# In the repository...
# Expedition 403: Eastern Fram Strait Paleo-Archive

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**The Long Road Home**

What was once an endless expanse of sea is replaced by a Dutch industrial landscape that slowly trods by as the *JOIDES Resolution* (JR) makes its way back into the port of Amsterdam. Greeted by two tugboats at the mouth of Lock IJmuiden, the expedition would end the same way it began. With the North Sea to its back the large gates of the lock closed, allowing the water table to lower and match that of the 30km of canal ahead. It was a symbolic transition that meant after two months of working under the Arctic sun, Expedition 403 was coming to an end.

A crowd gathers on the picnic tables below the bridge, overlooked by the same looming windmills that hung overhead at the start of the Expedition. With every kilometer passed, the crowd grows larger until enthusiastic shouts from the dock can be heard. In a blink, the offloading process flew by, from the first mooring lines being cast to the shuffling luggage onto buses.

What made this return to port so different was there wasn't another science party waiting on that dock; instead waited a group of technicians ready to begin the process of decommissioning the vessel. All of the specialized lab equipment that has been refined expedition after expedition would have to be painstakingly removed and brought into storage. With this in mind, every step of Expedition 403, from the arrival of the last core on deck to the serving of the last lava cake, was infused with significance.

For a program that has devoted so much time and and so many resources toward looking into the past, the vision of both the expedition and extended groups of people that made it possible remained dutifully upon the future. As a high-recovery cruise, over 5 kilometers of sediment cores were successfully retrieved, and upon reading this, they will have already arrived safely to their final resting place at the University of Bremen's core repository. The samples will serve as a source of analysis to better understand the complex inner workings of the Arctic for decades to come.

## Science Objectives

Led by Renata Giulia Lucchi (National Institute of Oceanography and Applied Geophysics-OGS) and Kristen St. John (James Madison University), Expedition 403 was focused on achieving three primary objectives:

- to reconstruct the West Spitsbergen Current variability transporting warm North Atlantic Water to the Arctic Ocean,
- to understand the influence of oceanic water patterns on climate changes particularly during key climate transitions (late Miocene–Pliocene transition, late Pliocene–Pleistocene transition, MPT, mid-Brunhes transition, and suborbital Heinrich-like events),
- and, to measure the impact this exchange has on the Arctic glaciations, ice shelf development and stability, and sea ice distribution.

High-resolution, continuous, and undisturbed sedimentary sequences are the only method available for attaining the information required for meeting the stated objectives. After two months at sea, samples at the selected drill sites along the Vestnesa Ridge, the Svyatogor Ridge, the Bellsund Drift, and the Isfjorden Drift were successfully retrieved. This data will be valuable for ground-truthing climate models of projected future $CO_2$, temperature, and ice sheet stability.

With every new batch of core to arrive on the sample table from below the seafloor, members of the science party would swarm around to see what distinguishing features could help solve the puzzle of the when and what they were looking at. The silty clay/clayey silt, sandy mud intervals, various amounts of evidence of bioturbation, and the occasional mixture of dropstones all provided useful hints. Excitement continually came from being the first humans to see the sediments since they originally came to rest on the seafloor. Co-chief Renata Giulia Lucchi described the experience as feeling like visiting another planet for the first time. Our planet's climate has changed so much throughout its history that if we were to go back in time far enough, what we would find would be a place that is completely unrecognizable. Perhaps the projection of visiting another planet is appropriate.

This glimpse into the Eastern Fram Strait's history will help fill in knowledge gaps and provide higher-resolution views of the region's past. Through a better understanding of the formation and history of the West Spitsbergen Current, researchers can gain a deeper understanding of the role it plays in bringing heat, moisture, and salt into the Arctic Region. Equally as important is the modality of decay of a former ice sheet that covered Svalbard and the Barents Sea roughly 21,000 years ago. The ice sheet is considered the best

available analog to the modern, marine-based West Antarctic Ice Sheet (WAIS), which poses a significant threat to sea level rise, if warming global temperatures lead to significant melting.

Considered a "sentinel of climate change," the area around Svalbard is very sensitive to climatic variability. The samples retrieved on Expedition 403 will provide a clearer view of that "sentinel" and, in doing so, help guard us against changes to come, whether that be a warming Arctic or rising seas.

**Outreach**

Like the core samples safely stored in Bremen the outreach efforts of this Expedition were primarily focused on capturing history with the future in mind. Although typical outreach objectives were achieved in the form of a YouTube web series, multiple magazine articles, blogposts, and social media posts, a vast majority of the focus was put onto shooting a feature length documentary on the subject of paleoclimate research and its methods.

Every working member of the Expedition went above and beyond to assist in reaching this goal. These efforts included allowing time for in-depth interviews, a continuous exchange to keep the representation of the science accurate, and, above all, unprecedented access to the vessel while in action. One example of this was an exciting perspective directly above the moon pool taken while a free fall funnel was dropped into place. This was achieved through the mounting of a cinema camera to an extended crane above the funnel as it was released into the pool. The resulting drop had the splash land squarely in the center of the frame, paying homage to the compositional style of science fiction films taking place in space.

Unique angles can be exciting, but the goal was to capture the amount of coordinated work that goes into a single expedition. The Arctic Ocean provided a surreal backdrop to tell this larger story, and with the help of everyone onboard, over 40 terabytes of footage successfully made it home. Like with the core samples now safely in Bremen, the hope is that this story will provide inspiration for future scientists for decades to come.

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