are, said <u>Marissa Despins</u>, Lamborg's Ph.D. student at the University of California, Santa Cruz. "So it's a lot of fun because you get to go to an interesting place and be surrounded and immersed in science."

The majority of the 67 passengers on the *Palmer* were researchers, mostly graduate students supervised by a few principal investigators and chief scientists. Although affiliated with universities in the United States, researchers came from all over the world, including Australia, France, Germany, and Nepal. They were largely divided into two main groups: analysts processing and analyzing samples in *Palmer*'s onboard labs and the so-called supertechs, science technicians in charge of the sampling.



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Apart from the science team, there were also marine technicians, hired by the U.S. Antarctic Program to oversee deck and machine operations; a marine project coordinator; a <u>marine lab technician</u> responsible for lab safety; electronics technicians; and 21 crew members. And there was me, a journalist.

The responsibilities of GP17-ANT kept scientists and crew so busy that most interactions between the teams were confined to the chief scientists and the captain and mates to discuss the *Palmer*'s route.

Wearing safety helmets, steel-toe boots, heavy orange floating coats, and rubber pants, the supertechs had the most physically demanding jobs among the scientists on board.

Supertech responsibilities included helping set up equipment like the <u>rosette</u>, a large barrel-shaped metal frame with more than a dozen sampling bottles clustered around it. (The ship had two of these, nicknamed Gladys and Rosie after the results of an informal whiteboard poll.)

A cable lowered this instrument into the sea with bottles cocked open. As the instrument sank, the bottles closed to collect water at different depths. Once the rosette was back on deck, the supertechs either filled separate containers with the water or carried the rosette's bottles directly to the *Palmer*'s labs, where the samples were analyzed or stored for later studies.

On this cruise, the supertechs also collected samples from pumps attached to a wire and lowered into the ocean to get large volumes of water and from the <u>tow-fish</u>, a small torpedo-shaped sampler towed alongside the ship to collect surface water.

"Typically, on every cast, each technician collects at least 25 kilos of water and moves those samples around, up and down stairs in the ship," said supertech <u>Marty Fleisher</u>, an oceanographer at Columbia University's Lamont-Doherty Earth Observatory. "My back hurts, but that's OK. I've gotten used to it. You know, every cruise is the same. I'm here to eat, sleep, and work," Fleisher added stoically. At 65 years old, he has been to Antarctica on the *Palmer* four times.

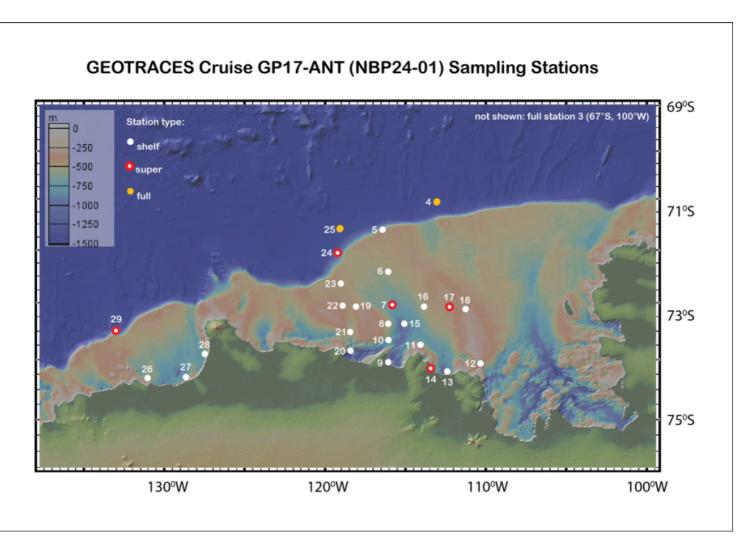


The author poses in her emergency floating suit designed for the icy waters of the Southern Ocean. Credit: Sofia Moutinho

Superstations, Vans, and a Bad Case of Cruise Hands

Some labs were set up in rooms inside the ship, whereas others, called vans, were truck-sized shipping containers installed on deck. Despins spent most of her time during GP17-ANT inside a van analyzing mercury concentrations in seawater samples. She secured all her equipment to the floor and walls with cables and ropes, which proved necessary when the ship broke through ice.

"There's a general rumbling in the ship, but it is 10 times worse in the van, where the walls are shaking, and everything attached to the van is shaking," said Despins. "It almost feels like you're in an earthquake."



