
PICTURE ALLIANCE/PHOTOSHOT

The icebreaker and research ship *Polarstern* set sail for Antarctica from Chile on Monday.

in February 2018. "We were close," says Katrin Linse, a BAS marine biologist in Cambridge, who led the foiled expedition. "And it was a devastating day when the captain decided to turn round."

Linse is unable to take part in this year's cruise, but members of her team are on board. In her Cambridge office — 13,000 kilometres from Puntas Arena — she nervously studies maps of sea ice every day, hoping that the route will be clear.

Conditions look favourable: the ice that stopped the BAS expedition is now drifting out of the Weddell Sea, a Southern Ocean region between the Antarctic Peninsula and mainland Antarctica to the east.

In January, a team on board the South African research vessel *Agulhas II* anchored at a site 200 kilometres north of where the iceberg broke off. It took ocean and sea-floor samples there, but sea-ice conditions and other research priorities meant it didn't go further south. The *Polarstern* will now attempt to advance farther south, to the site where the iceberg calved.

The *Polarstern*, operated by the Alfred Wegener Institute, is Germany's flagship polar-explorer vessel and one of the best-equipped research icebreakers in the world. Satellite imagery and renaissance flights by its two helicopters will guide the ship through the pack ice — ice floating in the sea, formed by smaller pieces freezing together — which can be abundant even in southern summer months, when the extent of sea ice is close to its annual minimum.

UNDER A SOUTHERN SUN

If ice and weather conditions allow, the team could reach the site from Chile in just a few days. The scientists would then have several weeks of southern summer to extensively sample ocean fauna and chemistry, and to map the uncharted sea bed. "We'll work around the clock to collect as much data as possible," says Dorschel. "We've tools on board which should provide a perfect view of the ocean and the sea floor."

As well as standard water-sampling tools, the scientists will use a small, remotely operated vehicle for underwater exploration, and a towed ocean-floor observation system for optical and acoustic surveys of deep-sea topography and habitats. The team suspects that a deep-sea ecosystem such as that observed in the Weddell Sea evolved in the darkness beneath the ice.

That ecosystem could change significantly within a few years if new species colonize the area. Isotopic analysis of tissue from species such as gastropods and bivalves could reveal whether the food web has already changed since the iceberg broke off, because chemical signatures in animals' tissues hold clue to their diets.

UNTOUCHED BY HUMAN HANDS

Samples collected in the pristine area, completely unaffected by commercial fishing or other human activities, would be an invaluable resource for biodiversity researchers. The data could help scientists to address questions relating to how marine communities develop, and how quickly new species colonize previously ice-covered areas, says Linse.

Rapidly rising temperatures in the air and ocean around the Antarctic Peninsula, a hotspot of global climate change, add urgency to such research: any changes in species composition and food-web structure following the disappearance of ice might shed light on the fate of polar ecosystems in a warming world.

"Here's a unique opportunity to find out how vulnerable or resilient marine life is to rapid environmental change," Linse says. "This is exciting science for us all — I hope very much that it can be done." ■

GRAVITATIONAL WAVES

LIGO set for major upgrade

Plan could double its detecting power.

BY DAVIDE CASTELVECCHI

Spotting gravitational waves is due to become an almost hourly event in the next decade. Starting around 2023, the Laser Interferometer Gravitational-Wave Observatory (LIGO) will undergo its most significant upgrade since 2015, UK and US funding agencies said on 14 February.

The US National Science Foundation is contributing US$20.4 million to the Advanced LIGO Plus (or ALIGO+) project, and UK Research and Innovation is providing another £10.7 million (US$13.7 million), with a small contribution from Australia. The upgrades at LIGO's sites in Hanford, Washington, and Livingston, Louisiana, will include the addition of a 300-metre-long, high-vacuum optical cavity. That will help scientists to manipulate the quantum properties of the lasers at the heart of LIGO's detection system, and cut down noise.

LIGO first operated from 2002 to 2010, and restarted in 2015 after extensive upgrades. Its first detection — of gravitational waves from the merger of two black holes — came later that year. It has now bagged ten black-hole mergers, plus one merger of two neutron stars.

The observatory has undergone periodic improvements, and is about to reopen after an upgrade designed to increase its sensitivity by 50%. But the ALIGO+ upgrades will be more drastic, allowing LIGO to detect neutron-star mergers that occur within 325 megaparsecs (around 1 billion light years) of Earth, says Ken Strain, a physicist at the University of Glasgow, UK. That would nearly double the design sensitivity of 173 megaparsecs that LIGO expects to reach before the ALIGO+ upgrade. LIGO can already spot black holes billions of parsecs away; by 2022, it should detect about one merger per day. The ALIGO+ upgrade should push that to one every few hours.

The changes will enhance the quality of detections, not just their frequency, said former LIGO director Barry Barish at a press conference in Washington DC. Reducing noise will enable researchers to tell how black holes spun before they merged, which can provide clues to their history. "It gives you the ability to measure things you can't do now," said Barish, a physicist at the California Institute of Technology in Pasadena who shared the 2017 Nobel Prize in Physics. ■