

Surveying the Stability of the East Antarctic Ice Sheet



On 6 January, the research vessel *Polarstern* set off from Cape Town in South Africa for an expedition of around eight weeks to the Antarctic. Extensive preventive measures allow the Alfred Wegener Institute to tackle the important research on former instabilities of the East Antarctic Ice Sheet, despite the Coronavirus pandemic. The research will be continued on two further planned

expeditions in the coming years. Interested parties can follow this and subsequent *Polarstern* expeditions live in a new app.



The future response of the East Antarctic Ice Sheet and its surrounding Southern Ocean to human-induced warming is currently subject to many uncertainties. Too little is understood about the ice-ocean-atmosphere feedbacks and the associated changes in the rate of sea-level rise, as well as the Southern Ocean's ability to absorb heat and atmospheric CO₂. Because of its unique flow pattern, the Southern Ocean acts as a buffer against climate change: although it covers only one third of the area of the world's oceans, the Southern Ocean absorbs up to 75% of the excess heat and about 40% of the man-made CO₂ emissions absorbed by the world's oceans. One of the main questions of the

expedition is whether the increasing heat transfer to Antarctica and the resulting increase in melting rates could exceed a critical threshold that disrupts circulation, reduces buffer capacity and accelerates climate change.

Travelling Back in Time Through Sediment Layers

An international research team of about 50 people is therefore travelling to the Southern Ocean with the *Polarstern* to dive deep into the past: pulling metre-long cores from the sediments on the seabed, but also from the sediments of lakes near the coast. To do this, a land team is flown out by helicopter and picked up again 14 days later. The geophysics group even allows insights into even deeper sediment layers and their structures and thus even further back in the Earth's history. Today's conditions are recorded via measurements and sampling in the water column. The combination of the different research approaches allows the scientists to reconstruct the past instability of the East Antarctic Ice Sheet, with a primary focus on times when it was warmer than today. A better understanding of these periods will form the basis for more reliable predictions of future climate change.



Research vessel *Polarstern* on its way to Neumayer Station.

"Our work focuses on the Antarctic continental slope and the coastal region between the Weddell Sea and the Cooperation Sea further east," reports Prof. Ralf Tiedemann, marine geologist at the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) and leader of the expedition. "Large amounts of Antarctic bottom water are formed in the Cooperation Sea today. The Antarctic bottom water supplies the lower part of the global oceanic circulation. It aerates the deep ocean and sequesters heat and carbon on a timescale of several decades to millennia. We will sample both the water column and the sediment archives on the seafloor to record present and past changes and processes in the formation of Antarctic bottom water," explains the AWI scientist.

Ralf Tiedemann continues: "In addition, we are particularly interested in the ice sheet's line of contact; in other words, the point where the glacier rests on solid ground on the land side before it floats on the ocean on the sea side. This location is particularly susceptible to the influx of warm deepwater masses, as these can lead to increased melt rates and subsequently to instabilities of the ice sheet."

Preglacial and Glacial Sedimentation Processes

Special attention is being paid to the Ekström Ice Shelf under which the scientists have discovered a subterranean cavern up to 1,000 metres deep using acoustic methods near Neumayer Station III as well as sediment archives that perhaps date back to the Cretaceous period: "With our planned measurements, we are extending profiles into the marine realm. This will allow us to analyse the preglacial and glacial sedimentation processes in the ocean both before and below the ice shelf. This is a great combination of land-based and sea-based research," says the AWI geologist, who is looking forward to the upcoming tasks.

The international experts from marine geology, micropalaeontology and geochemistry process some of the extracted sediment cores

directly on board. Another part of the muddy cargo will be safely packed and later analysed in more detail in the home laboratories of the participating institutes. Two more *Polarstern* expeditions to the Southern Ocean sector off East Antarctica are planned in the 2023/24 Antarctic season to continue the research. The current expedition is scheduled to end in Cape Town on 28 February.

The researchers are now eagerly awaiting the science, including the new wintering team from Neumayer Station III, which will disembark at a stopover in Atka Bay on the way to the study area. The expedition members have taken on quite a bit for this: on Boxing Day, they travelled to Cape Town where, fully vaccinated and boosted, they lived in strict individual quarantine until they sailed. Only those who tested negative for five PCR tests could take part in the expedition. The last negative test results for all arrived on Monday.

The experiences of the *Polarstern* expedition participants will be reported several times a week in the new Polarstern app, which interested people can download to their mobile devices or view on their computers using the link: <https://follow-polarstern.awi.de>.



Processing of sediment cores in the geolab on board of the Polarstern research vessel.