

Polarstern Expedition

Oasis of life in the ice-covered central Arctic

Scientists are exploring oceanic ice worlds with new robots

[20. October 2016] Under the ice of the Arctic, unknown habitats conceal an unexpected variety of living beings. On October 23rd, 46 scientists are expected to return to the home port in Bremerhaven from an Arctic expedition with the research vessel Polarstern. Over the past six weeks, they had explored life in ice, ocean and seabed with new robots and camera systems.

The ice-covered, central Arctic Ocean beyond 85° North is known for its harsh climate, low productivity and poor colonisation by marine animals. Because of the difficult ice and climate conditions, only a few scientists have had the opportunity to explore this region extensively. The current Polarstern Expedition PS101 had the goal of exploring underwater sea-beds and deep-sea trenches of the central Arctic Ocean and investigating how ice, ocean and life have changed due to the massive ice decline of recent years.



Pillow lavas (Photo: AWI OFOS)

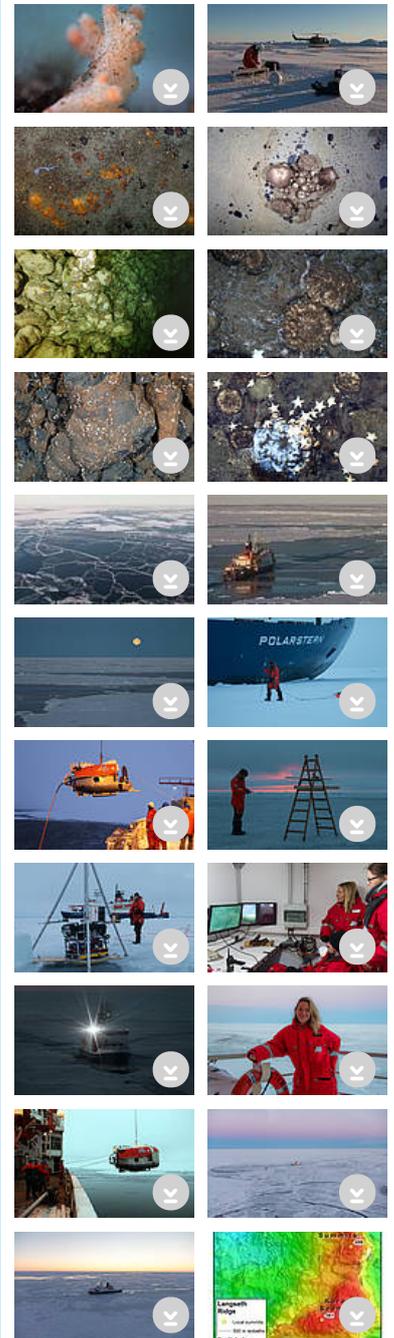
Already in the year 2001 during a German-American expedition with the research breakers Polarstern and Healy, many seamounts along the Gakkel Ridge of the Central Arctic were surveyed, but until now it lacked marine technology to dive down to them. One of the largest seamounts of the Gakkel Ridge is the Karasik seamount, discovered in 2001 and rising from a depth of 5000 m to 650 m. Seamounts are generally regarded as oases of life in the ocean as they provide marine animals with a variety of habitats and food sources. But whether they are also richly populated in the icy Arctic, which is scarce in food, has so far been unexplored.

"With the first pictures of the summit of the Karasik seamount we did not believe our eyes: It is overgrown with huge globular sponges. Between the sponges lie centimetre-thick mats of needles and worm-burrows. We were able to observe different species of fish which were not to be expected here, and caught a glimpse of the northernmost corals discovered so far. There are huge white starfish, blue snails, red crabs and white and brown clams between the sponges", reports chief scientist Prof. Dr. Antje Boetius from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI), regarding the first dives under the ice. The plankton, which mainly float in the water, especially crabs, jellyfish and worms, also brought astonishment to the explorers.

The deep sea robot NUI of the American marine research institute WHOI, a prototype for the exploration of ice-covered oceanic worlds, filmed the hitherto unknown deep under the ice and collected specimens for the species determination. It dived repeatedly to the sponges of the Karasik seamount. The giant sponges are up to a meter in size, hundreds of years old and seem to be able to move on their needles. They are, in turn, a habitat for innumerable animals that find themselves at home in the sponges.

The researchers found a particularly extreme habitat under the ice at hot springs in the valley of the Gakkel Ridge. On a still unnamed volcanic lake, the team encountered ghostly structures of freshly solidified lava rock, between which hot water rose out of small vents and cracks - at an ambient temperature below the freezing point. They observed vanes of hydrogen and methane above the hot springs used by special deep-sea bacteria as a food source. In addition to swarms of crustaceans, sea anemones and bacterial mats, fish and many fish skeletons were found at the hydrothermal vents. The

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researchers therefore assume that the hydrothermal activity feeds energy into the food web of the deep sea.



Working on the ice (Photo: Alfred-Wegener-Institut / Marcel Nicolaus)

Climate change also plays an important role in the Karasik seamount region. The AWI ice physicist Dr. Marcel Nicolaus summarises the observations: "This year's thin ice in the study region confirms the long-observed trend. While in the 1990s, the Polarstern had to sail around two or three meters thick ice floes in the investigation area, in 2001 the first surveying of the seamounts was with less than two meters in average sea ice thickness. At the moment, we have mainly found thicknesses of less than one meter and hardly any more large ice-floes." The sea ice explorers have released a series of autonomously drifting ice buoys during the expedition to monitor the sea ice and the climate of the Arctic and to improve the predictions for the change of the Arctic.

The international expedition has profited from the development of technology at the joining between deep sea and space exploration. Researchers and engineers from the [Helmholtz Initiative ROBEX](#) (Robotic Exploration of Extreme Environments) have collaborated with NASA's PSTAR program (Planetary Science and Technology Analog Research). Project leader Chris German (WHOI) notes: "The Earth is only one of up to ten planetary bodies of our solar system on which ice-covered oceans are suspected. From the PS101 expedition to the ice-covered Arctic, we were able to learn about technologies for exploring other planetary oceanic environments."

The Polarstern will spend the next two and a half weeks on routine maintenance and repair work at the Bremerhaven Lloyd shipyard. The research and supply vessel will start to the Antarctic season on the 12th of November 2016. On the transit to the south, a training course for international young scientists will take place. Until the spring of 2017, oceanographic and geoscientific expeditions as well as the supply of the Neumayer Station III will be on the agenda.

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