Researchers working on the decks experienced firsthand the harsh and rapidly changing Antarctic weather. They were outside on sunny days and foggy days, as well as in heavy snows and winds and when temperatures dropped to as low as -21° C (-6° F). Because of the constant exposure to the cold, water, and sea salt, many ended up with what they call "cruise hands."

"I'm getting a very bad case of cruise hands," French oceanographer <u>Margot Debyser</u> told me, showing her dry palms and fingers covered with small cuts. A postdoc researcher at Woods Hole Oceanographic Institution, she spent long hours outside during the cruise setting up pumps and analyzing radium isotopes in the seawater. "My hands feel like sandpaper right now. When I am in bed, they catch on the sheets. It's kind of gross. I've been trying to do [exfoliating] scrubs, but it's not really worked out."

Sampling seawater takes a long time. The pump deployment alone takes up to 9 hours. At the *Palmer*'s so-called superstations (sites where all instruments can be launched to several depths) the process can take more than 40 hours.

Different teams took turns operating each instrument. Half of the scientists worked in shifts of 12–16 hours, whereas the other half were available at any time. With such intense work, keeping a healthy sleep routine could be challenging.

When we spoke, Debyser was on her way to mastering the skill of taking several naps instead of getting a full night of sleep in her bunk bed. "I'm just sleeping when I can once my instruments are running, which ends up being 3 hours in one go, 4 hours in another," she said.

Still, researchers were unanimous in telling me that this cruise was one of the best they had been on regarding time to rest. Many scientists were used to working on cruises during which they'd had to stay awake at times for more than 24 hours straight.

Walled In on the Vast Sea

The *Palmer* is divided into six decks accessible by heavy steel doors and stairs. Unlike those of the leisure cruise ships we encountered in Punta Arenas, accommodations were humble. Scientists and crew had tiny cabins shared by up to four roommates. We slept in small bunk beds with sliding curtains to maintain a minimum of privacy and had a few cabinets in which to store our clothes and objects—barely enough to fit the voluminous extreme weather gear provided by the U.S. Antarctic Program, which manages all U.S. scientific research on the continent and its surrounding waters.

To blow off steam, we had a small sauna, a gym, and a video room equipped with a foosball table, some board games, a guitar, books, massage chairs, and a TV.

But it was hard to forget that we were confined in a metallic beast. All around us were cues indicating how dangerous life on board a ship can be. From the hallway walls hung emergency kits, fire axes, and

signs warning "Danger" and "Caution."

The science party had to take online training on shipboard safety and preventing sexual harassment before departure and attend onboard orientation sessions on what to do in emergencies. As part of the training, we all learned how to muster and wear our floating suits, a rubbery dark orange covering that makes you look like either a Teletubby or a giant lobster.

The loud alarm of weekly emergency drills echoed through the steel rooms, reminding us that threats were always lurking. Immense icebergs floating in the sea like ghosts amplified this eerie feeling, as did the knowledge that melting glaciers could collapse at any moment, producing waves capable of harming the vessel and its equipment and passengers.

Less alarming but definitely distinctive was the ship's water supply, which we all bathed in and drank. Although safe, the water—distilled and desalinated from local seawater—could be very smelly when we were in regions where the ocean had high algae concentrations, because the treatment system could not remove the unicellular microbes. Descriptions of the stink varied from rotten lettuce to farts.

Despite a relatively placid sea, some people fell seasick and required attention from the doctor on shift in the *Palmer*'s small infirmary designed to deal with simple health issues. Serious illnesses were not expected because everyone had to undergo an extensive medical evaluation involving dozens of blood tests, vaccinations, and heart exams to be allowed on board. GP17-ANT was fortunate to have had no major emergencies.

Learning from the Environment

The *Palmer* did not dock anywhere in Antarctica, as the point of the expedition was to study the ocean. But <u>Laura Whitmore</u>, a chemical oceanographer at the University of Alaska Fairbanks and one of the principal investigators of GP17-ANT, had the luxury of leaving the ship several times, sometimes on an inflatable boat called a Zodiac and sometimes lowered directly to sea ice by an onboard crane.

Whitmore drilled cores in the sea ice and collected snow samples with a few other scientists. GP17-ANT was her first trip to Antarctica, and she said her time on the ice was the best part of the experience because she fully connected on a personal level with the place she was studying.



Even in the Antarctic summer, towering icebergs dwarfed Zodiacs in the Amundsen Sea. Credit: Sofia Moutinho

"There's no better way to learn than to be out here learning from the environment itself," Whitmore said. "It's a very different experience to work in a place where a penguin is running up to you and just watching you for a while."

