AWI's underwater robot Tramper successfully recovered

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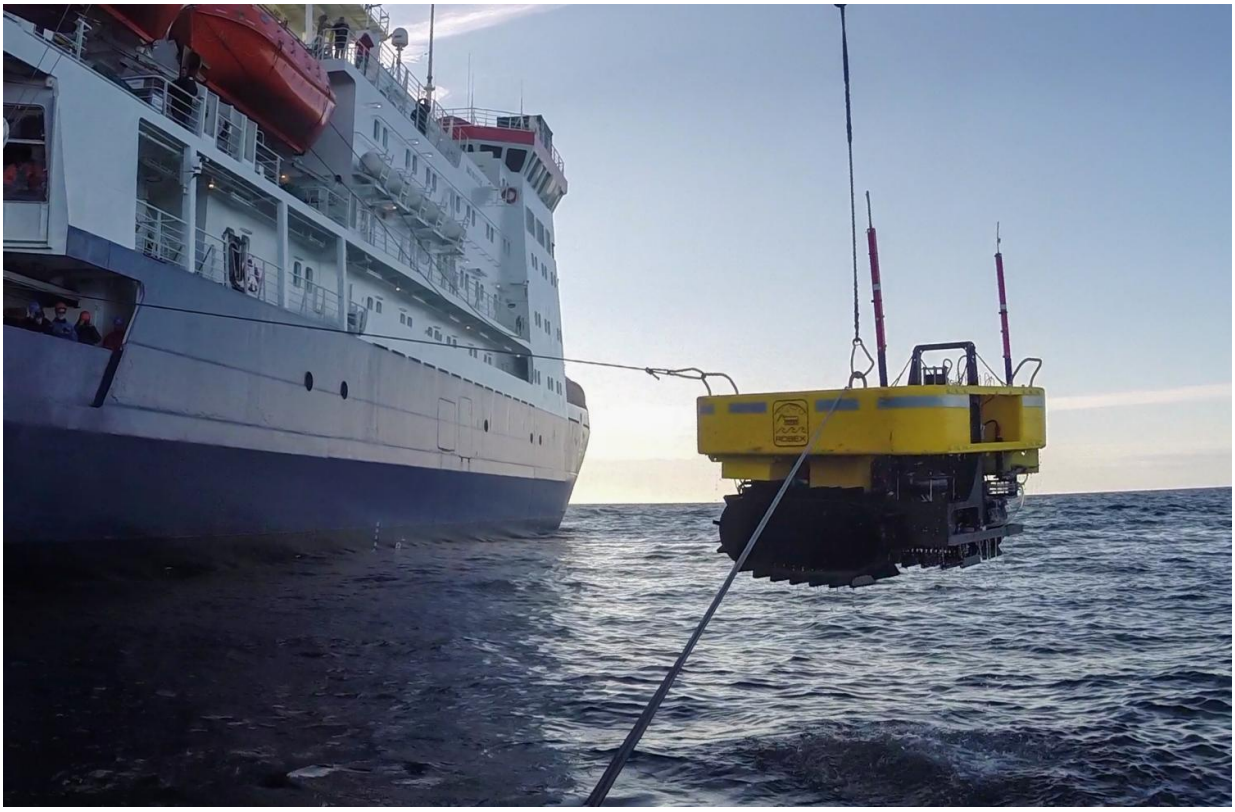

AWI underwater robot is lifted on board RV Polarstern. Credit: Alfred Wegener Institute

On 27 August 2017, deep-sea researchers from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) recovered the underwater robot Tramper, which had been taking

measurements at a depth of 2435 metres for nearly 60 weeks - the first long-term mission involving a crawler under the Arctic sea ice. For the first 24 weeks, the robot took biogeochemical readings at various sites, just as it was intended to. Unfortunately, because of a broken tread, Tramper got stuck in the same place in January, though it continued to record the oxygen content in the sediment.

It was an exciting weekend on board the research icebreaker Polarstern: the deep-sea and aerospace researchers from the Helmholtz Alliance ROBEX entered the Fram Strait on a nearly direct course from the Norwegian port of Tromsø. On Friday, 25 August they then launched the remote-controlled underwater vehicle ROV Kiel 6000, supplied by the GEOMAR Helmholtz Centre for Ocean Research in Kiel, at the same location they had deployed Tramper on 11 July 2016.

"We started by dropping down to Tramper's starting point, and found the exact place where we launched it," reports the scientific leader of the expedition, Dr Frank Wenzhöfer, from on board the Polarstern. A live feed from the ROV's cameras was set up in the ship's winch control room. "The ROBEX team followed the search for Tramper with baited breath from the winch control room," recalls ROBEX coordinator Martina Wilde, whose background is in aerospace research. The expedition team was able to watch in real-time how the ROV followed Tramper's tracks. "We could see where it had driven, and that it still seemed to be in good condition," says AWI biogeochemist Wenzhöfer, before adding: "As it then filled the camera screen, we were a bit puzzled as to why it was standing at right angles to its path." The answer: one of its caterpillar treads had broken down, as a result of which Tramper spent the second half of its mission time turning in circles.

Scientists and engineers have a first look at the Tramper after its recovery. Credit: Alfred Wegener Institute

Once Tramper had been found, the researchers and engineers had to have a bit of patience before it could be brought to the surface. The robot can only be retrieved with the help of an inflatable boat - but, given the high winds (five to six on the Beaufort scale) and two-metre waves, this was only feasible two days after initial contact. Once the seas had calmed, the recovery could finally begin. The researchers transmitted a signal to Tramper, which released its ballast as planned and began rising to the surface, taking two hours to ascend the 2435 metres. The expedition team then retrieved it with an inflatable boat and hauled it on deck with a crane.

An assessment of the data and a closer visual inspection confirmed that the measuring and recording systems (camera and sensors) had worked perfectly. "All of the programmed cycles (sleep - drive - sediment check - photo - measure - photo) worked as they were meant to - unfortunately, for the second half of the mission, only in one spot over and over," explains Wenzhöfer. Because of the broken tread, for weeks Tramper dug itself deeper and deeper into the seafloor. As a result, the robot covered a total distance of roughly 360 metres. "The first 24 weeks show some exciting data that we'll now begin carefully analysing. And that means we now know more about variations in oxygen consumption on the Arctic seafloor over half a year (July to December)," summarises Wenzhöfer. What's more, the robot's designers were amazed to see how much battery charge it still had - an aspect they had been somewhat concerned about. Since Tramper used up only half its charge, it could have kept going for almost another full year. Battery performance at 0.8 degrees below zero is difficult to predict, making this a welcome surprise.

Needless to say, it's a pity that the mission didn't yield data on oxygen-consumption variation for the second six-month period (January to August): the sensors kept recording, but always at the same spot where Tramper had become mired. The expedition team will now attempt to repair the caterpillar tread. If they succeed, they'll replace the crawler's batteries and sensors and redeploy it, so it can gather data for an entire year-long cycle as planned.

The next highlights of the expedition will include tests of the GEOMAR underwater crawler VIATOR and an underwater glider developed at the University of Bremen's MARUM (Centre for Marine Environmental Sciences) in the context of the Helmholtz Alliance ROBEX.

Provided by Alfred Wegener Institute