One of the most memorable happened the night before Christmas. The *Palmer* was moored on "fast ice," sea ice that is connected to the continent, and I joined Whitmore and her colleagues as they sampled.

Not long after the work started, I saw black dots on the white horizon. They were moving fast, and right toward us. Eventually, a long black line formed. They were Adélie penguins, perhaps a hundred of them walking or sliding on their bellies like a clumsy army.

Our visitors arrived ruffling their wings. They inspected the science work closely, gracelessly gaiting around the equipment and finding a special interest in the shovels.

The scientists (some in tears of joy) were divided between watching the birds and keeping their site intact. After the rendezvous, the winged



"It allows me to go home and do better work with the data I collected because I know exactly where it came from." visitors got bored and proceeded to take naps close to the ship, to the delight of those on board.

Whitmore emphasized that in addition to allowing her to meet playful penguins, the Antarctic fieldwork improved the quality of her science. "It allows me to go home and do better work with the data I collected because I know exactly where it came from," she said. "I know exactly how it was sampled and maybe even what issues happened when it was sampled."

For <u>Bettina Sohst</u>, a lab supervisor and technician at Old Dominion University in Virgina, the landscape allowed for the introspection necessary to develop and organize ideas. "I've had great ideas just staring at the ocean," she said. "No pressure, just looking out there: no people, just blue and white in my eyes."



Scientist Alexis Floback gets to be outside as she ferries samples from the deck

to the lab. Credit: Sofia Moutinho

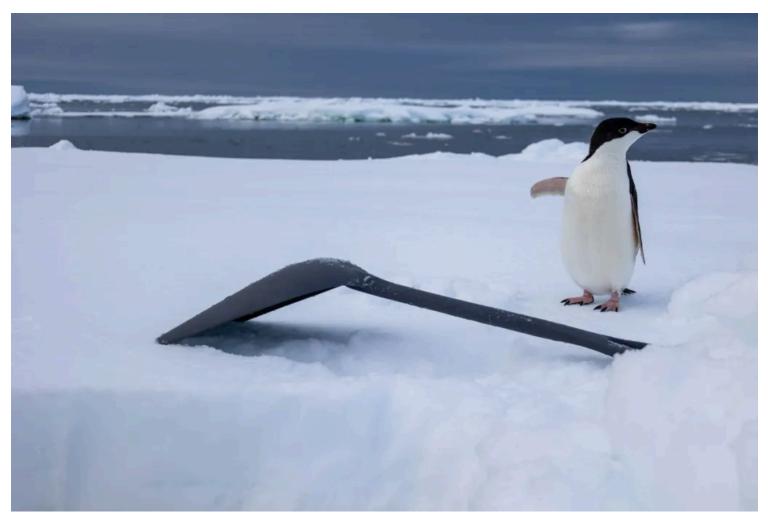
Every day, we witnessed breathtaking landscapes and an overwhelming abundance of wildlife. We saw multiple species of penguins: Adélies, chinstraps, gentoos, and emperors. In areas covered by sea ice, it was routine to spot crabeater seals alone or with their cubs. Humpback and fin whales also got close to the ship, showing off their tails and spouting feathery jets of water.

The intense science work, however, could easily overtake a researcher's day, making it difficult to enjoy the scenery. University of Minnesota Ph.D. student Nicole Coffey spent several hours

a day processing seawater samples in a windowless lab on the ship's lower deck. It was her first time in Antarctica, and she made it a routine to take short breaks whenever she could to breathe fresh air and appreciate the view outside.

"I joked around that I sometimes helped carrying bottles to the rosette just because it got me outside and I could see things," Coffey said. "It was surreal. Half the time, I felt like the landscape was a green screen and this was all a big prank."

Lost in Time...and Routine



A penguin shows particular interest in a small shovel. Credit: Sofia Moutinho

Antarctica is the only continent that does not have any official time zones. With the summer Sun shining 24 hours a day, however, the hour on the clock didn't make much difference.

We started our journey following the time at our departure point in Chile. Then, throughout the trip, the captain announced time changes so we would arrive at our final destination, New Zealand, at the local time.

"My perception of time here merged into this massive blur, and I feel like it goes both really fast and really slow at the same time," said Debyser.

The passage of time was marked mainly by the meals served on a military schedule. In the mess, where the noise of ice hitting the hull was loudest, we ate breakfast, lunch, and dinner, plus an extra midnight buffet nicknamed <u>midrats</u>. The menu included a variety of American classics, like burgers and pizza, but also a recurring Taco Tuesday and frequent Asian Mondays with dishes to please the majority Filipino crew.

I have never seen people so happy as the day that the cook decided to serve breakfast food for midrats. Exclamations of "It is the best day ever!" could be heard across the communal tables as hungry

scientists devoured waffles and pancakes with syrup and whipped cream.

People working at night and waking up for lunch had been missing breakfast for more than a month, but I suspect that was not the only reason for the enthusiasm. It was the change in routine that tasted so good.

Life on a ship is a weird mixture of excitement and intense work, with moments of boredom and a lot of repetition. "Repetitiveness is almost required because you want to be sure that you're doing things the same way each time so that there's not some issue related to how you collected the samples or something like that," said Fleisher.

Regardless, people found other ways to break the routine and have fun. One of them was a quiz game in which the chief scientists had to answer funny questions about the cruise, in the style of the American TV show *Jeopardy!* (whose reruns played over and over on our cabin TVs). Another was a secret ceremony near the end of the cruise to mark our crossing the Antarctic Circle. Such ceremonies, **sometimes called baptisms**, are common when crossing geographical markers at sea, like the equator or the tropics.

As a participant in this voluntary ritual, I am allowed to say only that King Neptune and his court paid us a visit and set up a tribunal to judge those crossing for the first time. The accusation: loitering in his most southern domain and stealing his precious water. To find redemption, the newbies (like myself) had to pay our dues by entertaining the royal court. By doing so, we entered the select group of the **Order of the Red Nose**.

Weather Is King

Things often don't go according to plan in Antarctica. The science schedule was erratic and unpredictable. Most of the time, the culprit was the weather. Shifting winds and thick sea ice cover often prevented the ship from following its planned course.



Scientists and their equipment are lowered to the sea ice by a crane. Credit: Sofia Moutinho

For instance, the expedition's lead scientists had planned to sample seawater in Pine Island Bay, a coastal region of West Antarctica highly understudied because of its remote location and because it is frequently filled with heavy packs of sea ice.

GP17-ANT chief scientist <u>Peter Sedwick</u>, an oceanographer at Old Dominion University was excited to get to Pine Island Bay to analyze the water chemistry of this delicate ecosystem. However, after a few attempts, it became clear that we wouldn't make it. The sea ice was just too thick for the 32-year-old icebreaker. (Traveling at 3 knots (5.6 kilometers per hour), the *Palmer* can break through about a meter of level ice.)

"The captain described the ship as a little kid coming up and trying to hit you as hard as they could, and an adult was keeping his hands on the little kid's head," Sedwick said. If we persisted in entering Pine Island Bay, he said, we risked being trapped between the ice pack and the continent.

Because of issues like this, our route and daily work plans had to be constantly updated. Scientists followed updates on a detailed schedule available in many places on board: written on a whiteboard in the main lab, posted on the ship's intranet, and broadcast to televisions in every room. Because the schedule was always changing, scientists jokingly called it "the board of lies."

"My mom asked me for an itinerary before we lost service. And I was like, 'No one has an itinerary," said first-time cruiser **Annie Stefanides**, a research assistant at Woods Hole Oceanographic Institution.

"There's a plan, but there's no plan. You know? So it's really how much we can get done in X amount of days."

At the beginning of the cruise, the official itinerary included 30 sampling stations. Despite delays, the researchers managed to sample at 27 of the original planned stations. They made it to that many only because the National Science Foundation had permitted doubling the number of engines running on the ship, making transits faster.

It Takes a Village

On the one hand, there was intense work, harsh weather, isolation, and confinement. On the other, there was the chance to do science in a unique and wild place almost untouched by humans. For people on board the *Palmer*, the trade-off was more than worth it.

"Not every moment on the cruise is some amazing epic moment where you're seeing something that just blows your mind. There are also low moments where you're missing home, bored, and wish you were sleeping in your own bed," said Despins, who spent her last two



Carl Lamborg, Kameko Landry, and Nicole Coffey celebrate a job well done. Credit: Sofia Moutinho

Christmases and New Years on cruises. "But then you remember that you're in the Southern Ocean and how amazing that is."

For others, the isolation and remoteness are actually sources of inspiration. "Here, we have no cell phone service. We have no Internet. Then you get to focus on what we're doing in a very different way that I find refreshing and energizing," said Coffey.

For Lam, who has been on more than 20 cruises, the union among colleagues is what makes the experience so special. "I like it more and more the older I get," she said.

"On land, everyone's too busy with their own lives. But here," she said, "no one has a life except for the life on the ship. So this becomes your village, and you help your village members."

—Sofia Moutinho (<u>a)sofiamoutinhoBR</u>), Science Writer

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